
LESSER KNOWN ANIMAL RESOURCES OF INDIA

A.K.GHOSH

ZOOLOGICAL SURVEY OF INDIA

Lesser Known Animal Resources of India

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PREFACE

The issue of Biodiversity Conservation for Sustainable Development has drawn worldwide attention during last one decade. India's faunal resources have been recognized as one of the most significant in the global profile.

In this publication, a number of selected mammalian, avian and other species have been dealt with. This report aims to promote research on their possible potentiality for genetic researches. Lesser known animal species hold promises for future but many of them are threatened due to habitat loss and fragmentation of wilderness areas. The use of indigenous resources could only be materialized with series investigation in field-biology and laboratory researches.

This report was conceived with inspiration received from Dr. T.N. Khoshoo, well known specialist in biological science, former Secretary to the Govt. of India, Department (now Ministry) of Environment. The support of late Dr. B.K. Tikader, former Director, Zoological Survey of India is gratefully acknowledged. My deep and heartfelt thanks are due to my colleagues at ZSI, each specialist in their own field for their valuable input; Dr. R.K. Ghosh, Dr. Sujit Charaborty, Mr. S.S. Saha, Mr. J.M. Dasgupta and others provided valuable support.

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A.K. Ghosh

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INTRODUCTION

Being strategically located at the conference of European, African and Indo-malayan realms, Indian subcontinent supports a variety of ecological habitats producing a great genetic diversity. Approximately 40,000 species of insects, 4,500 of Molluses, 3,500 of Helminthes, 1,000 of Crustacea (i.e. more than 65,000 species of animals) are recorded from India.

Unfortunately no thought was ever given to a planned and systematic exploitation of this rich genetic resource. Large wild Bovines like Gaur, Yak and Wild Buffalo were hardly used to improve the milch and farm animals. Wild sheep and goat (about a dozen species) which are rugged animals, have undergone periods of rigorous (natural) selection, can survive in difficult terrain and for age conditions, were never tried as possible sources of meat and hides or potential improvers of the domestic breeds. Similarly other groups of wild animals like Birds, Reptiles, Amphibians, Butterflies were never treated as a resource for large scale utilisation.

On the contrary this rich, natural renewable resource was frittered away for small immediate gains. These wild animals were thoughtlessly hunted for trophies, flesh, fur, skins, & hides, horns, antlers, ivory, musk, fat and claws, etc. At the same time their habitat was destroyed on a large scale under socio-economic pressures. As a result the populations of many of these animals have now been reduced to such an extent that their very existence is threatened. Many of these animals still survive in good numbers in India's vast network of conservation areas comprising 52 National Parks and 223 Sanctuaries created specially for their conservation.

Even now it is not too late to harness this underutilised resource. The useful species that have become endangered can be revived by captive breeding for utilisation. The wild animals being protected in conservation areas can be judiciously cropped. Without utilisation preservation is doomed to failure. Every conservation area is going to face, sooner or later, the problem of overcrowding when the conserved species outgrows the optimum carrying capacity of the reserve. If left uncropped at this stage, the wildlife resource is going to destroy itself by habitat destruction (through over grazing, etc.) and diseases that follow over crowding, thus annulling the advantages that should flow out of augmented populations, achieved at a tremendous management cost. No wonder then, that the recognized goal of wildlife management is utilisation oriented. Indigenous wildlife species able to perform well, often in inhospitable, sparsely vegetated or tough desert/mountaneous terrain thus become the best vehicles for resource utilisation.

MAMMALS

The study of Indian mammals dated back to 18th Century but more systematic account appeared in the second quarter of 19th Century. India with its varied ecological conditions offered an ideal condition both for the naturalists and big and small game hunters. While on one side, "The Fauna of British India, Mammalia" were published on the basis of scientific studies as early as in 1888-1891 by W.T. Blanford, on the other hand a host of publications on "Game of India" appeared. Large scale exploitation of mammalian species for fur, hide, ivory and other products or simply for the excitement of big-game hunting resulted in a situation which perhaps lends the title of the book. 'The Twilight of Indian Wild Life' by B. Seshadri in 1969.

The Government of India while promulgating "Indian Wild Life (Protection) Act in 1972" had to enlist 41 species of mammals under Schedule I offering total protection and 19 species under Schedule III and 20 species under Schedule IV offering partial protection through regulated hunting. When compared with total number of mammalian species approximating 350, the figure enumerated (under three Schedules) will become significant and alarming. However, a rational Wild Life action plan, surely can convert the situation from a gloomy appearance to a better, brighter prospective. Many of the threatened mammals can be saved, along with common but underutilised species, through ranching, captive breeding, restocking and even can be turned into a renewable, utilisable, resource. In this sections, four species of bovines, two species of sheep and goat, four species of deer and antelopes and a single species of wild pig has been delt.

LAGOMORPH

INDIAN HARE : *Lepus nigricollis* Cuvier

Appearance and size :

The Indian Hare, is characterised by a decidedly longer ear (approx. 13 cm. or so from crown) than the tail, and having about the height of a Jungle Cat, with a head and body length of 40 to 50 cm. only, and hind feet longer than the four feet. The common northern Indian Hare, *Lepus nigricollis ruficaudatus* Geoffroy, is characterised by the rufousbrown coat mixed with black on back and face; the breast, limbs, upper part of tail and nape rufousbrown; the throat, belly and underparts of tail appear white. The common southern Indian Hare, *Lepus nigricollis nigricollis* Cuvier is distinguished in having a black nape and upper parts of the tail blackish-brown.

Distribution :

The Indian Hare is most conspicuous in the number of sub-species, and is widely found throughout the plains and in the hills up to c 3000 m. altitude. Extralimally, it is also well known in Pakistan, Bangladesh and Sri Lanka.

Habitat and Environment :

The Hares in India occur in a wide range of habitats as grasslands, flood-plains, scrubs, arid areas, outskirts of forests, countryside and high above in the mountains (Prater, 1965; Ghose, 1985).

Status :

While they have now been exterminated from many areas of their occurrence, population in certain areas appear surplus in their natural habitats largely due to diminishing size of undisturbed habitats. However, no attempt has yet been made to estimate the actual population of this economically important animal (Ghose, 1985).

It is included in the Schedule IV of the Indian Wild Life (Protection) Act.

Biology :

Compared with the rodents, the Indian hare have low rate of breeding. Although evidences of population fluctuation in Hare have been recorded in many places of India, but no information is available on the factors responsible for such fluctuations. So far, we only know from literature that these hares breed twice or thrice in a year and give two or three young ones per litter (Ghose, 1985). In the desert form of the Indian Hares (*Lepus nigricollis dayanus* Blanford) males have been recorded to be in reproductive condition throughout the year but the females produce young only during the spring and summer months (in captivity) and the period of gestation varies from 42 to 44 days (Prakash and Taneja, 1962). The southern Indian subspecies, *L. n. nigricollis*, produce two young in early November in captivity. The eyes remains open at birth. The northern Indian Rufoustailed Hare, *L. n. ruficaudatus*, is said to produce one or two young (Prater 1965). However, no information is available as to whether availability of food has any relation in rate of fecundity reproductive success, control in population size, etc. (Ghose, 1985).

Behaviour :

Not much is known on the behaviour of the Indian Hare in the wild. The Indian Hare does not excavate burrows, but normally it rests by day in a slightly hollowed nest in a clump of grass or under a bush. In fact, the survival of this timid and shy animal can be attributed to their extreme alertness. They have acute hearing and a well developed sense of smell and sight. Lying still, the hare is not easily detected and remains safe, unless stumbled upon. Then it bolts wildly or goes off at an easy canter, usually stopping at the end of its run to sit up and look around.

Usually they emerge to feed around dusk or in the early hours of the night and resume feeding just before dawn. They graze mainly on grass, herbs, bulbs, roots, etc. In recent years, records of hares in agricultural fields, nurseries and orchards in search of food and cover, have increased.

Uses :

Skin of the hare is used for preparation of garments, fur coats, caps, gloves, etc. The meat of the Indian Hare is considered to be very delicious, for which it is hunted on large scale traditionally, specially by tribal communities.

Potential advantages :

The common occurrence of the animal, its size, behaviour and acceptability both as protein food source and for other research purposes, makes Indian Hare a potential animal for utilisation under a management plan.

Limitation :

The lack of detailed information in biology poses a major limiting factor besides their low rate of fecundity.

Research and conservation needs :

Except for some scattered information on the ecology authentic data on such important factors as population density, reproduction, fluctuation of population, food, grazing succession, predator-prey relationship, etc. appear to be extremely inadequate. Immediate attention should be paid to field studies so as to fill up the gaps of information on important elements, for a proper management plan.

BOVINES

The hoofed animals are broadly divided into two groups, even-toed ungulates, Artiodactyla comprising oxen, sheep, goats, antelopes, deer and pigs and odd-toed ungulates Perissodactyla comprising horses, rhinoceros and tapirs. The largest family of even-toed ungulates, Bovidae have many heterogeneous members now separated into several subfamilies many members of which are already domesticated to great extent or in a limited localised area. (Yak in Central Asia, Mithan in northeastern India). One of the subfamily of Bovidae is Bovinae which include cattle, yak, gaur, bison, etc. In bovines, horns are smooth except for keels, which may be light or strong and placed further back on the head than on the sheep and goat. Colour pattern in bovines usually consists of row of spots on haunches sometimes vertical white stripe, white band between the eyes, white mark on throat and lower segments of limbs.

Of the bovine mammals, at least four species, namely, Gaur, Mithan, Yak and Wild buffalo, available in the Indian region need extensive research and conservation. Investigations are needed to be carried out to investigate their potential as livestock resource, or otherwise, with possibility of interbreeding with conventional livestock and inducing newer characters to hybrid progeny. Some of the bovids, already identified as ancestors of domestic livestock could definitely be regarded as genetic reservoirs for maintaining and further improving the quality of domestic

breed. While others may be tried for captive breeding for management and utilisation specially in those areas which offer natural habitat condition.

The new and existing techniques of embryo transplants, whereby multiple eggs are fertilized and transplanted to other female animals have opened up great possibility of using common livestock to raise rare animals.

GAUR OR INDIAN BISON : *Bos gaurus* H. Smith

The gaur is a large bovine with massive muscular development. Two subspecies of gaurs are recognised :

Bos gaurus (India, Nepal)

Mithan (*Bos frontalis*) is believed by many scientist, as a domesticated form of gaur.

Appearance and Size :

Gaur is one of the biggest animal among bovines with its huge head, massive body, and sturdy limbs, the gaur is the embodiment of vigour and strength. It is among the biggest of bovines. Bulls weight 600 - 940 kg. and stand 1.6 - 1.9 m. tall at the shoulder, but a record bull of 2.2 m. and 1,225 kg. has been recorded. Cows are only about 10 cm. shorter in height, but they are more lightly built and weigh 150 kg. or less.

On their shoulders gaur bulls have a striking muscular ridge that slopes down to the middle of the back, where it ends in an abrupt dip. The horns are crescent shaped, creamy yellow, and taper to a sharp point, which is usually tipped in black.

New borns are a light golden yellow, but soon darken to coffee or reddish brown, the colour of young bulls and cows. Old bulls are jet black, their bodies almost hairless. Gaurs have light coloured forehead and yellowish or white stockings. Their eyes are brown but in certain lights, because of reflection, they appear blue.

Distribution :

Once common throughout South and Southeast Asia, gaurs now survive only in scattered remnant herds of up to 30 animals in the hill forests of India, Nepal, Burman, Thailand, Laos, Kampuchea, Vietnam and the Malay Peninsula. In Indian region, it occurs from Nepal to Arunachal Pradesh, then south to Nagaland, Assam, Mizoram, Duars of West Bengal, Bihar, Orissa and in Peninsular India.

Historically, the largest concentrations have coexisted with farmers in areas of shifting cultivation. The animals adjust to disturbed land, and they also adapt to man's presence if not unduly harassed. For example, gaurs will feed in agricultural fields, along roadsides and near occupied houses. Herds in national parks feed

peacefully while tourists stand by. Gaurs in zoos also become quite tame and manageable.

Habitat and Environment :

Gaurs typically live on gentle, undulating terrain with natural mineral licks. They inhabit gaps in the forest, such as abandoned clearings, where they inhabit

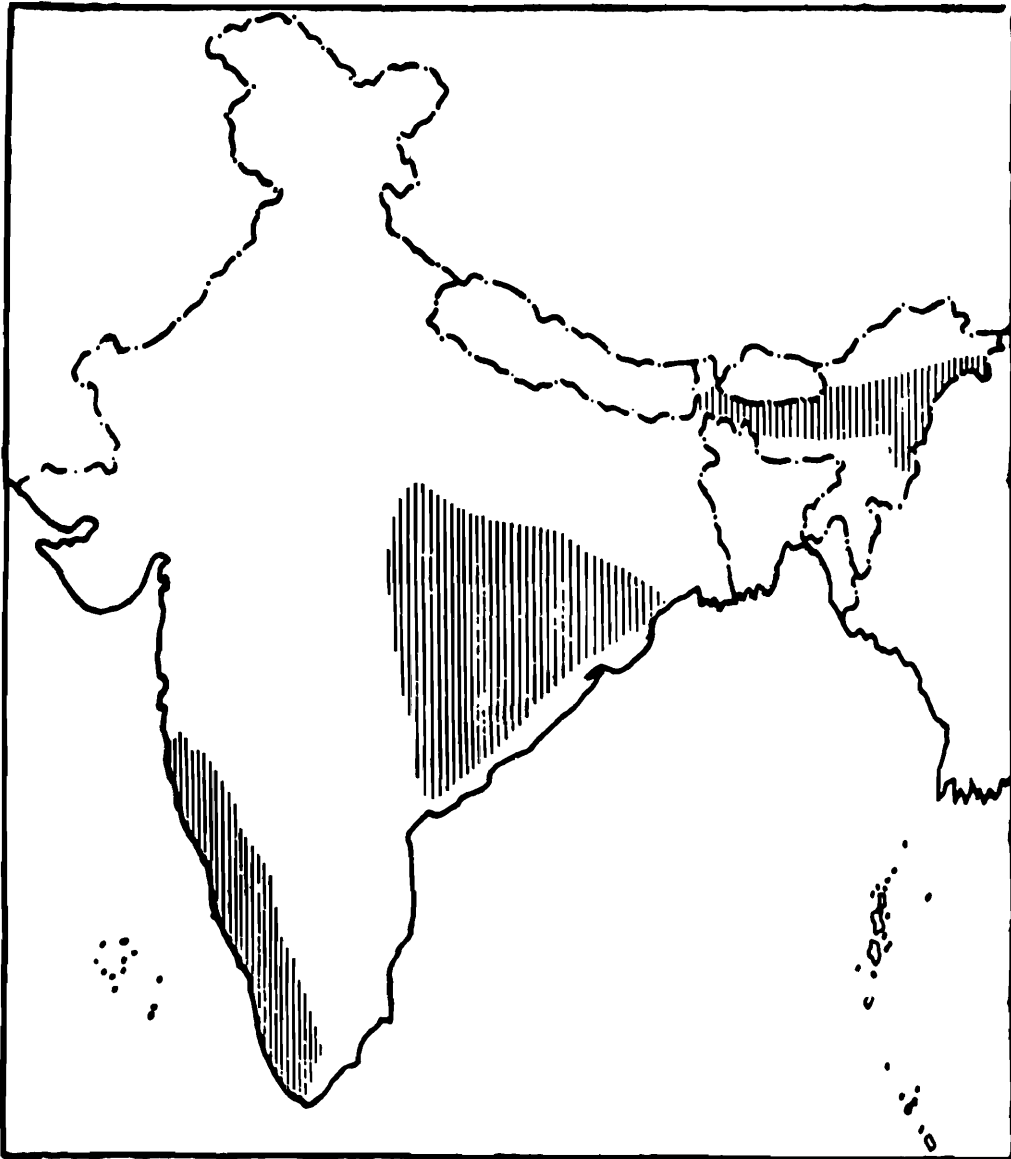


Fig. 1 : Approx. distribution of Gaur in India

deciduous and semideciduous hill and mountain forests with light bush and many grassy clearings. In the lowlands they live in open bamboo jungles, grassy plains near forests, or dense forests broken by glades or open meadows. (In the forest they probably depend to some extent on the slash and burn agriculture of hill people).

The animals appear to be adapting to increased human presence. They make use of such man-modified habitats as logged forests and fringe areas of agricultural estates that abound with grasses and early second growth vegetation.

Status :

Population not protected in parks and reserves are in immediate danger of extinction. Even in the remotest hill forests gaurs are harassed by hunting, exposed to the diseases of domestic cattle, and driven from their natural habitat by human invasion. Most herds outside of parks or wildlife reserves are threatened by agricultural development, hydroelectric dam projects, human settlement, or extensive logging.

In India, large populations still exist in the large sanctuaries such as Mudumalai and Kanha Tiger Reserve. In Thailand diseases carried by domestic animals, poaching, and habitat destruction have reduced total gaur numbers to fewer than 500. In Malaysia, the population is estimated to be only 400 animals. It is classified as "vulnerable" under IUCN classification.

Biology :

Gaurs are combination of grazers and browsers. They feed on the grasses of forest openings as well as on the young leaves, fruits, and bark of shrubs and juvenile trees. In one study in Malaysia, grasses comprised 41% of their diet, forbs 23% and woody browse 36%.

Gaurs develop large muscular bodies and maintain excellent condition on relatively low-quality feed. In the Malaysian study, crude protein content of grass species varied from 7.0 - 7.6 percent and phosphorus content varied from 0.11-0.17 percent; yet calves reached weights of 300 kg or more during their first year.

Birth and survival rates of up to 100% have been reported for wild gaur populations. Calves are born at any time of the year. The gestation period is 270 days, a little shorter than for banteng or domestic cattle and longer than for yak or kouprey.

Captive gaurs calve first breed at 2.5 years of age.

The gaur interbreeds with the mithan and both have diploid chromosome number of $2n = 58$.

Behaviour :

By nature gaurs are shy and timid. As with most wild bovines, their hearing and eye sight seem comparatively poor. Their defence lies in their massive size and acute sense of smell. When a herd with juveniles is threatened by a predator the adults form a protective circle around the young. Although individuals retreat from danger if they can, they have a unique form of threat : they approach their opponents broadside instead of head on, displaying the huge muscular body and dorsal ridge.

In common with other wild bovids, gaurs habitually visit mineral licks, which appear to be necessary to their habitat and influence the herd's movements.

Unlike water buffaloes, gaurs do not wallow. They take cover in the forest during the heat of the day and may feed at night and in the early morning during hot weather. In populated areas such as near agricultural estates, they may feed only at night to avoid people.

In the past, gaurs were seen to be associated in loose herds of up to 400 animals but today groups of only 5 to 12 animals are normally found. The herds, which are of more stable composition than those of banteng, are separated by sex for most of the year; however, during the rut stronger bulls form a series of "tending bonds" with estrous cows.

Uses :

Gaurs are thought to be interfertile with domestic cattle. If so, their attributes of size, massive muscular development, tolerance of heat and humidity, and resistance to diseases and parasites can contribute to beef production in the tropics. A gaur-cattle hybrid might also have immunity to some cattle disease; if it retains the mild temperament of the domesticated parent, an extremely powerful beast of burden could be produced.

The gaur is a truly majestic animal. Its habit of using grassy forest clearings and salt licks makes it a likely tourist attraction in parks and reserves.

Potential Advantages :

In a climate and environment where domestic cattle are susceptible to heat stress and parasite infestation, gaurs thrive and maintain body condition. Further, they are able to develop large muscular bodies and maintain excellent body conditions on relatively low-quality forage by feeding on a variety of woody browse, grasses, and forbs.

Retaining its wild instincts for survival, the gaur is better able to withstand predator attacks than domestic cattle. This could be an advantage when animals graze in remote areas are strong enough to defend themselves against a predator as powerful as a tiger. In addition, they are also very protective of their young.

Limitation :

Gaurs have little immunity to some cattle disease. In many regions of India, cattle driven into the forest to graze infect gaur herds with rinderpest, foot and mouth disease, cattle plague, very susceptible to malignant catarrhal fever.

Gaur numbers are declining throughout their range. If this trend is not reversed, it could effectively prohibit the use of gaur for domestication or cross-breeding purposes.

Gaurs are shy and excitable, making them difficult to catch, but once in captivity the animals clam down. Second generation zoo populations are easily worked and handled.

Gaurs on occasion damage cultivated crops such as young rubber trees and cassava. They require sturdy and well kept fences.

Research and Conservation needs :

Research is needed to establish and manage new gaur herds in forest reserves and build up the gaur population in the world's zoos. Techniques have been developed to capture and release wild gaur safely.

Fertilized gaur ova have been successfully transferred into a foster Holstein cow. The cow carried the gaur foetus to a successful delivery. This could be the forerunner of an important means of rapidly expanding captive herds by transferring gaur embryos into cattle in different parts of the world.

Research is also needed on the basic physiology and production potential of gaur.

Crossbreeding experiments should be started immediately to establish the degree of interfertility between the gaur and other bovine species.

MITHAN : *Bos frontalis* (Lambert)

The mithan is believed to be a domesticated form of gaur. However, it resembles the banteng and some authors have proposed that it is a gaur-cattle cross, others a gaur-banteng cross. The mithan is a domestic animal indigenous to parts of India, Burma and Bangladesh. Because of large size and the high butter fat content of its milk it is widely used to crossbreed with cattle in Bhutan. It deserves greater recognition both in Asia and elsewhere.

Appearance and Size :

The mithan is a handsome animal. Bulls may occasionally exceed 1.7 m. at the shoulder and weigh 1,000 kg. but the average bull is about 1.5 m. tall and weighs 540 kg. Cows are shorter and weigh less.

The animal has a dorsal ridge on the crest of the shoulders, a small but pronounced dewlap, and a generally flat forehead. Mithan horns are often of unusual girth; they are straight or gently curving, and many have an enormous base that practically covers the top of the skull.

Most calves and females are brown, but adult males are generally black with white stockings on all four legs. Some, however, are light brown, white, or piebald.

In the hill ranges of Assam, where gaur are still plentiful and inter-breeding between mithan and gaur frequently occurs, the mithans are massive and gaur like. But in the Chin Hills, where gaur are scarce, the mithans have lost their bulky proportions, probably by interbreeding with cattle. With them the high dorsal ridge on the shoulder (which lends so much to the imposing stature of the gaur) has disappeared, the horns are cowlike, and the varied colouring of the domestic cow begins to appear.

Distribution :

Mithan are kept in a domesticated condition by the hill tribes of north-eastern India (Mishmis, Mizos, Nagas), the Chittagong Hill tracts, and some Burmese hill ranges (Arakan and Chin Hills). It is the main domestic animal of the Nagas of Nagaland.

Many mithans are not domesticated in the strict sense. Their herds live in a semi-tame state near jungle villages and come to settlements only in the evening to lick salt.

Habitat and Environment :

The mithan is a grazing animal, but in some areas herds allowed to browse freely in the woods; some return to the villages for protection at night, while others remain largely in the forests. The villagers keep the forest mithans nearby by providing salt, for which the animals have an insatiable craving.

Feral mithan live in the same habitat as guars and said to move equally skillfully in mountainous terrain. Usually they are found at elevations from 600 to 3,000 m. However, in the Chittagong Hill tracts and the Mishmi country they descend to 300 m and lower, while in Bhutan they have been reported grazing in summer at altitudes as high as 3,300 m. for example around Thimpu.

Status :

In India feral herds totalling some 50,000 heads roam the jungles of Arunachal Pradesh. Recently the Royal Government of Bhutan has established two herds by purchasing animals from Arunachal Pradesh. Bhutanese farmers have some 60,000 head of animals that are hybrids of mithan and the local breed of cattle.

The Government of Bhutan is breeding mithans on Government farms and distributing males to private breeders to improve the genetic base.

Biology :

Mithans are fully fertile amongst themselves. Also, they interbreed freely with the gaur, banteng, yak, and cattle of both the tarsus and zebu types. Naga owners encourage the interbreeding with gaur, regarding it as an improvement of the race. They arrange this by placing salt licks in the forest. After gaur bulls have formed a habit of coming to the licks, mithan cows are left there and in due course mating takes place.

The crosses between mithan and zebu are also encouraged in certain districts. Unlike most crosses between bovine species, those between mithan and cattle result in fertile male and female offspring (although some owners indicate that the female is not a reliable breeder).

Behaviour :

This is an usually gentle animal with a quite disposition, as revealed in the the Chin tribe's expressing "gentle as a mithan" Normally even a stranger is safe to

approach one; if he gives it a bit of salt it will usually follow him about. Thus, mithan are easily managed in a regular cattle rearing operation.

Uses :

In some regions of northern India, mithans are used for field work and as draft animals. They are also important as a meat supply. The Bhutanese government is establishing a national dairy-mithan breeding program, which could result in a valuable dairy animal.

To many tribes of northeast India and Burma, mithans serve mainly as sacrificial animals. The Nagas use them as a kind of "currency" to pay for goods, to buy brides, and to pay penalties.

Hybrids resulting from backcrossing mithan with common cattle are also used as work animals. For at least a century, Bhutanese livestock breeders, particularly those in the eastern section, have mated mithan bulls to siri cows (*Bos taurus*) from India. This produces very profitable hybrid offspring that have high milk production. The milk is rich in total solids and produces exceptional yields of cheese and butter. The male of the cross (called "jatsha") is a powerful draft animal, and the female ("jatshum") is a prized milk cow. To this day, extensive crossing continues.

Potential Advantages :

The mithan is potentially an animal that can be used in difficult terrain where most domestic cattle breeds do not perform well. Mithan are superior when it comes to feeding on steep slopes and cliffs and for grazing native grass and the leaves of local fodder trees. They are also adapted to tropical and subtropical environments. And they are able to maintain themselves in small herds (6 - 10 head) in dense jungle.

The mithan could prove valuable in other parts of the world, and it could be important particularly for the genetic improvement of cattle in the tropics.

Limitations :

If they are disturbed, mature mithans can be temperamental. They can be difficult to hold with normal fences or chutes, because of their size. When given injections or otherwise subjected to pain, they are liable to bolt to the jungle and not return.

Research and Conservation needs :

The productivity of these animals needs to be better characterized and defined. Attention should be given to their grazing efficiency as compared with that of cattle.

The two farms the Bhutan Government has established for breeding mithans provide an opportunity to gather genetic information on the species and to have

experimental matings take place to establish the most suitable animal for various conditions.

The genetic relationship of mithan gayal, gaur, and cattle needs to be clarified. Although it is believed that the the mithan and gayal are the same animal, one of this report's reviewers points out that the mithan of Bhutan are strikingly different in colour, body shape, and horn structure from gayals seen in zoos in Europe and India. Although the mithan is now considered a domesticated gaur, many in the past have claimed it as a gaur cattle hybrid. Physiological research could remove lingering doubts.

YAK : *Bos grunniens* (Linnaeus)

Appearance and Size :

The Wild Yak is a massive, short-legged, blackish-brown bison like animal with dropping head and high humped shoulder. The body is covered with thick black hair, a deep fringe of black hair hangs from the flanks, shoulders and thighs. Its tail, about one metre long, bears a tuft of elongated hair at the lower half. A full grown male stands about two metres at the shoulder with horns a metre long and has a body weight of about 600 kg. The female is much smaller with short horns. During the winter the Yak grows a soft and closely matted, dense underfur, for protecting it from cold which comes away in great masses with the advent of spring. Domesticated yaks are smaller than wild ones, rarely exceeding 1.3 m. at the shoulder and weighing 250-550 kg. (males) and 180-350 kg. (females).

Distribution :

Within Indian limits, the Yak occurs only in the Changechenmo Valley in Ladak and also sometimes stray into the Sutlej Valley and into some of the passes as Kangri Bigi pass in east Kumaon. Extralimitaly, it occurs in Tibet and a part of the Kansu Provinces in China and also in northern Afghanistan, Pakistan, Bhutan, Mongolia and Soviet Union.

Habitat and Environment

An inhabitant of the coldest, wildest, and most desolate snow-covered mountains, where both Alpine Tundra and cold desert conditions prevail above the zone of human habitation. In fact Wild Yak's existence is one of continuous struggle against the adverse environment in the valleys at elevations ranging from c 4000 to 6000 m. However, in some places like Mongolia and Buryatia (U.S.S.R.) Yaks are found at as low as 1500 m. elevation.

Status :

The Yak has since long past been domesticated at the high altitudes of the Himalayas by inbreeding with domestic cattle, for human use. In fact, now the wild Yak population has been severely declined due to hunting by nomads and also by armed forces. Only a few are surviving in isolated pockets in remote areas.

Winter is a crucial time for the Wild Yak population, when many die of starvation and exposure.

The total number of surviving population is not known, although it is estimated that more than one million domestic Yaks are present in the World.

The species is included in the Schedule I of the Indian Wild Life (Protection) Act, & also Appendix I of CITES.

Biology :

So far known the rutting season of Yak is in autumn and the gestation period is eight to nine months. The youngs are produced in April-May. It becomes adult in about two years and is able to breed attaining age of two to two and a half years.

Behaviour :

Yak live in small herds of 2-5 individuals in winter. In summer and spring, large herds of cows, calves and young bulls congregate in valleys where sprouting grasses are available. The herds travel considerable distances in search of food. Its food consists of tufts of grass, shrub, salt-encrusted earth, etc. In severe winter when no food is available it starves for days together and takes frozen snow in place of water. Yak generally forages in early morning and evening times, and sleeps on the steep mountain slopes during the day. Like other bovines, Yak loves to stand or wallow in running water. Their wallows are, however, the icy streams which spring from the snout of a glacier. While travelling, they walk in a single file, each animal carefully placing its feet in the imprints left on the snow by the hoofs of preceding ones. Their sense of smell is acute, but sight and hearing are not keenly developed.

Uses :

Yaks are useful as pack animals being capable of carrying a load more than of 150 kg. in high mountain at a steady pace for days. Yak meat is considered important in parts of U.S.S.R. and in Mongolia with high altitude where it costs only half as much to produce as beef. In most areas milk production is practiced for husbandry; on an average more than 100 kg. of milk per lactation is obtained. Yak milk is much richer than cow's milk with a 6.5% fat, 5-3% protein and 4-6% sugar. Yak hide is used for making saddles and hair is used for making ropes, storage bags and tent. The annual yield of adult females and males is estimated at 750 g. and 1600 g. of hair and 350 g. and 600 g. of wool. Above timber line, Yak's dung provides important source of fuel. Heart and blood of yaks are used as epicure.

Potential Advantages :

Yaks are the only bovine species to live and work at rugged terrain in a cold climate. Yaks are most useful for production of meat and milk more efficiently and cheaply in high mountain areas.

Limitation :

The major limitation in use of Yak's is their inability to get rid of surplus heat at lower altitudes due to heavy coat of fur. They also become susceptible to disease at lower altitudes, as has been evidenced in Nepal.

Research and Conservation needs :

The primary area of research should be aimed at probable genetic potential of the species. The number and locations of purebred yak and also the total breeding population remains unknown and need to be investigated. Techniques for deep freezing yak semen have been successfully developed at Regent Park Zoo, London and can provide invaluable research tool for improving the breed.

Uncontrolled hunting of wild yak has already led the population to endangered status. It is imperative that yaks need total protection throughout their range and in adequately protected reserve with good pasture. Wild yaks should be isolated from domestic breed to keep a pure strain. People's Republic of China has taken some steps towards this end.

Research is needed to document breeding strategies, herd management, product processing, and herd hygiene in the entire range of distribution from Northern Afghanistan, Pakistan, Nepal, Tibet, Mongolia to northern India, Bhutan, Sikkim and Soviet Union, as in each of these areas, practices are known to differ.

ASIATIC WILD BUFFALO : *Bubalus bubalis* (Linn.)

Appearance and Size :

The Asiatic Wild Buffalo is much like the domestic buffalo, having a robust appearance, straight back, slaty black colour with scanty black hairs and dirty-white legs. Grown-up bulls measure 1.5-2.8 m. in height at shoulder and c 4.5 m. from the tip of the snout to the root of tail.

Horns of the wild buffalo is characteristic in being triangular in cross-section and transversely ridged; it may be as 2.0 m. in length. It also presents all types of patterns from curving upwards in a semi-circle to spreading outwards, almost horizontally from the head, with slight upward and inward curves near the tips. Horns of cows are generally longer but those of the bulls are more massive.

Present day domestic buffalos are derived from the wild species without much change in their external characters.

Distribution :

At present it is limited within our territories to certain sanctuaries and National Parks of Assam, Arunachal Pradesh, northern Bihar and southern Raipur and Bastar districts of Madhya Pradesh, Koraput in Orissa and Chandrapura district in Maharashtra. Outside India it is known from Nepal, Burma and Thailand to S.

Vietnam. It exists in feral state in Australia, Sri Lanka and some other parts of the World.

Habitat and Environment :

Tall grass jungles and reed brakes in the neighbourhood of swamps provide the ideal habitat for buffaloes, offering them both food and shelter, pools of water

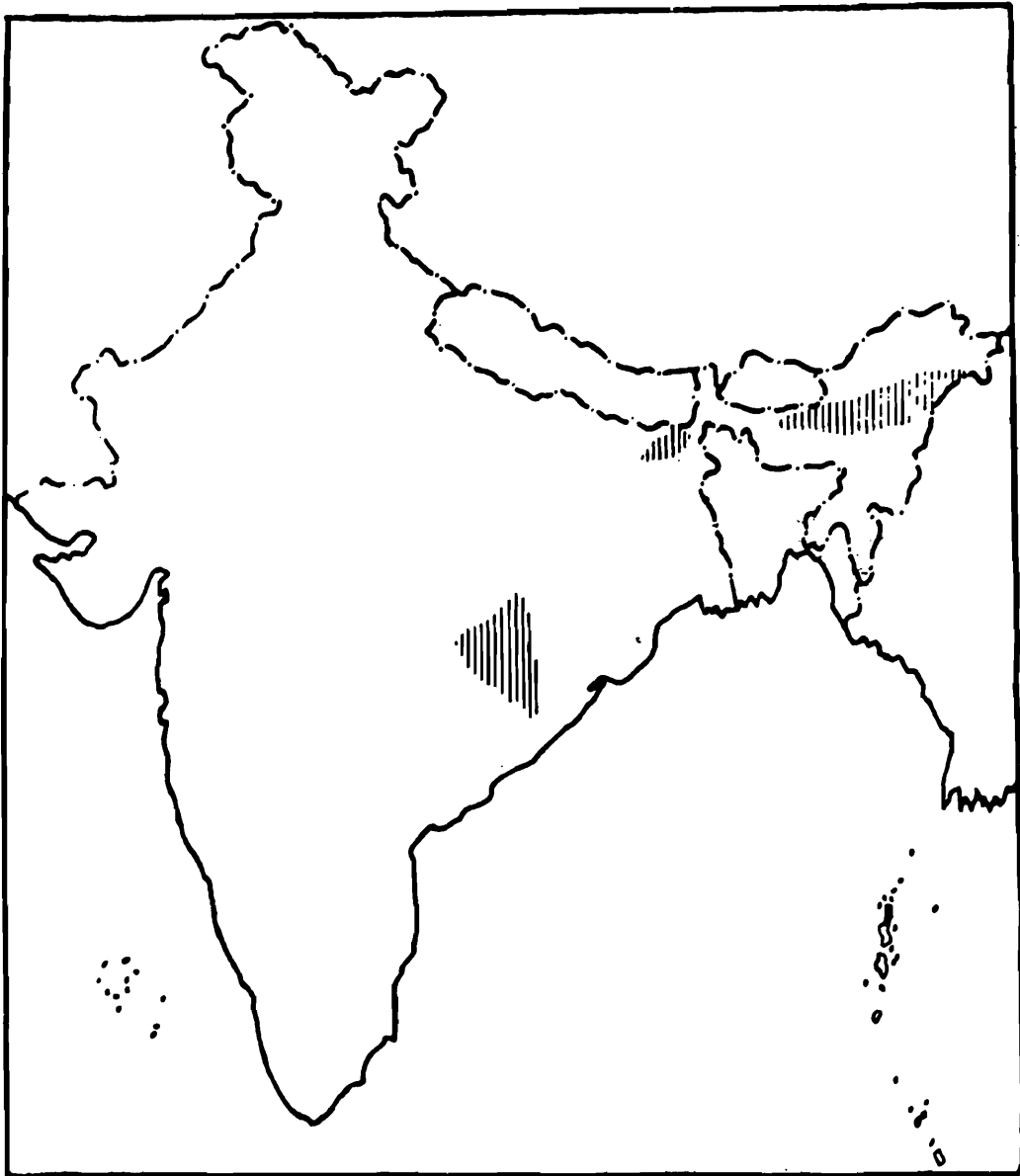


Fig. 2 : Approx. distribution of Wild Buffalo in India

to lie in, and mud wallows in which to roll and cake themselves with earth. Riverine flats of Assam and the Terai offer such ideal habitats; In the southern parts of their range, they live on drier and harder grounds, well broken up into nullahs and scattered with trees and open expanses of grass.

Status :

It is now regarded as an endangered species. Causes of depletion are primarily due to heavy poaching and contagious diseases, introduced by domestic cattle.

About a century ago it exist in thousands throughout the grass jungles of Terai and Duars of northern India, estuariene forests of southern Bengal and all over peninsular India, but today except for a few pockets stated above, it has disappeared from rest of distributional areas. There are not more than 200 animals left in Orissa and Madhya Pradesh together. In Kaziranga, and Manas Tiger Reserve in Assam, there are about 1100 that have lawfully been extended protection and are on the increase. In other parts of the World, except Nepal, the existing population is not known.

Wild Buffalo is included in Schedule I of the Indian Wild Life (Protection) Act., 1972.

Biology :

Mating takes place between February to June. The pairing season, however, continues as far as to the end of the rains. The gestation period is 300-328 days. Calves are generally dropped in March, April and May, but have also been observed in other months of the year. Generally one or two calves are born.

Behaviour :

The Asiatic Wild Buffalo remain in small herds which may combine to form large assemblage. They are selectieve feeders, feeding at dusk and dawn wandering long distances in the course of grazing and retiring into cover or to their wallows during hot part of the day or at night. During dry seasons, they often raid crops in nearby cultivations and the wild bulls approach and join the domestic bulls and stay in the herd for a priod.

In herds they are very wary but a solitary bull is aggressive in its attitude when one approaches. In fact, the wild buffalo is the most ferocious of the Indian wild cattle, as also a cow with its new born calf. Fight often occur among wild bulls and the winner takes care of the harem.

Uses :

Previously, traditional large-scale hunting for meat, hide and horns existed. The practice of driving tame buffaloes to the forests for mating with wild bulls, with a view to increase their breeding potentiality is known. The attributed of size, massive muscular development, tolerance to temperature and humidity can contributed to both milk and beef production.

Potential Advantages :

Though meat, hide and head used to be considered of much economic value before giving it a protection status, in recent years there is no information about its hunting for trade or meat. Present utilisation is aesthetic laragely for tourist attraction, as zoo specimen, etc. It can be effectievely utilised as a gene pool for better stock with traits of more muscular body and better adaptibility to graze in the wild.

Limitation :

Utilisation of this species could be difficult as a whole, particularly whilst most of the present populations occur in areas in which they are exposed to contiguous diseases from contact with domestic cattle. The species also appears to be more susceptible to diseases than most other bovids.

Research and Conservation needs :

The population of the Asiatic Wild Buffalo has greatly declined as a result of ever increasing encroachment of forest areas, opening up new road link and increased use of fire-arms. At present conservation cover to the species has been given to about 4500 sq. km. areas in different Reserves and Sanctuaries of Assam, Madhya Pradesh, Arunachal Pradesh and where they enjoy protected status. However, strict measure is required for preserving the surviving population of the animals. The setting aside of more conservation areas and reintroduction in suitable parts of former range could be considered.

Research is urgently needed to investigate its tolerance limit to climatological parameters before release of herds in reserve for building up of population. Scientific methods for transfer of fertilised ova to domestic buffalo cow may also be devised for expanding any captive herd. Research is also essential into the aspect of physiology and reproductive biology of wild buffalo.

SHEEP AND GOAT

The family Bovidae includes an array of animal taxa, some of which have been dealt under "Bovines" and some of the others will be treated under "Deer and Antelopes" Sheep and Goat also belong the same family but broadly separated under subfamily Caprinae (which also include "Deer and Antelopes") and more precisely under a tribe "Caprini" The tribe contains a total of 27 species under 11 genera which include most common domesticated goat and sheep on one hand and such interesting animals like Goral, Serow, Tahr, Bharal and Takin found within Indian region.

The domestic goat *Capra hircus* is believed to have its ancestor in wild goat *Capra aegarius* of western Asia and is regarded as the earliest of domesticated ruminants. It has been and still is utilised widely for production of meat and also milk and cheese. Its adaptability to diverse ecological condition and ability to endure stress condition has made goat an ideal animal for husbandry operation.

The domestic sheep, is also believed to have originated from Wild sheep *Ovis vignei* and has been used by man over thousands of years. It has also been introduced to distant areas over different period of time. It was Introduced in America during Columbu's time and to Australia only in 18th Century.

Of the goat and sheep, mountain sheep is regarded as animals which have managed to survive over different period of glaciation. The following is a list of genera from the World, of which some genera* are found in India.

Tribe Caprini

Pantholops	(1) Chiru
Nemorhaedus	(6) Goral*, Serow
Rupicapra	(1) Chamois
Oreamnos	(1) Rock Mountain goat
Hemitragus	(3) Tahr*
Capra	(9) Goat*, Ibex, Markhor
Ammotragus	(1) Barbary sheep
Pseudois	(1) Bharal*
Ovis	(2) Sheep
Budorcas	(1) Takin*
Ovibos	(1) Musk ox [Species number in parenthesis]

The Wild Sheep and Goat of India region as such offer an unique resource potential which may be effectively utilised. In the following chapter, two species Bharal (*P. nayaur*) and Himalyan Tahr (*H. jemlahicus*) have been delt.

BHARAL : *Pseudois nayaur* (Hodgson)

Appearance and Size :

Bharal or Blue Sheep is a medium-sized sheep, appearing as a half-way animal between goat and sheep. Its upper parts are brownish grey with a tinge of slaty blue. Legs, on the back and inside, belly and seat are white. Face, chest, and the stripe along the flanks and fore legs of adult sheep are black. The coat has hairs of uniform length throughout. Goaty odour is absent. Adult ram measures c 91 cm. in height at shoulder and weighs 54-68 kg. Ewe is comparatively smaller and lighter.

Horns are almost smooth with widely separated striations, unlike those of sheep, in an adult ram these are rounded at base and curved outward and downward, and at full-grown stage, backward; In ewes, they are shorter and oval at base. A good horn measures 64-76 cm. with basal circumference of 27-32 cm.

Distribution :

Bharal is confined to the northern ranges of the Himalayas at elevations from 4500 to 6500 m. In India its distribution range extends from Jammu and Kashmir (Zaskar Valley) to Sikkim. Extralimitally, it occurs in Pakistan and Nepal, northwards through Tibet and Mongolia into extreme south western China in Szechuan and Shensi.

* Source : Encyclopedia of the Animal World, 1972, p.246

Habitat and Environment :

These animals live in relatively arid mountain steppe country beyond the monsoon influence and above the limit of tree growth and are typically associated with broad stony valleys and ridges at the foot of higher mountain peaks, in regions characterised by extreme cold in winter and aridity throughout the year.

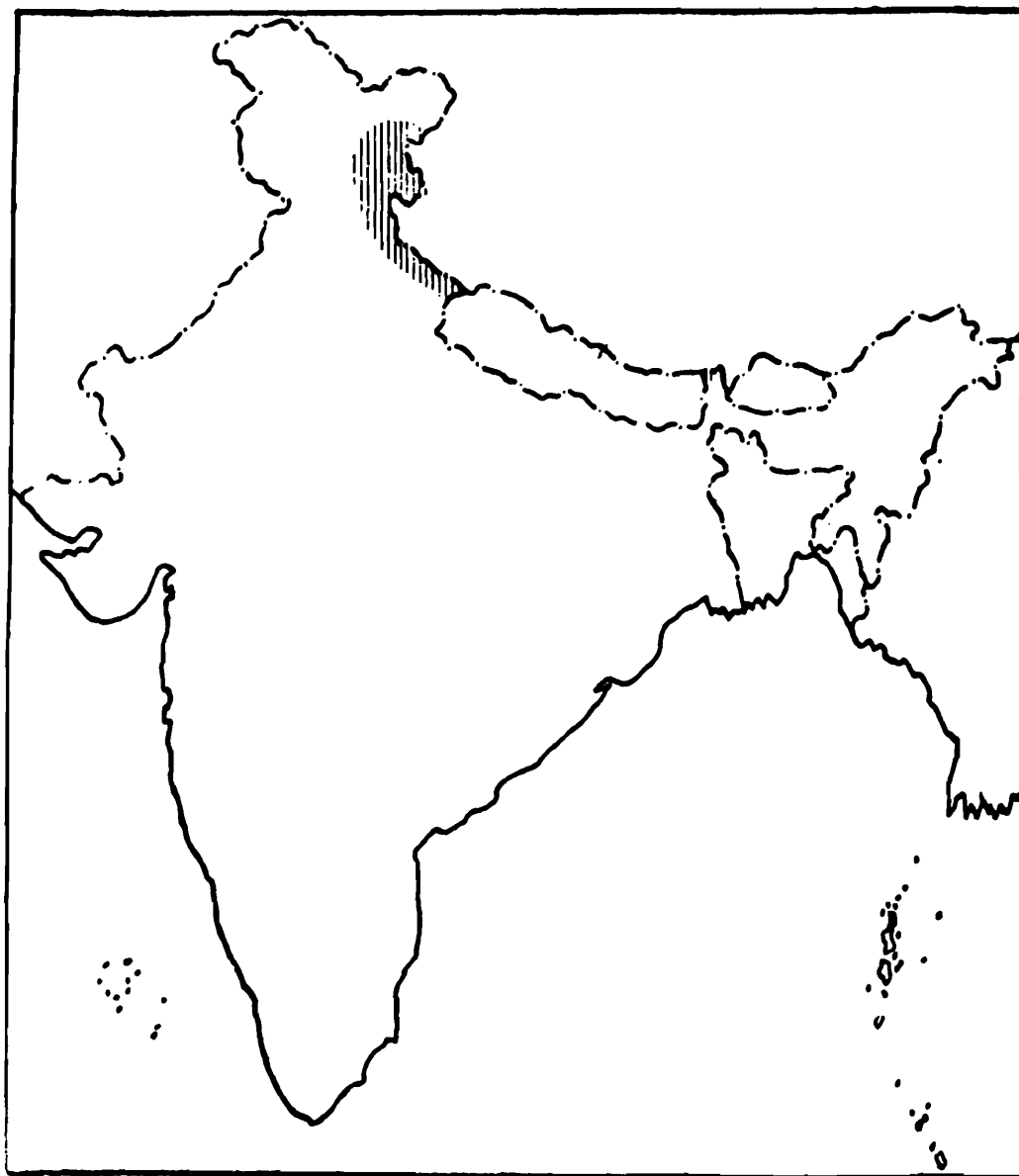


Fig. 3 : Approx. distribution of Bharal in India

Bharal and Siberian Ibex (*Capra ibex* Linnaeus) frequent the same ground, but Shapu (*Ovis orientalis* Gamelin) does not apparently occur in the same territory though they live in the same area.

Status :

Once the Bharals were considered fairly common in their remote inaccessible habitat but hunting pressure from local nomadic shepherds has reduced the

population to a fairly low level. Due to recently increased strategic importance of the frontier region of Kashmir, it is possible that the Bharal population may now be under increased hunting pressure due to easy access to their habitat.

Both Wolf (*Canis lupus chanco* Gray) and Snow Leopard (*Panthera unica* Screeber) share the same habitat and sustains largely upon Bharal.

Bharal is included in the Schedule I of Indian Wild Life (Protection) Act.

Biology :

Little is known about the biology of the Bharal in the wild. However, the rut probably do not start till mid November, lasting till early December, and the gestation period is about 150 days, but it appears that it might be longer than this. The majority of young are born in June and July and twins are common. In captivity the young is also known to born in August (in Zoo specimen).

Available information indicate that a captive female can live for 16 years.

Bharal, unlike Shapu, does not cross with domestic sheep.

Behaviour :

The Bharal is highly gregarious and diurnal in habits. It grazes intermitently throughout day, especially in the early summer when succulent new growth is available. Some growth of alpine annual grasses like *Poa alpina* and *Poa pratensis* in summer, and thorny clumps of *Astragalus zaskarensis* in winter, (which grow generally above c 4000 m. alt.) probably form important part in their diet. They also supplement their diet, when snow fall is heavy, by browsing on twigs of Alpine willow or even lichens and mosses. They may associate in herds of thirty to forty individuals but the old rams usually keep in separate small herds of five or six and remain at higher elevations than mixed herds of females and young.

The rams are known to fight during the rut when they rear up on their hind legs before striking sideways with their horns.

It cannot be easily tamed, but there is instances of its rearing in the Zoo Parks. In Regent Park Zoo, a captive breeding herd was maintained from 1882 to 1908, during which 43 lambs were born.

Uses :

Sport hunting for head and flesh, and occasional transportation to Zoo for establishment of new herd are only known. The use of it in laboratory research is not known.

In many parts of the Himalaya the meat of the Bharal is taken by the local population who hunt it out for food.

Potential Advantes :

Being highly adaptive to higher altitude and difficult terrain, Bharal can be effectively utilised under a management plan in high-altitude area.

Limitation :

No detail information on biology or physiology of this animal of high-altitude is known, which appears to be the limiting factor for its possible utilisation.

Research and Conservation needs :

At present, there is conservation cover to the species only in c 2870 sq. km. in Sancturaries and Reserve Forests in Himachal Pradesh, Uttar Pradesh and Sikkim. More National Parks and Sancturaries need to be set up in Western India, where besides protection of the animal, the habitat should be freed from human interference. An estimation of the population and study on the basic requirement for captive breeding for conservation is essential.

Research is also needed to investigate into its detailed reproductive biology and physiology for proper management plan in high-altitude region.

HIMALAYAN TAHR : *Hemitragus jemlahicus* (H. Smith)*Appearance and Size :*

The colour of body of this large wild goat is reddish brown; old bucks may be darker whereas does and young ones are paler. Head and face with short hairs, whereas body is covered with coarse, flowing hairs which are, in old bucks, shaggy and long, resembling mane hanging down to the knees. Does posses two pairs of teats in the udder. Standing height of the animal is c 1 m. at shoulder and weight of an adult an average is c 91 kg. Horns are closely set, stout at base but compressed and keeled in front, and transversely wrinkled, except at the tip. They diverge and curve backward. In bucks, they measure c 30 cm. in length and horns as long as 42 cm. have also been recorded; in does they are shorter.

Distribution :

This species is distributed throughout the Himalaya from the Pir Panjal range in Kashmir (from east of the Jhelum River) to Sikkim, and also in Bhutan, in high elevation but usually within tree limits.

Habitat and Environment :

Generally, the Himalayan Tahr prefer the precipitous terrain of towering cliffs, rocks, dense scrub and thick forests of oak and fir, within the tree-line above 3000 m.

Status :

There is a great decline in the number of the Himalayan Tahr. No estimation has been made as to the total population of the species. However, Schaller counted 45 individuals around Kang Chu Valley in eastern Nepal in 1975. Survey parties of the Zoological Survey of India encountered small herds of the Himalayan Tahr in several areas of Sikkim and in the Neora Valley in West Bengal, during 1979-1983.

Included in the Schedule I of the Indian Wild Life (Protection) Act.

Biology :

Detailed study on the biology and behaviour of the species is not known. The old males join the females late in autumn. Mating takes place in winter and a single young is born in each litter in the summer. Hybridization of this species with domestic goats has not been successful. However, an instance of its intercourse

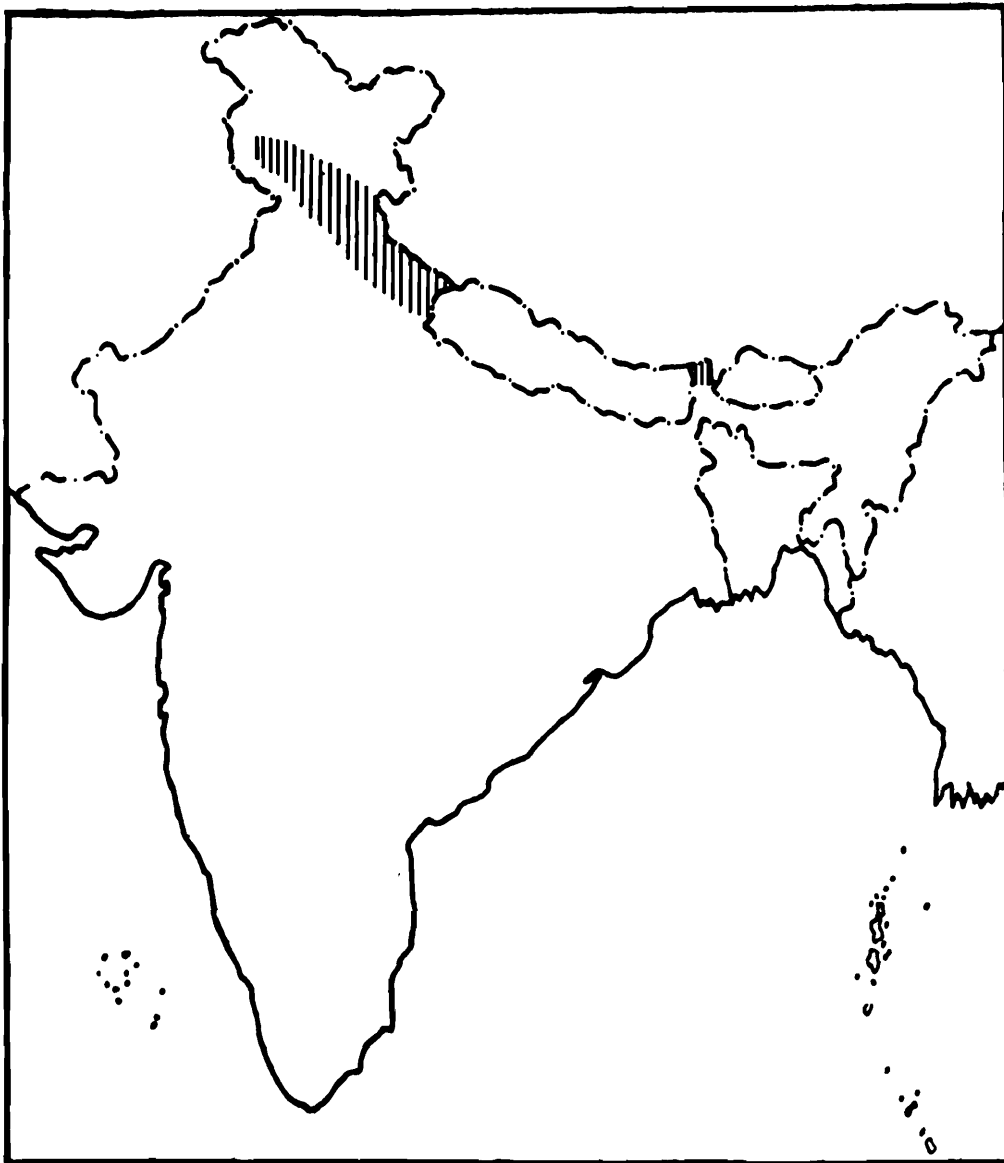


Fig. 4 : Approx. distribution of Himalayan Tahr in India

with a female Spotted Deer (*Axis axis* Erxleben), which produced a hybrid of mixed appearance, more like mother than the father, and lived and grew up a fine animal, is known in literature.

Behaviour :

It is a bold animal. Moves in herds of 6-12 individuals, some times found solitary, also seen in flocks of 20, 30, or even 40 individuals. In March-April the

herds come down in the valleys, and ascend to higher and inaccessible areas of the hills in summer when the old males live away from the herds. During rutting season the male always exhibit fighting tendency and many of them are killed by falling down the cliffs. It feeds on the grassy spots among rocks. If alarmed, they can all go off at speed with a clattering sound, but soon halt to gaze on the intruder. They generally follow the guidance of an old male in their movement. In the north-west, they are said to be sometimes seen along with Markhor (*Capra falconeri* Wagner).

Uses :

Flesh of the female Himalayan Tahr is reported to be delicious and is much sought after, but that of the old males is scarcely edible for a strong 'goaty' scent. An excellent quality of fleece, similar to the Chinese tartary shawl fleece, is obtained from the Himalayan Tahr.

Potential Advantages :

Except for unauthorised killing for meat and hide and exploitation for the excellent fleece, no other important use of the animal is known. The animal is easily tamed and is known to be reared in Zoos. The use of it in laboratory research seems to be negligible.

Limitation :

The lack of information on biology and behaviour of the species and its occurrence in inaccessible mountain ridge will be the major limiting factors for better utilisation of this wild goat.

Research and Conservation needs :

In Himachal Pradesh, Uttar Pradesh and Sikkim, the species has conservation cover of about 3750 sq. km. in National Parks and Sancturies, which is not considered enough for its total areas of occurrence. More National Parks and Sancturies need to be set up where it is still found, particularly in Kashmir, Himachal Pradesh, Sikkim, where besides protection, the habitat should be free from any interference.

Research is urgently needed in its biology, including productive capacity and possibility of hybridization and captive breeding.

DEER AND ANTELOPES

Deer as a group belongs to family Cervidae and differ from members of related family Bovidae in having a fissure in the skull, below the eyes, canines on the upper jaws (bovines don't have canines) in most species and by absence of gall-bladder except in the Musk Deer and above all by the possession of solid horns, which unlike bovine species can be shed and grown again. It is believed that the Deer is one of the most primitive of typical ruminants. Most of the species inhabit forest and grass-land. At least nine species of deer are known from India.

Antelopes are regarded as the most primitive of ruminants and belong to subfamily Caprinae under Bovidae while some scientists consider Nilgai (*Boselaphus*) should be under a separate tribe Boselaphini under Bovinae. Well known for their graceful appearance and syre-shaped hollow horns, antelopes and gazelles have drawn attention of both naturalists and sport hunters in the past. Of the five species of antelopes and gazelles from India, Nilgai enjoyed immunity from poaching in some regions, due to their apparent resemblance with sacred cows. It seem to be a promising species for proper management and has been dealt in this chapter.

Of the nine species of deer, three species, viz., Sambar, Chital and Musk Deer are selected here for advantages of utilisation of these species through extensive research, conservation and management measures. It may be noted that in Texas, U.S.A., Chital present (6,450) in 69 ranches and Nilgai (4000) in 7 ranches, have already been used for commercial game ranch operation.

NILGAI OR BLUE BULL : *Boselaphus tragocamelus* (Pallas)

The Nilgai or Blue Bull is the largest of all antelopes in India. It is a great ungainly animal somewhat horse-like in built, with high withers and low rump.

Appearance and Size :

Males may reach up to 140 cm. height while females are much smaller. Adult males are coarse iron gray in colour with white lips and chin. A ring below each fetlock and two spots on each cheek, innerside of ears and under surface of tail are white. A small bread like tuft hangs from lower chin. Young bulls and females are tawny in colour. Both the sexes have dark manes. Females have very small beard. The bulls have stout cone-line horns, distinctly keeled, triangular at base and circular towards tip. Horns c 20 cm. long.

Distribution :

The Nilgai is found throught the northern plains and plateau of peninsular India to the south to about 16°N latitude. It does not occur in the eastern part of the country nor in the coastal plains. Introduced to New Zealand.

Habitat and Enviroument :

Nilgai avoids dense forest. Its usual haunts are undulating grounds sparsely dotted with trees, or covered with grass and patches of shrubs. It freely enters the cultivated fields. It grazes and browses equally. It can hide in sparsely vegetaged tracts with ease.

Status :

The Nilgai, as its alleged immunity to hunters, is not included in the first two Schedules of Indian Wildlife (Protection) Act, 1972, and finds its place in Schedule III.

Biology :

The Nilgai lives in small herds of about ten animals. Cows, calves and young bulls associate together. Old bulls keep to themselves or a few may associate together. Youngs are produced all through the seasons. Period of gestation is about eight to nine months.

Behaviour :

Nilgai is known to have keen senses of smell and sight and moderately developed sense of hearing. When alarmed, a grunting sound is produced and the herd escape in an ungainly rather slouching gallop. Like other antelope, Nilgai often resort to the same spot to deposit their droppings. It can remain for long period without water and prefer to feed on leaves and fruits of *Zizyphus* and freshly fallen flowers of mohwa and others.

Uses :

The Nilgai venison is a favourite meat but to a restricted group of people. Hindus regard it as a relative of cows and therefore it is considered sacred. The hide of Nilgai is used for leathers of tough quality and uses of its leather is restricted to certain sections of the people.

Potential Advantages :

The Nilgai is a potential animal that may survive in a little covered areas. When the dense forests of India is fast vanishing Nilgai has been occupying those areas with scanty vegetation. It is also enjoying the immunity from the hunters for its alleged sacredness. The Nilgai can do for long periods without water. It has the habit of resorting to the same spot to deposit their droppings. Such a rendezvous may be a means of re-assembling the scattered members of the herd. The youngs are produced at all seasons.

Limitations :

The Nilgai has keen sense of smell, sight and hearing and its chief means of escape is its speedy movements in ungainly slouching gallops, even in most difficult ground. It would take a very good horse to catch up a galloping Nilgai, for any utilisation in farming.

Research and Conservation needs :

Although, the Nilgai has been well thriving in the captivity and also in the sanctuaries, their detail management know-how is not yet clear. Research is needed to formulate a management strategy for captive-breeding under controlled condition.

SAMBAR : *Cervus unicolor* Kerr

The Sambar is the largest of all deers in India and is the typical forest deer of South-East Asia.

Appearance and Size.:

Sambar coat is coarse and shaggy. General colour is brown with yellowish or greyish tinge, underparts are paler. Females are lighter in tone. Old stags tend to become very dark. Stags have a rough mane around neck and throat, and carry a pair of stout and rugged antlers with three points in rutting seasons. Full number of points are attained in the fourth year. Every year the antlers, as a rule, are shed after the rutting seasons and a new set is grown.

At shoulder, a Sambar attains about 150 cm. height, and a full grown may scales over 300 kg; antler may reach 129 cm;

Distribution :

The wooded parts of whole of India. The Malay Sambar is said to be replacing the Indian Sambar in the North-eastern States.

Habits and Environment :

Sambar are typical forest dwelling species. Hot humid forests are their favourite haunts.

Status :

Sambar is included in Schedule III of Indian Wildlife (Protection) Act, 1972.

Biology :

Sambar stags are usually solitary, and defend their territory from rival stags. Each stag fights to obtain sole rights over some favoured area. The possessor of the area eventually becomes the master of the harem of hinds that enter the territory. The stags cast their antlers in spring and begin to grow in late summer and in autumn the antlers appear fully grown and the dried velvet peeled off. During this time, pairing takes place. A stage's harem is limited to a small number of does. After the rut, the stag deserts the harem. Youngs are born at the commencement of rains. Young stags remain with the mother until fully grown at the age of about third year. Sambar group usually consists of a family headed by the hind and only during rut the stag may adhere to such family party.

Behaviour :

Sambar feeds on leaves, grass and wild fruits, usually after dusk and retreat to dense forest during day time. Sambar has keen sense of smell and hearing and moderately developed sense of sight. A water loving animal it can swim with the body submerged, keeping the face and antlers above the surface. Sambar stag clean antlers by rubbing them against rough surface of tree.

Uses :

Sambar has been a favourite game animal. Its venison, hide and antlers are much favoured. And in nature, it is the one of the principal prey animal of the larger carnivores and particularly of the Wild Dog.

Sambar leather is much fancied for tough and stardy leather products.

Potential Advantages :

Sambar is a common species in the forests of India. It has been thriving well in captivity. Matriarchial system in the social organisation leaves ample scope for the doe to fond for her offsprings.

Limitation :

Sambar have been kept in captivity in a number of zoos in India and abroad. However, details of reproductive biology and parameters for successful breeding operation in different environmental conditions is not available.

Research and Conservation needs :

Research is needed to establish a proper captive breeding technique for farming for commercial utilisation, under hot-humid climatic zone or controlled condition.

CHITAL OR SPOTTED DEER : *Axis axis* Erxleben

The Chital or Spotted Deer is the most handsome deer of all the Indian deers. Both the sexes have beautiful form and coat colour. Adult males develop three point antlers. This beautiful species of deer is a gregarious animal at all seasons. Its venison is good and the skin is much sought for rugs and other fancy articles. Antlers are also used for many curvings and other decorative purposes.

Appearance and Size :

Size moderate, a little less than a metre at the shoulder in adult bucks, and considerably less in the does. Coat is smooth all through and magnificently coloured chestnut spotted with immaculate white in both sexes and at all seasons and ages. All along the spinal column, from nape to tail a dark line of richer colour runs through. Throat, belly and under tail white. Some old males develop much richer and deeper colour in coat.

The antlers have three points in each, a short brow-tine and two branches at the tip of the beam. Total length is about a metre long and in girth it is about eight centimetres at the centre of the beam.

Distribution :

All most through out whole of Indian territory except the North-eastern States and the hills of the Himalayas; beyond the foot hills, from the mangroves of Sundarbans to the plains and plateau up to about 1200 m. altitude and Sri Lanka.

Introduced in the Andamans and New Zealand and elsewhere.

Habitat and Environment :

The Chital or Spotted Deer is fond of forest, bordering streams. Equally adapted to the swampy mangroves of Sundarbans or rugged plateau of Central India. Starndale says-“Spotted Deer has no objection to plains or to the neighbourhood of man, provided larking ground or forest is available for a refuge,...Generally, Spotted Deer and lovely scenery are found together. There is no such beautiful sight in creation than a Chital stag in a sunflecked dell”

Status :

Indian Wildlife (Protection) Act, 1972 includes the Chital as the Schedule III animal.

Biology :

Chital are gregarious at all seasons. Production of youngs may occur at any time, as does the shedding of antlers, but antlers are mostly shed in spring and the rutting frequency increase in autumn. Gestation is about six to eight months. Many works have been done on their behaviour in the herd and other family affairs. Parasites and other pathogenic elements causing diseases are moderately known.

Behaviour :

Chital feed till late in the morning and also in the afternoon and prefer to rest lying down in the interval in the shaded area of the forest. Chitals often enter, cultivated fields and do not seem to avoid the vicinity of villages. Many biologists often associate occurrence of Chital with other forest animals specially with monkeys. In a recent study carried out during dry season in Tamil Nadu on social behaviour of Chital, it has been seen to exhibit a bimodal pattern in diurnal activity changing their grouping behaviour and vegetative use. It was seen that Chital makes no attempt to form a harem group, nor do they establish territory.

Uses :

Spotted Deer venison is a favourite meat to all. In Andamans, until recently, the Spotted Deer venison was much sought for protein and it replenished the protein requirements of the inhabitants of those islands. In Port Blair market Chital meat was much cheaper than mutton or other meat. The beautiful hide is a fancy fur and has been in use for rugs and luxury drappers. The skin has also been used for making shoes and chappals, ladies hand bag and sundry other fancy articles. The antlers are used for fancy curvings and ornamental handles for many articles of utility. Mounted antlers, skull with antlers, mounted head with antlers are used for interior decoration. The rugs made up of Chital skin are used for seats in the places of worship.

Potential Advantages :

The Chital or Spotted Deer is an animal that can thrive in the difficult terrain where most of the domesticated cattle, sheep or goat do not prosper well. The classic example is that of Andamans. A handful of animals introduced about a century back have proliferated and occupied most of the principal islands of the Andaman group and established itself as a native species by now. Until recent days, the Spotted Deer meat replenished the steady supply of venison to the Port Blair market and elsewhere.

With wake of wildlife preservation and conservation many wildlife sanctuaries and other asylum of wildlife have been coming up. Many of the sanctuaries do contain the Chital. And Chital is increasing and has been increasing very quickly. In many places the Chital occupies the major area and possibly deprives the other species from the natural resources. Soon a policy for culling or cropping out would be sought for in many such areas.

From ancient times, the magnificent species of deer, the Chital lived and breed particularly well in captivity both in India and elsewhere and is well known in menageries. Introduction to new areas (viz. Andamans and New Zealand) proved fruitful.

Limitation :

The adult males with antlers may be dangerous when in rough mood or during rutting seasons. Such males in a herd may flight with each other inflicting injuries. Handling of such animals need much careful approach.

Research and Conservation needs :

Population estimate at present should be mapped. Management in menageries, sanctuaries, etc. should be extended and utilised properly.

MUSK DEER : *Moschus moschiferous* Linnaeus

The Musk Deer has a small head, pointed face, noticeably large ears and measure about 90-95 cm. in head and body length. Absence of horns in both the sexes, and presence of the greatly elongated incisors or tusks in the upper jaw, and a purse-like scent or the musk gland situated anterior to prepuce in males distinguish this deer from the other cervids. A facial and caudal glands are also present. The legs are slim, long and the rump higher than the shoulder. The general colour is rather variable, from dark sepia and brownish to paler iron grey, with lower cheeks, throat and belly being withish. The colour however varies from dark chocolate brown to speckled grey in summer and winter respectively. The coat of the body is peculiar, lacking any under wool but being very coarse, pithy in texture and brittle. The tail is a mere stump, up to 38-50 mm. long and

completely buried in the fur of the caudal region. The eye are large with a golden brown iris, and the rhinarium is naked black and always moist.

It measures about 50 cm. high at the shoulder, C.H. Stockley recorded a specimen as standing 62 cm. at the shoulder and 67 cm. high over the pelvis. The tusks measure about 85 mm. or less along the curve.

Distribution :

In India it occurs from Kashmir to Sikkim and Arunachal Pradesh (Namdhapa Biosphere Reserve) in the Himalayas. Extralimitally, it occurs in Nepal, Tibet, south-west China and northern parts of Pakistan.

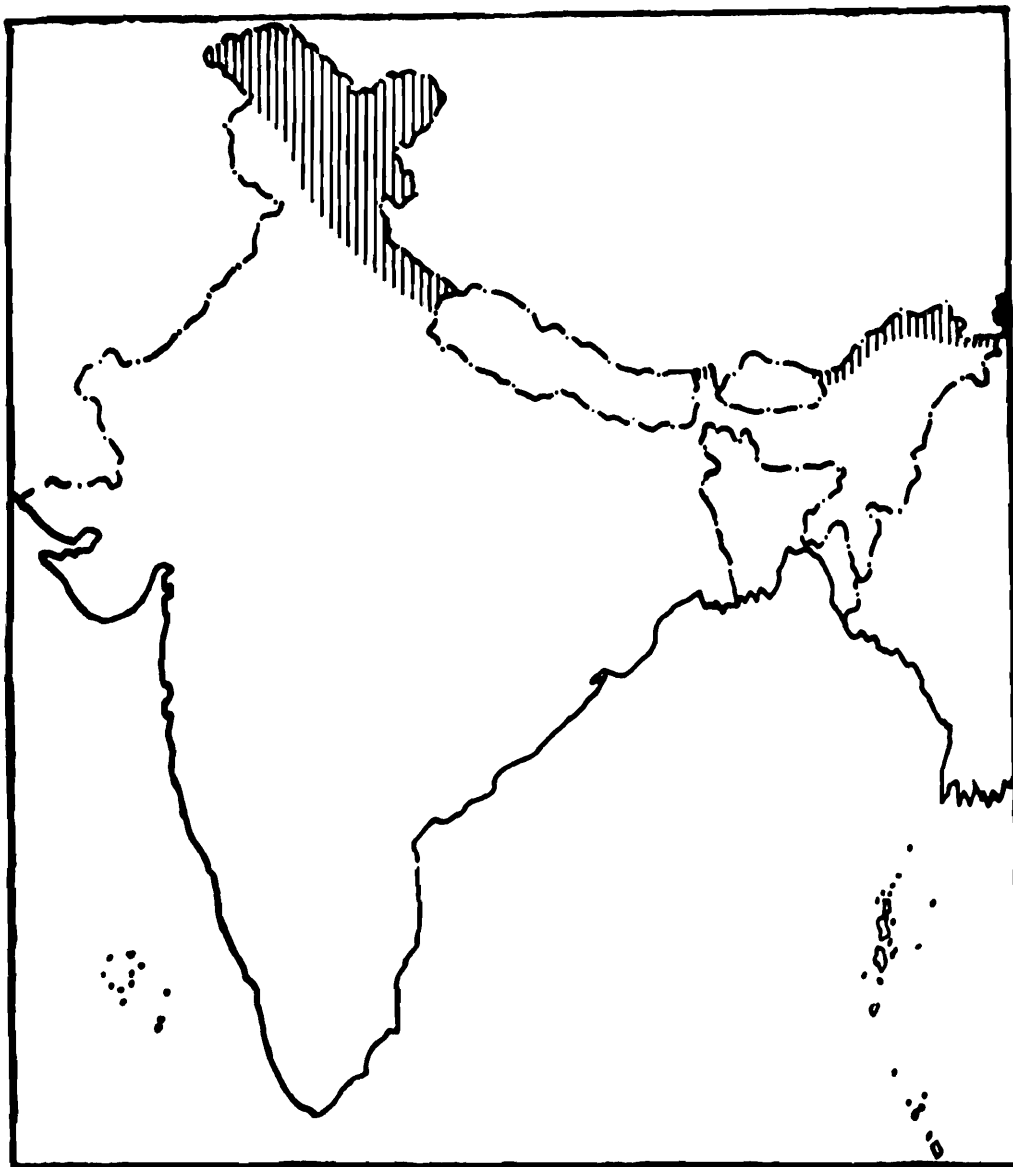


Fig. 5 : Approx. distribution of Musk Deer in India

Habitat and Environment :

In the north-west Himalayas it is associated with the sub-alpine scrub zones, above the coniferous forest. It particularly favours steep slopes and narrow gullies

near mountain crests where winter snows provide sufficient moisture in spring for growth of stunted bushes such as the wild current (*Ribes* sp.) wild celery (*Ferula* sp.) and dwarf juniper thickets. Even in mid-winter it remains at high elevations, usually above c 3000 m. In summer it occurs mostly between c 3350 m and 4000 m in association with Birch (*Betula utilis*) and dwarf juniper (*Juniperous* sp.).

Status :

The Musk Deer has probably never been as plentiful in the northwestern part of the Himalayas as in regions further east where it is able to subsist at lower elevations because of the higher rainfall and greater vegetative cover. In the more accessible Himalayan regions it has obviously become excessively rare due to constant persecution by hunters. Its chances of survival in the remote but much less favourable arid plateaus are better, but if it is to have any chance of future survival in most regions of India, it should be totally protected.

Man is probably the most serious predator of this little deer, because of the high value of its musk pod, but they also occasionally fall victim to Snow Leopard and Wolves, both of which frequent exactly the same habitat. The young of the Musk Deer are susceptible to predation from martens, lynxes and even Golden Eagles and this could be another reason of their population decline.

Musk deer is included in Schedule I of Indian Wild Life (Protection) Act and Appendix I of CITES.

Biology :

The rut takes place in November and December and only at this time two or more non-related individuals can be encountered together. The gestation period is believed to be 160 days. The Russian scientists consider the gestation period to be 5 months. The young are born in late May and early June. They are small and weak at birth and it is believed that the period of suckling is relatively extended. Females become sexually mature at 18 months of age and males at three years of age. Usually only one young is produced though twins have also been reported occasionally.

Behaviour :

This is a shy and secretive animal in the Himalaya and there are no detailed accounts of its behaviour or habits, though the Siberian population has been better studied by Russian Zoologists. However, it is solitary in habits and seems to be territorial, regularly frequenting a particular bit of ground. Musk Deer spend most of the day in some thicket, and forage actively only during the early morning and late afternoon. In summer they feed on all kinds of herbs, young and grasses. In winter they have to resort to eating the bark and twigs of willow (*Salix himalayensis*), wild current (*Ribes emodense*) and honey suckle (*Lonicera beteryphylla*) which grow at these elevations, and also consuming the lichen off the rocks and tree holes. Probably very sharp hooves of musk deer assist them in digging in the snows to explore vegetation.

Males are reported to be highly excited and even ferocious during the rut, and eat very little throughout this period. They also smell penetratingly of musk during the rut period and rub their caudal scent glands against twigs and stones to mark their territory. They fight with their canines leaving deep slash marks in the brittle fur of the other males.

The only vocalisation recorded is a loud 'hiss' or a 'hoarse peeping'. Their alarm call is said to be a 'chirp'.

When disturbed, Musk Deer move away with long erratic leaps, either up hill or down, despite the steep and difficult terrain.

Uses :

This deer is largely trapped by noose method or hunted for the "musk" which is produced in the musk-pod of the animal. The commercial term for musk in Indo-Nepal area is "Tonquin" and in USSR & China it is known as "Carbandine" and is very highly priced. Besides musk, the hide makes excellent buck skin and the tubular leg bones are utilised as arrow heads by nomads.

Potential Advantages :

Commercial importance of the animal is well known throughout the world for the odorous organic compound known as Muskone, accumulated in the musk pod. There is great demand of this product in perfumery and in medicine. Its odour has been long recognised as one of the best natural fixatives for perfumes which is so strong that one to 3000 parts proportion retains the perfume. Generally 50 to 60 gm. of musk, in the form of irregular reddish brown grains, is obtained from a full grown buck.

A method for extracting musk without cutting the deer has been developed in China.

'Musk' deer is well known in international trade, as also live as zoo and laboratory animals.

Limitations :

The detailed information on biology and physiology of musk deer is lacking specially under Indian condition. The natural and secretive habit of the animal makes it difficult to investigate into this aspect in the wild and only captive animals have so far provided the scanty data. Information on its susceptibility to disease and survival under changed environmental condition is also wanting.

Research and Conservation needs :

Due to ruthless persecution of this deer in Kashmir, Himachal Pradesh and Sikkim in India, as also in Nepal, its population has become very thin. It is now under protection and the export of musk has been completely prohibited.

In India the species is under conservation cover in approximately 5000 sq. km. in National Parks and Sanctuaries of Jammu & Kashmir, Himachal Pradesh, Uttar

Pradesh, Sikkim and Arunachal Pradesh. However, monitoring of the population is essential, beside providing conservation coverage in more areas of its natural habitat.

Research is needed on detailed physiology and reproductive biology for proper utilisation and management of this highly valued species. The method for obtaining musk by surgical operation has already opened up vast potentiality for its utilisation.

MOUSE DEER : *Tragulus meminna* (Erxleben)

Appearance and size :

The Mouse Deer or the Indian Spotted Chevrotain is a tiny little animal with slender limbs, high hind quarters small tail of about 2 to 4 cm. in length. The head and body measures 45 to 56 cm. and the standing height at the shoulder 25 to 31cm. Unlike other deer, the Chevrotain have no antlers, but are furnished with well developed tusk in males. The colour of the animal is generally brown or olive brown, minutely speckled with yellow but white on underparts. The sides of the body bear elongated white and buff markings and the throat possess three stripes. The ears are brown.

Distribution :

It is found in southern India, and through eastern part of Madhya Pradesh and Orissa to Chota Nagpur area in Bihar. Extralimitally, it occurs in Sri Lanka.

Habitat and Environment :

It inhabits dense forest areas and generally found among rocks and grass-covered hill sides up to c 1850 m. altitude.

Status :

The Mouse Deer has become very scarce in many of the areas of its range of occurrence. The decline in its population is largely due to over hunting by man for its flesh, which has probably been made easy by its timid nature (Anon, 1981). It has been fully protected under Indian Wild Life (Protection) Act and export of mouse deer is prohibited.

Biology :

Very little is known on the biology of the animal. The rutting season is about the middle of the year (June - July) when the male and the female is found together. The young, usually twins, are born at the end of the rains or the beginning of the cold weather (Jerdon, 1867; Finn, 1929).

Behaviour :

The Mouse Deer are timid and delicate animals, but can become very tame. They walk on the tips of their hoofs which give the legs a rigid appearance. They trip about most daintly on the tips of the toes, and look as if a puff of wind would blow them away. In the wild they usually take refuge in the crevices of rocks during

the day and never venture into the open country. It is said to avoid movement during winter on the forest floor as its sharp hoofs can penetrate the leaf litter thus obstructing the movements (Jordon, 1867; Finn, 1929).

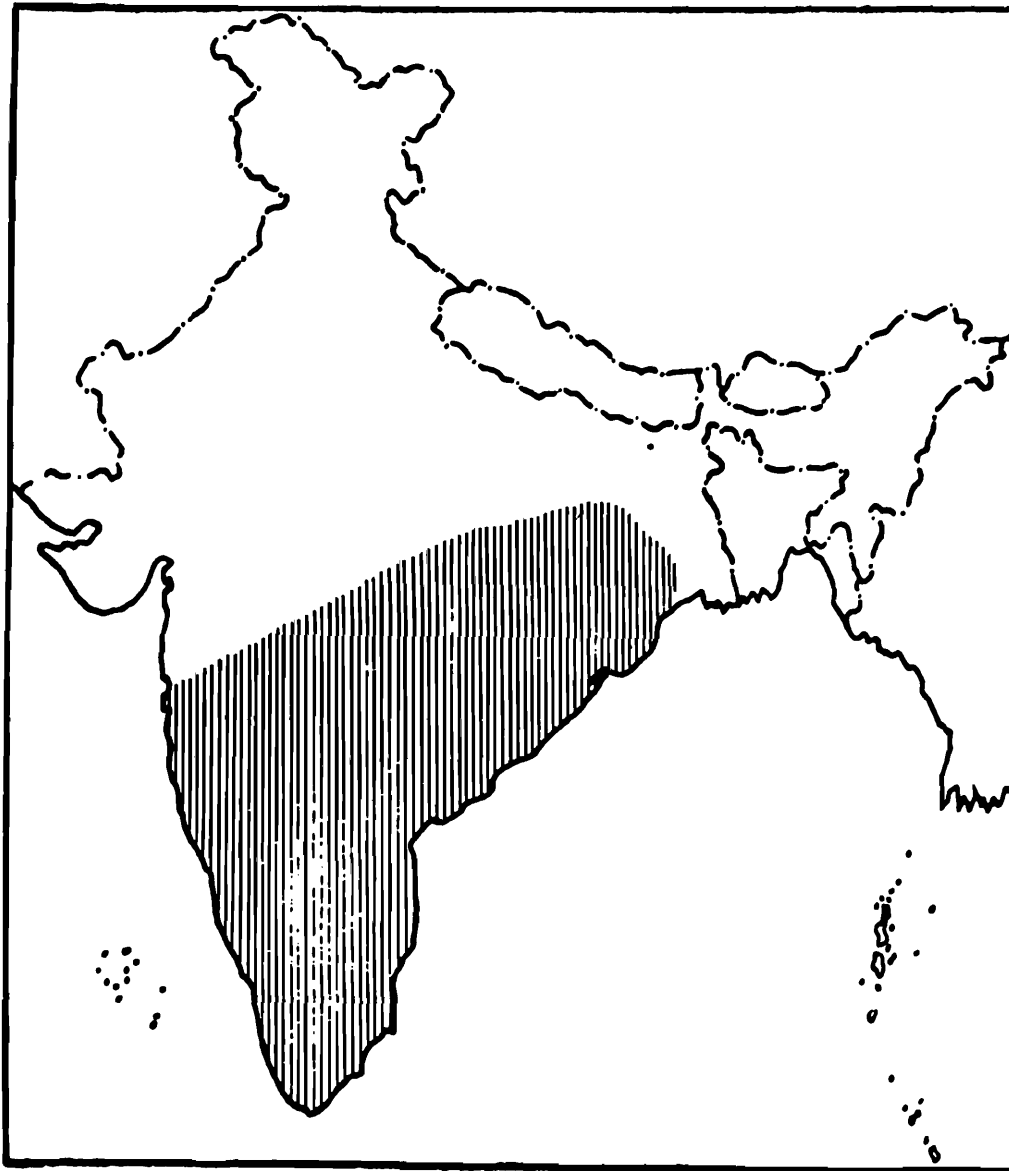


Fig. 6 : Approx. distribution of Mouse Deer in India

Uses :

Sport hunting for meat, and occasional transportation to zoos are only known. Its infrequent use in laboratory research is also known. Live individuals and hide are not known in international trade.

Potential advantages :

The small size and timid nature of the animal may offer advantage in its study in captivity.

Limitations :

Inadequate information on biology and feeding and other habits appear as major limiting factor. Low breeding rate also limits its utilisation on a large scale.

Research and Conservation needs :

Detailed research on biology is urgently needed.

In Tamil Nadu, Kerala, Goa, Karnataka, Maharashtra and Madhya Pradesh the species has conservation cover of about 2800 sq km. in National Parks and Sanctuaries, which is not enough for its total areas of occurrence. However, monitoring of the population is essential, besides providing conservation coverage in more areas of its natural habitat.

PIGS

Pigs are recognised as separate group under Suidae of Artiodactyla. All pigs and pig like animals have incisor teeth on upper jaw. Stomach of pigs and pig like animals are much less complex than true ruminants and in some, consist only of one chamber. Pigs, Peccaries and Babirusa are grouped together and in India, Pigs (Suidae) are only represented by Wild Boar and Pigmy Hog; a third is recognised as Andaman-Pig. They have elongated head, truncated snout ending in a flat disc bearing nostrils; their upper canines curve upwards and outwards and feet are narrow. Of these three species, the Pigmy Hog is a much smaller animal of only 60 cm. long, a very shy, secretive one, known from northeastern India and is limited to a small number.

Pigs have been used by man for at least last 5000 years since Neolithic Period. It is surmised that Asiatic pigs were domesticated and brought to Europe, and Wild boar in Europe was domesticated at a later date. Pigs have been recognised a major source of meat and cooking fat but it is evidence that in Ancient Egypt pigs were used to tread the corn, for rounding up cattle, retrieving game and detecting fungal delicacy called 'truffles' It is also believed by some scientists that since Neolithic times, pigs have been used for clearance of ground by the farmers to convert open woodland into arable and pasture land.

It is believed that hybridization between five Asian species and common pigs has resulted in a confusing diversity of forms. However, wild pigs still represent a gene-pool of potential importance which can be effectively utilised for developing one of the important sources of protein food for man.

INDIAN WILD BOAR : *Sus scrofa cristatus* Wagner

Appearance and Size :

The Indian Wild Boar is allied to the European boar (*Sus scrofa scrofa* Linnaeus), but distinctive in its sparse coat and fuller crest or mane of black bristles

reaching from the nape down to the back. The colour of coat is black mixed with grey, rusty brown, and white. The young are browner and old boars are greyer. New born wild boars are brown with light or black stripes. In adult males the canine teeth become greatly developed into tusks. The upper canines are shorter and thicker and fit behind the lower tusk (external length 7.5 - 10 cm.) which curve forward and outward.

The head and body length of adult varies from c 115-150 cm and the tail c 18.23 cm. long. Males are considerably larger and heavier than females and stand 84-91 cm. at the shoulder. Larger boars are also known. A 160 kg. specimen from Nagpur stood 96.5 cm. at the shoulder, with 21.6 cm. tusk. In central India, A.A. Dunbar Brander recorded the heaviest male as weighing 165 kg and the maximum length of tusk as 25.5 cm.

Habitat and Environment :

The Indian Wild Boar is highly adaptable, and is found in thick cover of bushes, reeds and tall grasses in which they take shelter and rest during the day. Sometimes it is also seen in dense forest areas. It is typically associated with riverine tracts having thickets of grasses like *Saccharum* spp. It has adapted well to irrigated forest plantation around cultivations. It does not penetrate far into arid areas and deserts, but can ascend hills in the Himalaya up to a considerable height.

Status :

Extension of irrigation and development of forest plantations have favoured the increase of wild boars in few areas where they are now considered to be serious menace. In many areas, however, due to shrinkage of the riverine forest for flood, clearance of forest for cultivation and log collection, increased grazing etc. their number have recently declined. Besides these illicit killing persists.

The wild boars are the favourite food of the large carnivores, which leave them with no other natural predators except man.

At present it is included in Schedule III of the Indian Wild Life (Protection) Act.

Biology :

The Indian Wild Boar can breed throughout the year, but there is probably a peak period during the monsoon, as the abundance of succulent vegetation and insect life, offer ideal feeding condition during this season.

The female has irregular number of mammae, varying from 8-12, but five pairs is the most usual number. The female produces first litter between the ages of 12 months to two years. The litter size normally ranges from four to six. Many litters, however, consists of not more than two or three young, which indicate that mortality may be quite high amongst newly born young of Indian Wild Boars. It is believed that the males do not reach sexual maturity until their third year and they continue growing up to their fourth year.

The females build a rough nest with grass and leaves where the young are born which usually remain well concealed in a thicket of bushes, grasses or reeds. The young become active and able to run around within an hour or two after birth. When the young are strong enough to forage for food, they accompany their mothers and usually two to three sows form one herd with their litters combined in a mixed nursery group of different ages and sizes. Smaller groups consisting of two combined litters are more usual, and it is not known if they keep together, once the young attain two to three months of age.

Big herds may include about 14 to 16 youngsters in a group. A herd of 170 or more was recorded by A.A. Dunbar Brander in central India during early parts of this century.

In captivity the Indian Wild Boar at Calcutta Zoo has lived for 20 years, but presumably in the wild 10 to 12 years might be an exceptional life span.

The Indian Wild Boars have a strong rather acrid body smell which may be an important factor for maintaining social contact.

Behaviour :

The Indian Wild Boars are social animals, usually resting and feeding in small groups. Adult males, however, usually forage and lie up individually. They are nocturnal but seen emerging well before dusk. In areas where they are not disturbed they may even forage during the day and often cross through quite open country. Because of their sparse hair covering the body, they are sensitive to intense heat and normally spend the day in dense cover, and frequently resort to mud wallows, if available. They can sometimes chop grass and spread it in a heap and then burrow under this during the day. Their sense of hearing and smell is acute, but eye sight is weak. If wild boars are encountered in the forest, they will approach more closely after first sighting, as if to pick up the scent and determine if the imperfectly observed intruder represents danger or not. They are bold, fearless and very aggressive when alarmed and often their immediate reaction is to attack.

The Indian Wild Boars are omnivorous, but largely vegetarian in diet. They consume a wide variety of seeds, fruits, young leaves, tubers and succulent stems, as well as fungi, carrion, bird's egg, reptiles and insect larvae. Their preferred food, however, seems to be succulent roots and rhizomatous stems for which they will dig diligently even in harder ground. While digging they can eat any insects, lizards or even rodents which they might be able to pick up. They are fond of ripe fallen fruits of ber (*Zizyphus* sp.) and mulberry (*Morus* sp.). They can be very destructive to farm crops, particularly, potatoes, ripe sugar cane, trampling far more than they actually consume. They rarely eat green vegetation growing above ground.

The wild boars can produce different vocalisation. When at rest they can regularly communicate to each other with guttural grunts, but when disturbed they

give out a very low grunt. While aware of danger, both the sexes give a 'staccato snort', not unlike the 'whoof' of a dog.

Uses :

Pork is much sought after by many people of the country and the stiff hairs of the mane and the sides of the body are used largely for the preparation of 'bristle-hair-brush'. The fat of the animal is of commercial value, besides its medicinal use as ointment for cure from gout.

The bristly hairs of the hog is largely involved in national and international trade.

Potential Advantages :

Their ability to breed all through the year is a great advantage for utilisation of wild boar under a managed farming practice. Their omnivorous feeding habit will also facilitate rearing of the animals. The large body size can effectively offer mere protein food source.

Limitations :

The small size of litter in the wild, which is attributed to high mortality rate appears to be a limiting factor for building up of herds. Taming of wild boar is not known; possibility of its being husbanded in large group appears limited at present.

Research and Conservation needs :

There is conservation cover in c 15,000 sq. km. in about 40 Sancturies and National Parks of the country and the species could benefit if strict protection is enforced.

Research is urgently needed on its reproductive biology, fecundity and mortality rate and disease incidences.

PIGMY HOG : *Sus salvanius* Hodgson

The Pygmy hog is a very small pig measuring c 58 cm. in head and body length with a shoulder height of approximately 21 cm. and tail of 3 cm. The average weight is 10 kg. and the hindquarters appear more massive than forequarters. The pelage is medium brown, appearing blackish brown along mid dorsal line, hairs being longest and coarsest behind the shoulders. A facial band with short, dark hairs extends from the bridge of nose to below the eye. No underhair is present.

Distribution :

Originally known from wide areas of southern foot-hills of Himalaya, but the present day distribution is restricted to forest belt of north-western Assam, pending verification of reports from other areas like south eastern Nepal, Cachar region of Assam, etc.

Habitat and Environment :

The Pygmy hog inhabit tall-grass savannah that occur along the foot hill region. It prefers flat, well drained and thinly forested areas, with mixed dense scrub jungle composed largely of thatch or elephant grass, of *Themida*, *Saccharum* and *Phragmites* spp. The areas underegoes prolonged monsoon and consequent inundation which alternates with annual dry season. Owing the dry

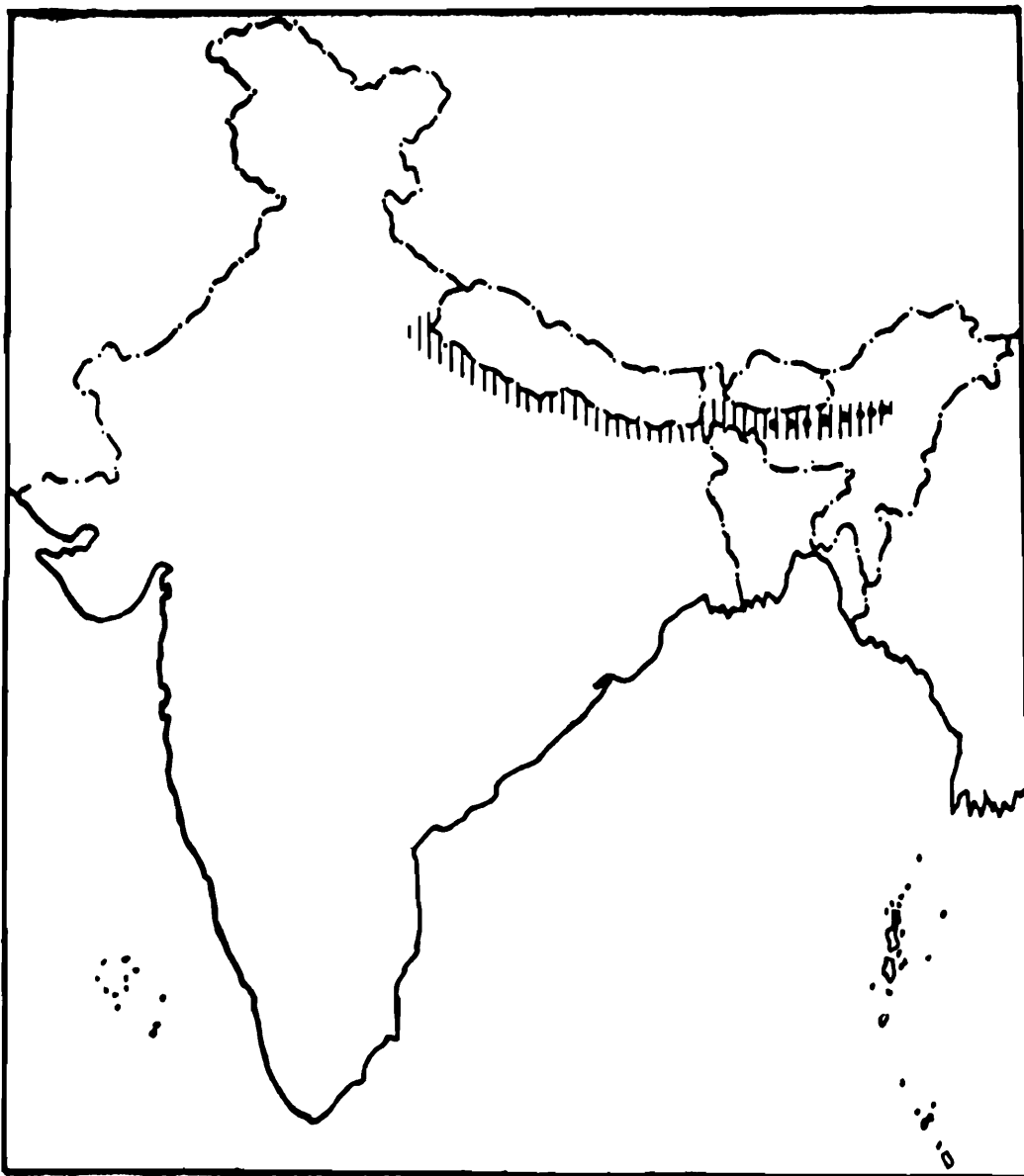


Fig. 7 : Approx. distribution Pigmy Hog in India
(solid black dots represent recent reports)

season, grassland is burnt ensuring annual regeneration of thatchland vegetation but it is apprehended that annual burning may lead to severe loss of habitat for a period of 2-3 months (January-March).

Status :

The Pygmy hog is included in the Schedule I of Indian Wildlife (Protection) Act. and is considered one of most endangered species which has already lost much of its original habitat during last 100 years.

Biology :

The nests are generally built by late term sows as a prelude to farrowing for protection of neonate infants (Olivier, 1980) with an average size of 114 cm × 76 cm., composed of grass and sometimes mixed with other plants and with a central depression. Duration of rut is not precisely known but appears to start towards end of December. The average gestation period is 115-120 days and youngs are usually born during the months of April/and May, the litter size varying between 2-6 (with an average of 3). Infant mortality is considered to be very high in wild population, largely due to inclement weather, predators and parasite disease.

Behaviour :

The Pygmy big is regarded as a diurnal animal and activity rhythm indicates a cycle starting shortly before the dawn and continuing well after dusk hour. Activity is said to be correlated with weather and ambient temperature and searching for food takes most of the active period. The animal is omnivorous and forage with their snout to dig and eat roots, tubers, grass, leaves, insects, earthworms etc. and also possibly eggs, and carrion, while foraging a large quantity of earth is consumed.

Generally tame and shy, they move in groups of 6 or more. Adult male join oestrous female during winter rut and chase away other males. Threat displays include broadside glance, yawning and curling of lips and exposure of tusk, champing of teeth and bristling of hair followed by violent charging.

Uses :

The Pygmy hog has never been reported to be domesticated but has been extensively hunted and trapped. At least 16 records of captive breeding in Zoo's and Tea Estates, mostly in India, (except four in London Zoo and two in Zurich Zoo) are available between 1883-1982 (Oliver, 1982) and it is presumed that there should not be any inherent difficult in maintaining the species in husbandry (Anon, 1983).

Potential Advantages :

The animal is expected to yield important data on physiology of pigs and pig like mammals and study in capacity may contribute to the understanding of maternal factors that influences the number and size of mammalian young at birth (Anon, 1983). It may be added that although the chromosome number (38) and karyotype appear similar to domestic pig, small but significant differences have been found using chromosome banding techniques.

Limitations :

The high rate of infant mortality, susceptibility to large number of ectoparasite (endoparasites are little known), small number of natural population and shy nature appear as the major limiting factor in husbandary operation.

Research and Conservation need :

The conservation efforts must include protection of remaining habitat in the reserve forest and National Parks and by restricting annual burning operation. More females should be made available as mates for the Zoo's stock. Research is urgently needed to establish age at puberty, length of oestrous cycle, length of gestation, physiology of digestion and essential nutritive requirement. Embryo transplantation to uterus of common pigs has also been advocated to set up new herds (Anon, 1983).

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BIRDS

The avian fauna of India is perhaps one of the most well worked out group, today. Thanks to the number of amateur ornithologists who have made significant contribution to regional avifauna and also described a number of new taxa. With the wealth of information available Jerdon published three volumes of "Birds of India" as early as in 1862-1864. Almost after hundred years through a series of excellent publications of several ornithologists including E.C. Stuart Baker's (1922-1930) six volumes on "The Fauna of British India : Birds" appeared the works of Salim Ali and S. Dillon Ripley (1969-1974) in ten volumes, on Birds of India and Pakistan.

However with nearly 1200 species in the country and more than 2000 species and subspecies in the subcontinent, the region attracted the attention of hunters and sportsman. With rapid industrialisation, urbanisation, habitat of many species become degraded or exposed and the Indian Wildlife (Protection) Act in 1972 enlisted 18 species of birds under Schedule I besides 36 groups under IV, the later with almost all the game birds which were abundant in the region. Recent studies revealed that many of the species need stricter conservation measure and be put under Schedule I. As in the case of mammals, many of these avian species can be effectively bred in captivity in aviaries and with worldwide interest on game-birds, the newly emerging technology will undoubtedly tend support to such efforts. In this section, six species of birds have been dealt with, all of which are believed to have promising economic future.

PHEASANTS, PARTRIDGES, QUAILS

The family Phasianidae which contains Pheasants, Partridges and Quails etc. —is represented by 86 species and subspecies in the Indo-Pakistan region (Ali & Ripley, 1969). These are better known as game birds, offering a valuable resources of protein food for man since earlier civilisations. Domestic fowl of today's world stands out as the most familiar representative of the group. All the world's pheasants including peafowl, junglefowl and tragopans are believed to have originated in Asia with one exception of rare Congo Peacock.

All members of the family Phasianidae are terrestrial in habit and possess stout legs for easy movement on ground; tarsi of hind legs possess one or more pointed spike-like spurs or blunt protuberances, either only in male or in both sexes; claws are short, blunt and strong, adapted for scratching on the ground while searching for food. In most of the pheasant species, males are far more brightly coloured than the females. Wings are short and rounded. Majority of members of the family lay eggs on the ground and their nest appear like open scrapes, hardly with any lining; new born young are able to run about within a short period after hatching.

Pheasants have been kept and reared in several aviaries and parks of the World. It is believed that no group of birds can claim to have made such an impact

on social and economic history of mankind as have the pheasants. As sporting birds they have been widely introduced throughout the world. The World Pheasants Association was inaugurated in 1975 with the objectives of saving most game birds facing dire damage of extermination due to habitat destruction and increased exploitation, by encouraging monitoring and building up of adequate population under control. India has since then become an active partner in the activities of "The World Pheasants Association" and considerable amount of work has been carried out by Indian scientists in collaboration with their colleagues from elsewhere. There is strong possibility, therefore, of proper management and future utilisation of the unique resource of game birds both for genetic research and other purposes.

KOKLAS PHEASANT : *Pucrasia macrolopha* (Lesson)

Appearance and Size :

The Koklas Pheasant is a medium sized bird, male measuring 58-64 cm and female 52-58 cm, with head and face in both sexes fully feathered. It has a well developed crest and sexes differ in colour. The male has metallic green head with a long brownish crest and two long tuft of metallic black plumes from above ear-coverts which are erected in display; upper parts in male appear greyish and streaked with black but largely chestnut. The female is mottled with black and brown, finely streaked with buff; crest of female is shorter and ear-tufts are absent underparts are buff coloured with streaks of black.

Distribution :

The Koklas Pheasant is distributed in the Himalaya from northwestern region in Afghanistan to Central Nepal and again in northeastern Tibet and western China, southeastern Mongolia. Four subspecies are recognised, viz., Chestnut mantled Koklas Pheasant in N.W. Pakistan and Afghanistan, Kashmir, Koklas Pheasant in northern Kashmir, Himachal Pradesh and Punjab, Koklas Pheasant (nominate species) in southern Kashmir to western Nepal and Nepal Koklas Pheasant; all subspecies are differentiated by colour of flanks in male and colour of tail feathers in females.

Habitat and Environment :

The Koklas Pheasant inhabits wooded ravines and steep hill slopes in coniferous forest with scrub and bamboo under growth, between c 1000-4500 m and comes down to lower elevation during winter months.

Status :

It has been regarded as "Endangered" in recent times (Tikadar, 1983) due to rapid decline of population which is attributed to uncontrolled hunting and destruction of habitat.

Biology :

Breeding season lasts from April to June. The nest is a scrape on the ground lined with sticks, leaves and grass, usually concealed under dense bushes or rocks. The female lays 5-7 eggs, pale yellowish in colour with spots, specks and blotches

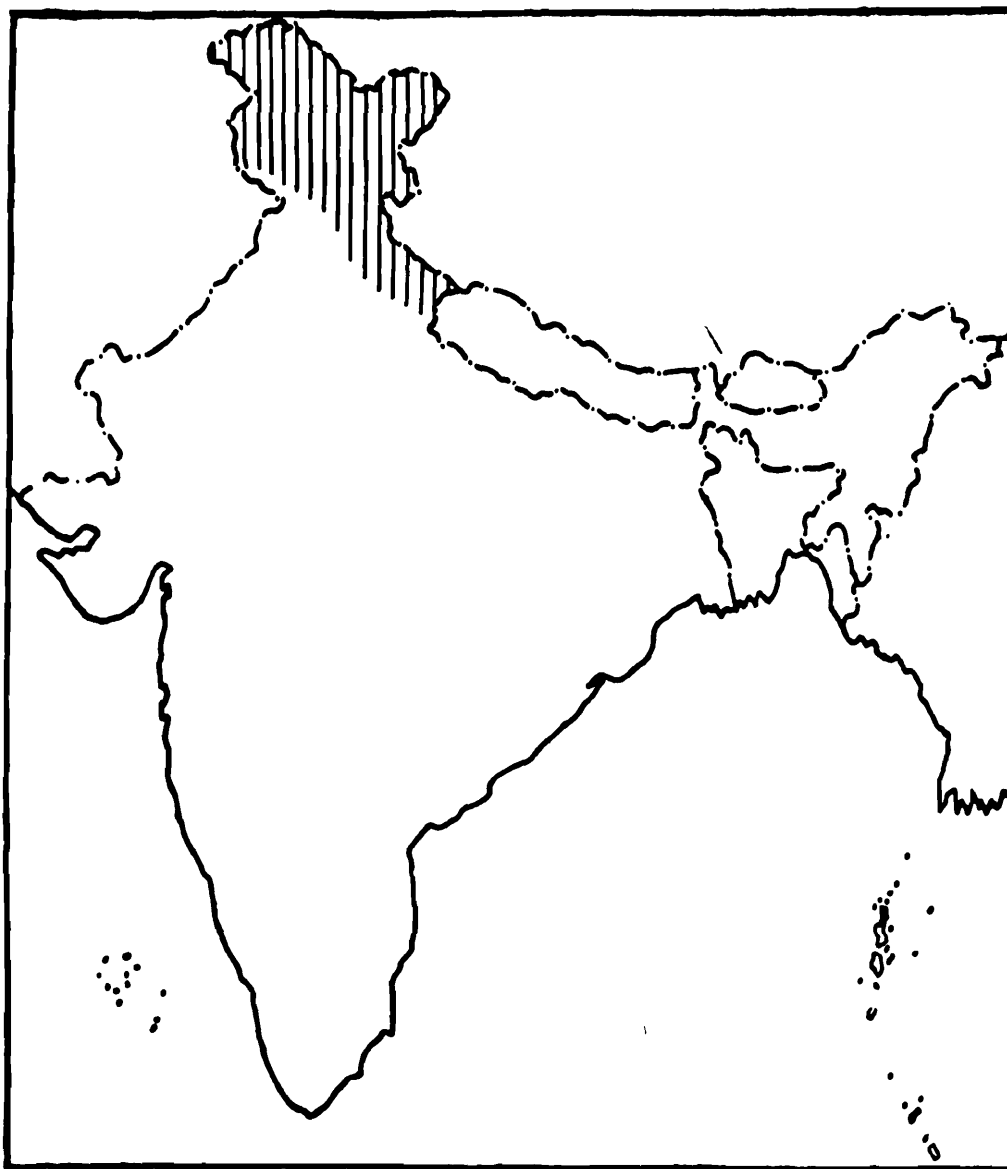


Fig. 8 : *Approx. distribution of Koklas Pheasant in India*

and incubates for 20-21 days. Chicks on emergence, can fly within a few days. Males are believed to be monogynous.

Behaviour :

The Koklas Pheasant is often met singly or in pair but several birds may haunt the same hillside for days together. When flushed, it flies like a rocket. It feeds on shoots, bud and leaves, tubers, berries, etc. and may predate on insects. Crow of cork is a loud ring Kok-Kok-Kok.

Uses :

It is largely used as an ornamental bird for display in the Zoos and is much admired by aviculturists and naturalists.

Potential Advantages :

It can be bred under captive condition either for stocking the Zoos within the country or for trade. It can also be used as a game bird in the hills. Process of capturing, acclimatization, maintenance on standard diet in pen and reintroduction have already been worked out for some species and have paid dividends even when tried in far away geographical areas from their original habitats. Possibility of large scale propagation in captivity, as such offers definite advantage with knowledge of artificial incubation, diet and other factors.

Limitations :

Captive breeding programme in general usually require heavy investment and special facilities and trained personnel. Many facts regarding social, psychological, and habitat requirement are still unknown. Diseases like avian tuberculosis and other may also be limiting factors.

Research and Conservation needs :

For all species dealt in the chapter, same fundamental research study is essential. Status survey and population study with sex-ratio count, crowing counts, brood counts and field drive counts are to be conducted in identified study areas has been done for Chir Pheasants in western Himalaya. A long term study will enable further to determine the effects of weather, change in the habitat, extent of natural predation and other ecological factors. Effect of land use pattern on existing game birds need to be seriously worked out in view of extensive forest clearance, overgrazing and intensification of agriculture.

The detailed biological study including life history in the field need to be utilised in captive breeding programme. As some standard techniques for maintenance of pheasants kept for breeding in captivity, have been formulated (Wayre, 1975) it may be expected that under proper care such techniques can be utilised in India to build up captive population for restocking nature and even for future utilisation under a management programme.

At present the group Phasianidae has been put under Schedule IV of Indian Wildlife (Protection) Act, except Blood Pheasants and Chir Pheasant, Humes Bartailed Pheasant, Monal Pheasant, Mountain Quail, Peacock Pheasant, Peafowl, Tragopan Pheasants and white eared Pheasants, which have been included in Schedule I, part III of the Act. It may be necessary to extend further protective cover to other species, on the basis of status survey report.

CHEER PHEASANT : *Catreus wallichii* (Hardwicke)

Appearance and Size :

A long tailed pheasant bearing a long narrow crest of hairlike plumes, naked bright crimson orbital patch; upper parts buffy white and pale rusty, barred with

black tail, buff grey and chestnut in colour pointed. Female (61-76 cm) smaller in size than male (90-118 cm) with more chestnut on undersurface bearing a brick red facial patch.

Distribution :

Distributed in the Himalaya between c 1400-3000 m in NW Pakistan, through Kashmir, Punjab, Himachal Pradesh, Garhwal and Kumaon in Uttar Pradesh to West Central Nepal.

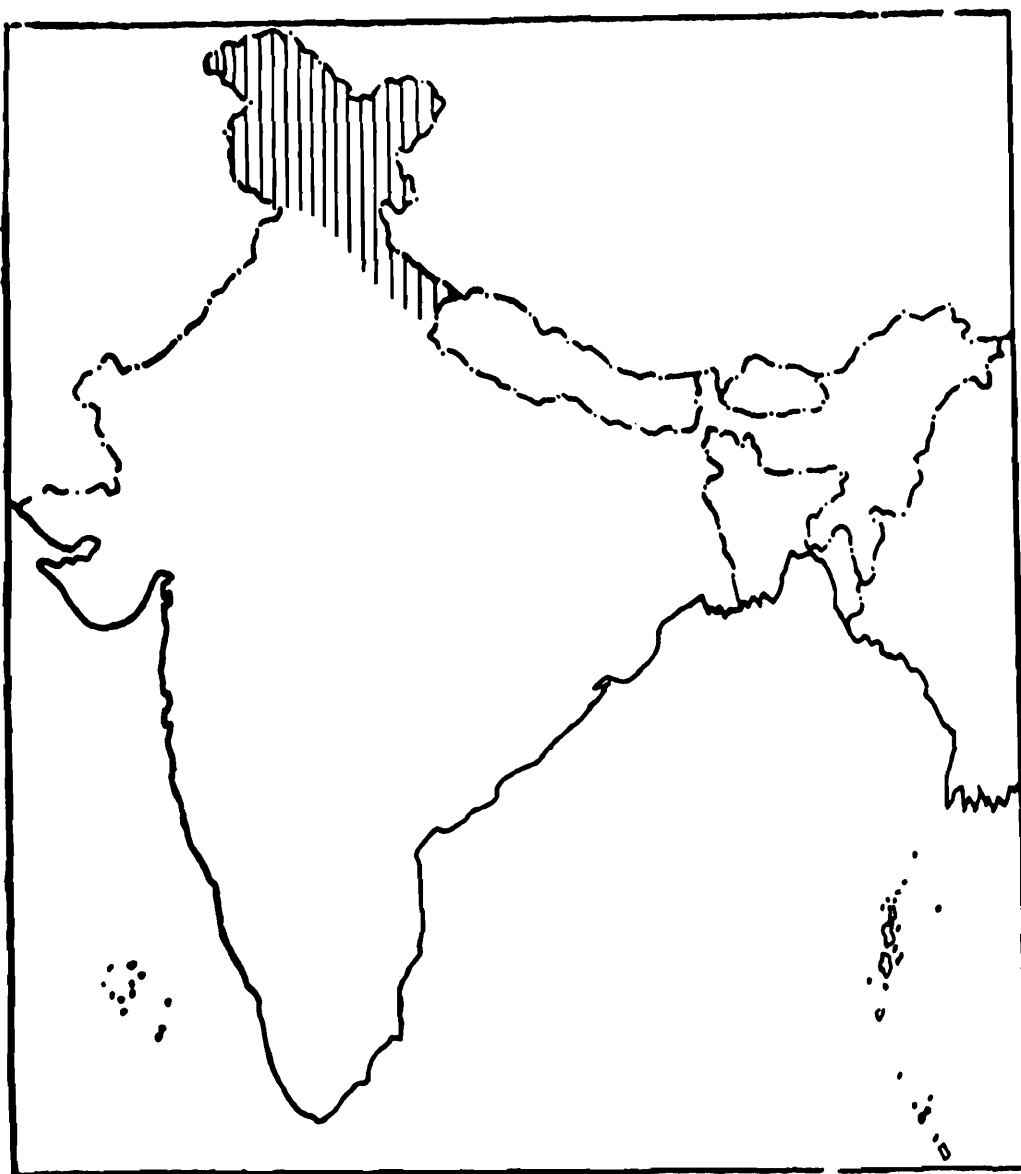


Fig. 9 : *Approx. distribution of Cheer Pheasant in India*

Habit at and Environment :

Cheer Pheasant inhabits hillsides, specially precipitous ravines, bushes, grasses, scrub and oak forests. The species is resident and does not show any seasonal altitudinal movement.

Status :

Cheer Pheasant is considered "endangered" in India. In a recent report Garson (1983) reports that population within Chail Sanctuary, south of Simla has dropped nearly by 50%, probably due to poaching, grass harvesting and habitat destruction and partly may be due to pathogen.

Biology :

This species breeds during late April to early June. Nest is formed as a scrape or depression at foot of boulder on rugged hillside in oak or chirpine forests, often concealed by grass. Female lays 9-14 dull creamy white, freckled eggs of 53.4 x 39.3 mm size and incubates the egg for about 26 days. Male of cheer pheasant is monogynous. Cheer pheasant has been successfully bred in captivity in England.

Behaviour :

The Cheer Pheasant remain in conveys of 5-6 birds, which feed on open hillside, well hidden by undergrowth. It can easily run uphill and lies close in cover and remain silent during day time but became noisy before retiring for the night and before day break. It feeds on roots and tubers dug out of the ground besides seeds, berries, grain, insects, grubs. Both sexes crow *Chir-a-pir, Chir-a-pir, Chir, Chir*.

Uses :

The Cheer Pheasant is regarded as one of the well known game birds and are heavily poached upon for meat. Pheasant meat is considered as expansive delicacy over a wider part of developed nations of the world.

Potential Advantages :

The Cheer Pheasant being already bred in captivity in large number, the farming technique is well established in western countries and this can be utilised with suitable modifications under Indian condition. Already at Indian Veterinary Research Institute, Izatnagar, U.P., Cheer have bred successfully.

Limitation :

Decline of wild population is usually attributed to poaching, grass cutting and pathogenic infection but no detail investigation has been made for intensive ecological and behavioural field studies of Himalayan pheasants. Heat and humidity during monsoon appear to affect introduced stock during rearing and disease poses great problem.

Research and Conservation needs :

Intensive research is needed for clear understanding of ecological and behavioural aspect and also on impact of changed land use pattern on breeding biology of Cheer Pheasant. Conservation through effective anti-poaching legislation is advocated (Garson, 1983) for Cheer Pheasant population in western Himalaya.

Extensive burning of grassy slopes during February and March need to be controlled as also land use pattern monitored and changed where ever necessary, for conservation. Effort to re-introduce Cheer Pheasant into part of former territory where it is now extinct, has been made by World Pheasants Association and for several years, eggs from captive stock in Britain have been sent (as in Pakistan) to be hatched, reared and for release of poults in suitable sites. The measure will undoubtedly help to conserve the species for better management and utilisation.

GREY PARTRIDGE : *Francolinus pondicerainus* (Gmelin)

Appearance and Size :

Body 33 cm long, greyish brown, rufous and chestnut above, mottled barred and vermiculated with buff and black. Throat yellowish-rufous. In the field, Grey Partridge appear a plump and stubtailed bird. Three subspecies are recognised based on difference in colouration of body and throat.

Distribution :

The species is widely distributed in drier region of peninsular India (except in Assam) and up to an altitude of c 500 m. One subspecies *mecranensis* is restricted to west of Indus River in Pakistan, the other *interpasitus* extends range from eastern Sind to West Bengal while the nominate species is resident in southern peninsular India, south of range of second named subspecies and up to Sri Lanka; it has also been introduced to Andaman Island in 1980 and has established itself at least around Port Blair region.

Habitat and Environment :

Grey Partridges inhabit dry grass land and scrub jungles, in the vicinity of agricultural fields growing dry-season cereals and grains. The bird is hardy and adaptable to similar exotic condition.

Status :

No precise data is available on the status of Grey Partridges : however it is reported that large scale illegal netting and trapping of the game bird has led to decline of population in many areas in recent years. (Salim Ali & Ripley, 1969). Included under Schedule IV of Indian Wildlife (Protection) Act.

Biology :

This species is known to be a prolific breeder and breeding season may continue throughout the year but more during April to September. Usually nest is a simple scrape in the ground lined with grass and leaves, under a tuft of grass or bush or open grass or scrub land. Female lays 4-8 oval, cream-coloured eggs and incubates for 18-19 days.

Behaviour :

Grey Partridges are often met in pair and family of 4-8 birds may be seen digging and scratching the ground with bill and feet in fallow land and cattle dung

for food. Usually food consists of grain seed, termites, grubs and other insects. The bird is largely ground-dwelling but roosts on trees like *bulbul*. When alarmed it can fly swiftly, rapidly beating the wings, but never at a height and often alternate with running, after a short flight of 50-100 meters. During night, this species prefer to roost on small tree tops, in a family group or inside dense bushes. It can survive on little moisture like dew drops, without drinking water for days. The call of cock is a ringing high pitched musical note like *kateetar*, *kateetar* or *pateela*, *pateela* in quick succession; female produce soft call *pela*, *pela*.

Uses :

At one time, this bird was much fancied by a group of people as a "fighting bird" It acts as a major predator of insects in agricultural field. Grey Partridges also provide excellent meat.

Potential Advantages :

It breeds readily under captive conditions and can be utilised both as a game and table bird. One pair of birds is expected to give 20-30 chicks per year through selective breeding.

Limitation:

Not much information is available on its ecology and biology in the world.

Research and Conservation needs :

These birds are illegally trapped in large numbers in Rajasthan, Haryana, Punjab and Uttar Pradesh and should be provided more protection through Wildlife (Protection) Act and actual monitoring of population.

A detailed study on status survey and ecology and biology of the species in the wild is needed before any captive breeding programme is initiated.

BLACK PARTRIDGE : *Francolinus francolinus* (Linn.)

Appearance and Size :

This bird appears in 3 distinct colour, darker or paler and all have an average size of ± 38 cm. Usually plump looking, the black partridge is chiefly black, spotted and barred with white and fulvous; of the colours, the glistening white cheek patches and chestnut collar of the cock is characteristic. Hens are considerably paler, mottled and speckled with black and white and with a chestnut patch on the nape.

Distribution :

Three races are recognised which are variably distributed in Northern India, Kashmir, Western Himalaya and Assam and Gujrat through Madhya Pradesh to Chilka Lake in Orissa, and also Pakistan and Bangladesh.

Habitat and Environment :

Black Partridges are restricted to well watered scrub land, cultivated countryside and grass-jungles; usually the agricultural fields growing millet and sugar cane

are favourite habitats; often they come out to the tea-garden areas in the evening specially in the sub-himalayan region.

Status :

Status is not clearly known but with increasing human settlement around many of the usual habitat area, population of black partridge has decreased, specially by large scale unregulated netting over years. Included under Schedule IV of Indian Wildlife (Protection) Act.

Biology :

The nesting season extends from April to July for Assam race but March to October in the race inhabiting Kashmir, northern India along foothills to Nepal, Punjab, Uttar Pradesh and other areas. Breeding season vary locally depending on break of rains and burning of grasses. Nests are shallow, with a pad of grass and leaves, placed on the ground, among roots of tall grasses and other vegetation. Hens lay 4-9 eggs of ± 37.0 cm \times 31.0 cm size and pale olive brown to chocolate brown in colour. Incubation is done by hen alone for about 18-20 days, Some race as in Pakistan have two breeding season, viz., March to May and again during August to October.

Behaviour :

The birds remain singly or in pair and enter crop-field to feed, during morning and evening hours; they feed on grain, grass seed, green shoots and also on insects. Black Partridges are known to be very fast runner and can fly with rapid whirring, wing beats. This species produces cheerful ringing high pitched call, often considered as of far-reaching quality.

Uses :

Black partridge is used both as a game bird and table bird.

Potential Advantages :

It can be bred in captivity and a large number of captive bred birds have been released in U. S.A. and they are reported to have established well.

Limitation :

The present state of knowledge on biology and ecology of wild birds remain very poor.

Research and Conservation needs :

Extensive field study in Indian condition on behaviour, bioecology and other related area is needed. Due to its trapping and shooting in Haryana, Punjab and Uttar Pradesh, present population status is also unknown. Conservation measures as such should include more effective protection in the wild and captive-breeding under a management plan.

PAINTED PARTRIDGE : *Francolinus pictus* (Jardine & Selby)

Appearance and Size :

Body \pm 31 cm long, brownish in colour, profusely spotted and barred with white and with ferruginous red in head and wings. Throat chestnut in male and usually whitish in female. Of the three subspecies, one (*pallidus*) from Gujrat, southern U. P. and northern Madhya Pradesh is pale rufous below, southern Painted Partridge (*pictus pictus*) is darker and dull earthy rufous below, while the third subspecies (*pictus watsoni*) distributed in Sri Lanka, is darkest and heavily marked with black below.

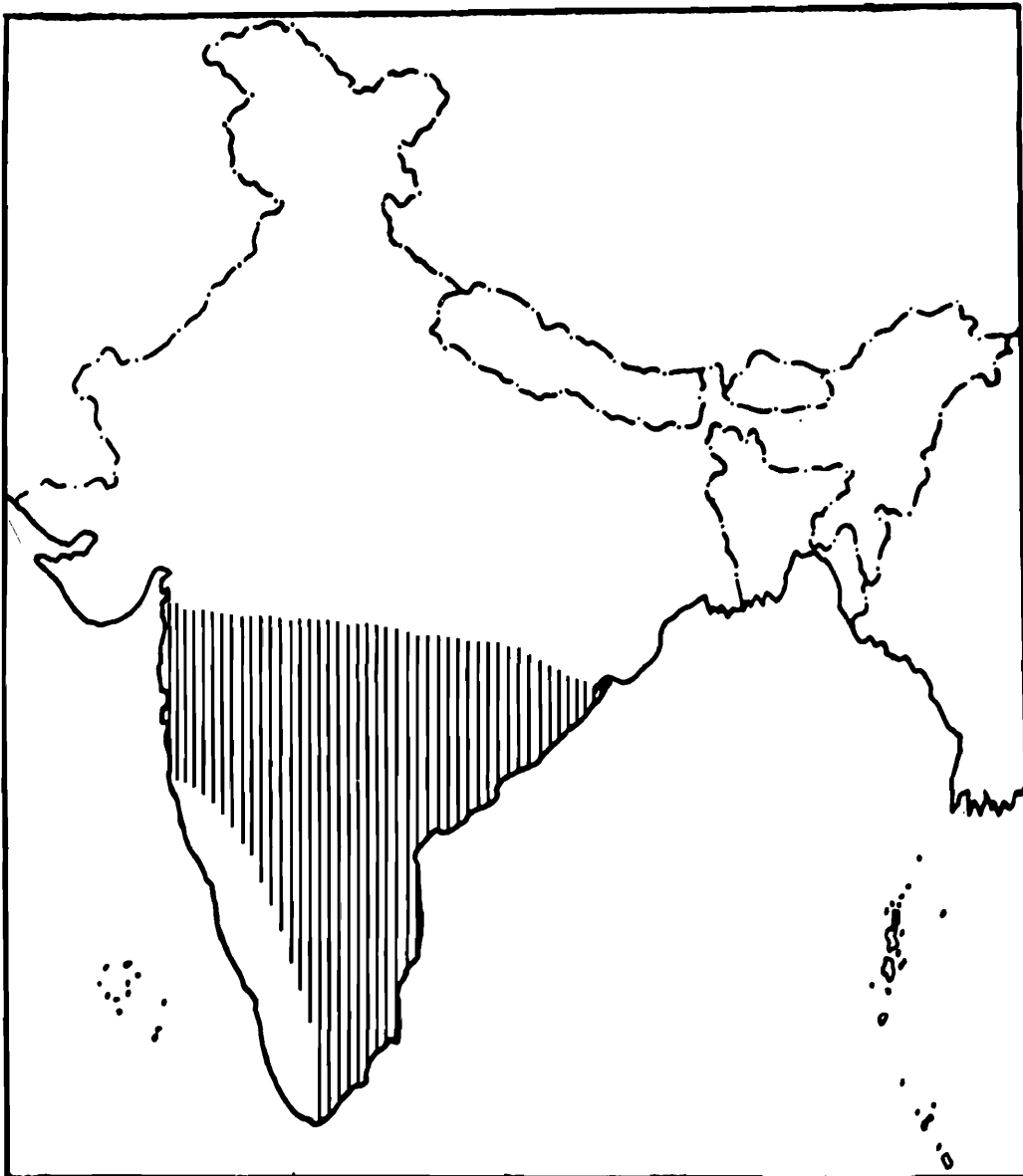


Fig. 10 : Approx. distribution of Painted Partridge in India

Distribution :

Peninsular India, usually south of range of Black Partridge and except in evergreen tracts of Karnataka and Kerala. Unlike Black Partridge, this species is

not known from Pakistan, Bangladesh and Burma. One subspecies is restricted to Sri Lanka.

Habitat and Environment :

The species inhabits grassland and scrub jungles of *Calycopteris*, *Diospyros* and *Zizyphus*; it also inhabits vegetation stretching along streams and is reported to spread out widely in monsoon when both food and water supply becomes abundant.

Status :

No report on status survey is available. Included under Schedule IV of Indian Wildlife (Protection) Act.

Biology :

The breeding season usually coincides with arrival of south-west monsoon rains in the month of June and may extend up to October but in Central India, earlier report indicates breeding of Painted Partridge during April to June (Whelohead 1911, *J. Bombay nat. Hist. Soc.* 21 : 168). It forms a scrape or hollow on the ground and built nest with grass and leaves. Nest-building is preferred in areas with standing crops or in a patch of grass and scrub jungles. Females lay 4-8 eggs of $\pm 35.0 \times 29.0$ mm size, with shade of olive-brown in colour and incubates alone for unrecorded period.

Behaviour :

The Painted Partridge usually remains in scattered pairs and sometimes family of parents and youngs may also move together, foraging in early mornings and late afternoon. When it runs, the tail is carried partly cocked. It often lies low to avoid attention and can rise with a loud whirr of wings. It can easily and preferably roost on trees as also on ground and produces high-pitched call for more than 15 minutes, at 20 seconds interval at a stretch. It feeds on cereals, grains, gram seeds, berries, drupes, termites and other insects.

Uses, Potential Advantages, limitations, Research and Conservation needs :

Not much information is available on uses and potential advantages of this species. For limiting factors and research and conservation needs, the statement under "Koklas Pheasant" is applicable in general.

GREY QUAIL : *Coturnix coturnix* (Linnaeus)

Appearance and Size :

Grey Quail is a plump and pale brown bird of c 20 cm length resembling partridge, with conspicuous spear shaped buff coloured streaks and irregular mottlings and barring of reddish brown and black on upper surface of both males and females. Males differ in colouration of undersurface from females in having chin and a line down to centre of throat black and in the rufous buff breast; in females chin and throat is creamy buff and breast is spotted with blackish.

Distribution :

This is a partly resident and partly winter-visiting bird; in winter, the population in Kashmir east through Bihar and West Bengal, Madhya Pradesh and Maharashtra is augmented and spreads out over wide area up to Kanyakumari. Outside India, this bird breeds in Europe, N. Africa, West Asia, Iran, Afghanistan and Pakistan.

Habitat and Environment :

Grey Quail affect standing crop of cotton, young wheat, gram, millets, etc., and inhabits flat and undulating countryside with cover of grass or paddy stubbles. During migration, as per recorded observations, it uses a passage both for inward and outward route through northwest Pakistan in Autumn and Spring; while migrating back, these birds concentrate in large number in northwest region and travel during the nights.

Status :

Very abundant in certain localities but number may vary from year to year. Included under Schedule IV of Indian Wildlife (Protection) Act.

Biology :

This species breeds during the month of March to July but mostly during March and April. It forms a scrape in the ground without lining or lines it almost with few leaves and grass but keeps this nest concealed in standing crop or grass land. The female lays 6-11 but usually 6-8 eggs of variable colour from yellowish buff to deep yellowish brown or reddish brown of an average size of 29 × 22 cm.

Behaviour :

Grey Quails usually move in a pair but many individuals may concentrate in the same feeding ground. When flushed, birds rise vertically for a few feet with whirr of wings, a whistling note and fly for some hundred meters before alighting on crops. Often caged call-birds are used to attract more birds to the field for shooting. Grey Quails feed on paddy, millets and grass and weed seeds and host of insects, like caterpillars, beetles, aphids, ants etc., which act as pests on the crop field. Calls are heard usually during morning and evening, as a whistling note followed rapidly by the two short ones.

Uses, Potential Advantages, Limitations, Research and Conservation needs:

Most of the remarks under partridges are applicable for this species.

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REPTILES

Reptiles represent the survivors of the group of animals that participated in the most successful adventure in the history of evolution—the emergence from waters, in which animal life is believed to have originated and invaded dry land. Reptiles are distinguished both from fishes and amphibians by the development of amniotic eggs, which means a special soft internal covering in which the embryos remain floated in a fluid.

Indian Reptiles can be grouped under Chelonia (Tortoises and Turtles), Loricata (Crocodiles and Gharials), Sauria (Lizard) and Serpentes (Snakes). Wide spread exploitation for flesh and egg as food, hide, skin and shell for decorative and fancy handicrafts and leather articles, teeth and bones as charms, far for alleged medicinal properties and venom for biomedical products, is already an acknowledged fact in the country.

CROCODILES

Three species of crocodiles found in India, viz., Estuarine crocodile, *Crocodylus porosus* Schneider, occurring in estuaries of large rivers and coastal areas including those of Bay islands, Marsh crocodiles, *Crocodylus palustris* Lesson, found in inland swamps and large water bodies all over the country and the Gharial, *Gavialis gangeticus* (Gmelin) occurring in big rivers, have already been included as protected species under Wildlife (Protection) (1982) as endangered (Estuarine Crocodile and Gharial) or vulnerable (Mugger) on a world scale.

ESTUARINE CROCODILE : *Crocodylus porosus* Schneider

The estuarine crocodile is the largest of all crocodylians, reaching up to a length of 6-7 meters and weighing over a ton. The species is widely distributed; the largest specimens has been recorded from Philippines, mostly at the end of the last and beginning of 20th Century. Although basically an inhabitant of coastal zones, this species can regularly swim out to the open ocean and feed on fish and other animals.

Appearance and Size :

Longest of all species of present day Crocodylians, usually measuring between 6-8 meters but may extend up to 10 meters in length. Body shielded by an armature of closely set, horn sheathed bony plates with saw toothed fringes along upper border. Adults are dark olive in life while young appear pale. Muzzle tapers to a point, jaws with less than 20 pivoted teeth on each side, which remain exposed even when mouth is closed; fourth tooth on each side of lower jaw enlarged and fits into a notch on upper jaw.

Distribution :

Extensively distributed from Sri Lanka, east cost of India, Andaman and Nicobar Islands, Bangladesh, then southeast through parts of Burma, Thailand, Kampuchia, Vietnam, the Philippines, Western Caroline Island, Malaysia,

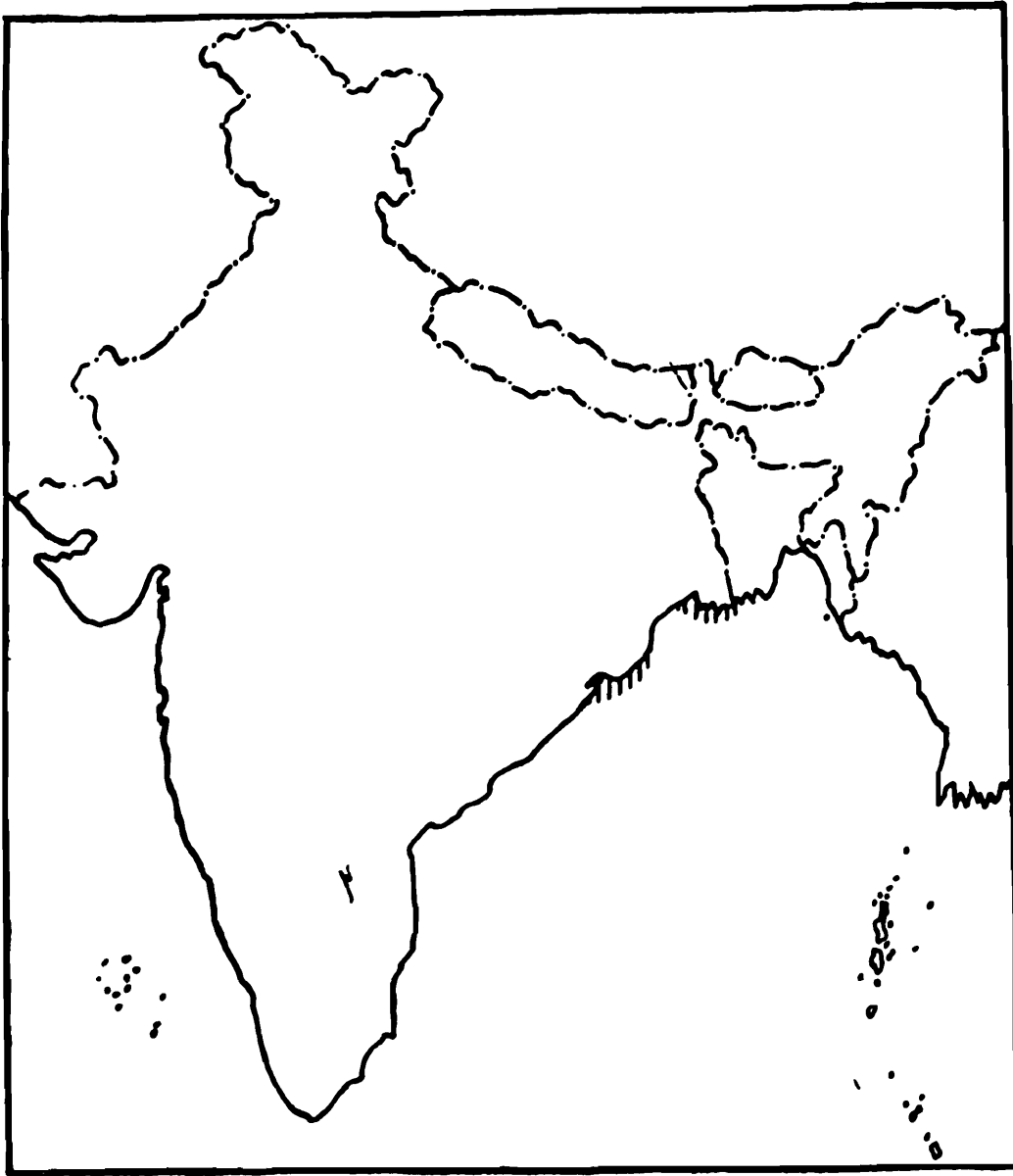


Fig. 11 : Approx. distribution of Estuarine Crocodile in India

Indonesia, Brunie, Papua New Guinea, Solomon Island, Northern Australia (IUCN Red Data Book).

Habitat and Environment :

Occurs in brackish water and inhabit estuaries of large river and deltas associated with mangrove vegetaion, even rivers outside tidal influence and fresh water pools and swamps. In Indian region, mugger occurs in pools and swamps and in Andamans, in the coastal streams with mangrove vegetation.

Status :

This species is now regarded as threatened throughout the world due to its over exploitation for hide and habitat destruction. The total Indian population is estimated between \pm 200-300, mostly restricted to estuaries of Ganga and Mahanadi and coastal region of West Bengal, Orissa and Andaman and Nicobar Islands.

Biology :

These animals attain sexual maturity at 10 years in males when their size reach 2.2 meters and at 16 years in females when size reach 3.2 m. Nesting time, varies between localities but may be correlated with annual wet season and spread over 90-150 days. In northeast India and Andamans, nesting time is April-September. Nests are constructed like mound from various vegetable debris. Completed nest have deep groove along the top which is indicative of crawling out of egg-laying female and each egg clutch inside the nest can contain 25-90 eggs. Eggs appear white, hardshelled and after 80-90 days of incubation, hatchling emerge. Female helps the hatchlings by opening the nest. Nests may often be destroyed by flooding, predation by man, monitor lizard, wild-pigs, etc. Hatchlings pass through the usual stages of juveniles, sub-adult and adult stages.

Behaviour :

These are carnivorous and feed during day and night on fish, crustaceans, insects and adults can attack any mammal near water edge. Larger animals always tend to take larger prey.

Uses :

The skin from belly is considered the most valuable part of a crocodile and small hides are used for shoes, hand bags, wallets, whereas larger hides are used for luggage articles. Internationally, the most valuable hides are produced by salt water crocodiles because of smallest belly scales and lack of calcium carbonate deposit under skin. Illegal and unplanned hide hunting is regarded as major factor for depletion of natural population.

Potential advantages :

Crocodile farming can permit the government to monitor the industry yield, plan number of regular harvest, regulate supply of standardised products to meet need of an international industry and in reducing wasteful loss due to bad handling and illegal poaching. Above all, farming may educate people about crocodile ecology and its habitat and the role it plays in economy. Like the common belief that crocodiles are harmful for commercial fisheries may easily be rectified by correlating the elimination of crocodile and decline in fish-catches. Because,

crocodiles prevent growth of unwanted aquatic vegetation and also enrich nutrient content by converting prey into faeces for food of fish and other aquatic animals.

Salt water crocodiles were earlier known from Cochin, western India through the peninsula up to Bangladesh and by 1974 it has been reported to be extinct in Kerala, Tamil Nadu and Andhra Pradesh. Small population existed in Brahmani-Baitarani delta area of Orissa, Sundarban in West Bengal and Andaman and Nicobar Island region. In 1974, a FAO report recommended proper management and in 1973, a salt water crocodile project was initiated in the tidal mangrove forest in Bhitarkonika, Cuttack District, Orissa. The project is aimed at husbandry/rehabilitation and was initiated in Bhitarkonika wildlife sanctuary in May, 1975 and in Sundarban, West Bengal, in March 1976. The first release took place in Orissa in 27th April, 1977 and by 1980, 125 animals were introduced to Bhitarkonika alone, and out of a total of 168 including 40 released in West Bengal and 3 in Andhra. Under the crocodile breeding and management scheme with assistance from FAO and UNDP, salt water crocodile, mugger, gharial are included for collection of eggs from nature, their hatching in captivity and rehabilitation of youngs in the wild, captive breeding of crocodile being the other objectives. A total of 26 project-centres have been set up in 9 States and Union territory of Andaman & Nicobar Island.

Limitation :

The species has not been captive bred in India but have been bred in Thailand, Australia and Papua New Guinea. Captive breeding and captive rearing can only meet demand of world trade which has a volume of 1,00,000 skin during 1970 but decline to 20,000 in 1980, with steep price hike. However low density enclosure to ensure optimum breeding success and large scale captive breeding may lead to several difficulties like male/female compatibility, gradual introduction of small sized females to avoid aggression between potential mates etc. Selection of farm size, access to veterinary care, are the other factors which may limit the operation.

Research and Conservation need :

To augment the depleting and extinct population in some areas and provide sustained supply of hide as also to create awareness, farming is necessary. Several measures to extend and improve current project are suggested by Bustard and Chowdhury (1980).

There is urgent need of research to provide standard technique for farming and wise investment in this R & D sector. Survey to determine population number, size structure of breeding stock is essential to plan setting up of sanctuaries to protect breeding stock, nesting ground and develop strategy for conservation, management and utilisation through rearing for restocking and captive breeding.

**GOVERNMENT OF INDIA/FAO/UNDP Scheme
ON
CROCODILE BREEDING AND MANAGEMENT**

Gharial

1. Sat Keshia Gorge Gharial Scheme, Orissa (H/R)
2. Nandankanan Captive Breeding Project, Orissa (H/CB)
3. Nehru Zoological Park Captive Breeding (1 +/CB)
4. Pappikonda Gharial Scheme, East Godavari, Andhra (R)
5. Kukral National Scheme, Lucknow, U.P. (H/R)
6. Katerniaghal Gharial Scheme, U.P. (H/R)
7. Chambal Sanctuary Gharial Scheme, Kotah, M.P. (H/R)
8. National Chambal Gharial Project, Madhya Pradesh, Rajasthan, Uttar Pradesh (R)

Mugger

1. Nandankanan Captive Breeding, Orissa (H/CB)
2. Nehru Zoological Park, Hyderabad, Andhra (H/CB)
3. Krishna Sanctuary Mugger Scheme, Andhra Pradesh (R)
4. Lanjumadugn Mugger Scheme, Godavari, Andhra (EC/R)
5. Nangjura Mugger Scheme, Andhra (EC/R)
6. Kinnusani Muger Scheme, Andhra (R)
7. Madura Project, Madras, Tamilnadu (H/R)
8. Sathanur Reservoir Mugger Scheme, Tamil Nadu (H/R)
9. Amravathi Reservoir Mugger Scheme, Tamil Nadu (H/R)
10. Hoggenakal Mugger Scheme, Tamil Nadu (H/R)
11. Neyyar Mugger Scheme, Kerala (H/R)
12. Paramikulam Mugger Scheme, Kerala (H/R)
13. Gir Mugger Scheme, Gujrat (H/R)

Saltwater Crocodile

1. Sundarban Salt Water Crocodile Scheme, West Bengal (H + R)
2. Bhitarkonika Saltwater Crocodile Scheme, Orissa (H/R)
3. Nandankanan Captive Breeding Project, Orissa (H/CB)

4. Nehru Zoological Park Rehabilitation Captive Breeding Project, Hyderabad, Andhra Pradesh (H/CB)
5. Goringa Saltwater Crocodile Project, Andhra Pradesh (R)

Note : Additional scheme have commenced/or in process of finalisation in Maharashtra, Karnataka, Arunachal Pradesh, Assam, Nagaland and Andaman Islands

Abbreviation used :

H = Husbandry, R = Rehabilitation, CB = Captive Breeding, EC = Egg Collection.

MUGGER : *Crocodylus palustris* Lesson

Smallest of the three species of Crocodile found in the region, Mugger or Marsh Crocodiles inhabit still or slow-running freshwater areas including rivers, ponds, reservoirs and is widespread in Indian region except in Punjab, Himachal Pradesh, Jammu & Kashmir and northwestern deserts.

Appearance and Size :

Muggers are broad-snouted but hardly exceed 4 meters in length. Adults appear dark olive while juveniles look pale and with black spots. Muzzle ranges from 1.50-1.75 times as long as broad at base. Dermal structure appears very similar to Estuarine Crocodile. Upper jaw has 19 teeth, lower jaw has 14-15 teeth on each side.

Distribution :

The epicenter of distribution is Indian subcontinent and present distribution range include parts of Bangladesh, India, Iran, Nepal, Pakistan and Sri Lanka.

Habitat and Environment :

Muggers are well adapted to any kind of freshwater bodies but can inhabit brackish water within tidal limit. Man made lakes and reservoirs have provided major shelter to the populations in Gujrat and Tamil Nadu in India besides the population known from North Indian rivers.

Status :

Population has been depleted considerably in recent years. A FAO report of 1974 stated the large scale hunting for skins has been considerably reduced by legal protection but poaching and destruction due to fishing activities (Saharia, 1981) continues. IUCN Red Data Book (1982) listed (i) set-net fishing, (ii) egg predation by humans, (iii) habitat destruction, (iv) use of body parts for medicinal use, as major threat to mugger population. The present population size, with conservation measures started from 1976, is estimated at 5,000 (Tikader, 1983).

Biology :

Muggers appear to be adaptive in nesting requirement and other aspects of biology. Eggs are laid by females in captivity from the age of six onwards, attaining

1.7-2.0 meters in size. Wild muggers, growing slower than the ones in captivity, may attain delayed sexual maturity. Male acts as dominant partner during courtship period (November to February) and mating occurs in open water. Female builds trial nest pits and finally actual nest pits and lay eggs in nest chamber, at 35-50 cm depth. Clutch size varies between 10-46 eggs, and nest temperature ranges between 30-34°C. Incubation period range over 50-65 days and hatchlings measure 25-30 cm in length, at birth.

Behaviour :

Muggers prefer to bask on rock in mid river on muddy banks. Muggers can form burrows up to depth of 8-10 meters on banks of their habitat to avoid extremes of temperature. This species feeds on insects, young fish, frogs, birds and small mammals but sometime may even prey on large mammals. Usually, muggers of different sizes prefer to remain confined in groups to own size-class except for males during breeding season.

Uses :

Mugger skins are used for making fancy leather goods and body parts are used for conventional medicinal purpose. Eggs are often used as human food. Use of hide may be listed as the single major use.

Potential advantages :

After the uses and status were known, at least 11 projects have been started in India during 1976-1980, to study husbandry/rehabilitation aspects of Mugger. These include four projects each in Andhra Pradesh and Tamil Nadu, two in Kerala and one in Gujrat. Since 1981, 2,000 eggs per year are collected for captive hatching by different States and the States of Orissa, Uttar Pradesh, Maharashtra and Karnataka have also been brought under the project. Since 1975, Government's wild life conservation agencies have reported production of 3,000 muggers and 400 of them have been released in suitable areas in Andhra Pradesh, Madhya Pradesh and Orissa. Released specimens have shown up to 100% survival rate. In 1981, mugger, reintroduced into wild in Andhra Pradesh started breeding. Several Indian Zoos have started project for breeding of mugger since first success in Jaipur Zoo in 1960. The Madras Snake Park has produced 800 hatchlings from captive stock. In Andhra Pradesh, at the Zoos of Vizag and Hyderabad it has been successfully bred and present programme of captive breeding at the National Park/Zoo in Orissa and in a National Park in Karnataka, may be added to the total list of captive breeding sites. Zoos at Ahmedabad, Delhi and Boroda have also successfully bred mugger during last 7-8 years.

Limitation :

Lack of enough study regarding utilisable technology to yield desired number of adults and also in proper sex ratio, will be the major limitation in the work.

Research and Conservation needs :

Research is urgently needed to investigate into the correlation between different temperature level during artificial incubation and sex-ratio of resultant

population, as a few degree variation is reported to cause all males in other Chelonians (cf. IUCN Red Data Book, 1982). Role of muggers in ecology of fishes also need serious research to prove the correlation, positive or negative, of occurrence of food fishes in the pond/lakes where mugger survive. Although, Government policy does not encourage commercial farming, the rehabilitation project and work on captive breeding in India exhibited the potentiality of commercial utilization through farming operation or free-range sustained exploitation (Choudhury, B.C., in IUCN Red Data Book, 1982). A pilot project on Mugger Farming in Tamil Nadu has been approved to study feasibility of the economic aspect of farming on a commercial scale.

GHARIAL : *Gavialis gangeticus* (Gmelin)

The gharial is a large distinctively slender snouted, fish eating crocodile restricted to rivers of Indian subcontinent specially in the Indus, Ganges and Bramhaputra drainage system.

Appearance and Size :

The body is armoured with scutes. The adult is olive green, reaches 6.5 meters length in males and 4.5 meters in females; young are lighter in colour and with dark spots or bars. Adult males have characteristic tough bulbous excrescence at the tip of snout resembling a pitcher or 'Ghara' and produces hissing sound as it emerges from water. Both upper and lower jaws with at least 24 sharp, pointed teeth on each side.

Distribution :

Currently known from Bangladesh, India, Nepal and Pakistan; formerly known from Bhutan. In Indian region, Himalaya fed drainage system of Indus, Ganga, Brahmaputra sustain the major population besides in Mahanadi River in Orissa, Gandak and Kosi in Bihar, Ramganga and Ghagra in U.P. and Chambal in Uttar Pradesh-Madhya Pradesh boundary areas.

Habitat and Environment :

The Gharial usually inhabits deep fast flowing rivers with clear water, high banks and deep pools and also are undisturbed banks for basking and nesting.

Status :

Earlier reported to be abounding in all great rivers of Northern India. In 1970, the estimated population reached an alarming low of 75 but since been augmented by a Government of India/FAO/UNDP Crocodile breeding and management Project and about 500 individuals in major rivers, may be estimated as on 1983 (Tikader, 1983) besides 1800 in captivity.

The critical condition of depletion, not only in India but in its entire range of distribution, is attributed largely to habitat destruction or modification, killing for skins or during fishing operation besides egg-collection by tribals, for food. Construction of dam, barrages and reservoirs for hydroelectric and irrigation

projects have been identified as major disturbing factors in Uttar Pradesh in India and in Nepal.

Biology :

Nesting season starts from late March to late April and appears to be specific in each area. Nesting occurs on sand banks and mid river and both temperature (32-34°C) and humidity level are ensured. Mean egg clutch size may vary between

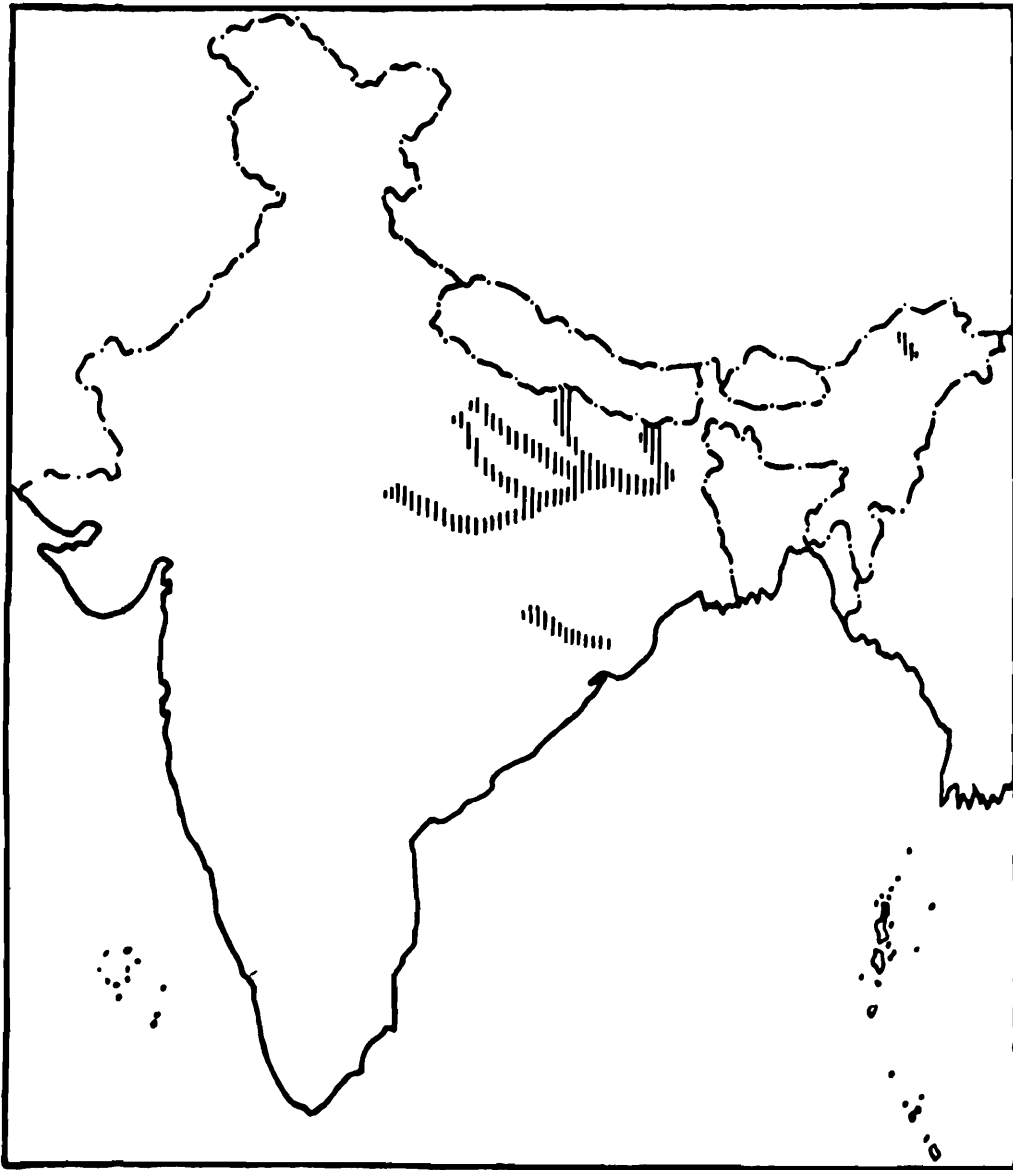


Fig. 12 : Approx. distribution of Gharial in India

28-43; eggs are elliptical, 85-90 mm long and incubation period extends over 83-94 days. Hatchlings on emergence measure about 375 mm in length. Both eggs and hatchlings are heavily predated by fish, monitor lizards, birds of prey, jackals and even by some tribal people and are usually guarded by mother for several months.

Behaviour :

During winter months, when water level and temperature remain very low, Gharials bask for long hours on sand banks; when floating in water, only the eyes and tips remain exposed. Major food consists of fish in running water but records of predation on birds and small mammals are also available.

Uses :

Gharial skin, like other crocodilian skin, are used for manufacture of articles and indiscriminate hide-hunting has been noted as one of the primary causes of its decline (IUCN Red Data Book, 1982). Eggs are eaten by some tribal population and are believed to have medicinal values.

Potential advantages :

After being protected by legislation under the Crocodile Breeding and Management Project started in 1975, in which Gharial was taken up as a priority concern, 500 eggs in first year and 100 hatchlings in second year was supplied by Nepal. Gharial eggs are now collected from wild and transported to rearing hatcheries from where at about 18 months age and 1.2 meter length stage, these are released in protected areas. Commencing the project in 1977, a total of 324 young have been released till 1980. The first successful captive hatching occurred in 'Tikerpara Gharial Research and Conservation Unit' in Orissa and breeding in captivity occurred for the first time in 'Nandankan Biological Park' in Orissa. From the available data, a distinct potential of using husbandry and rehabilitation on one side and captive breeding on the other can be evidenced under Indian condition.

Limitation :

The sex determination factor related with ambient temperature, remains a major limitation to formulate farming operation in a commercial scale.

Research and Conservation needs :

The temperature requirement during incubation has been identified as a major critical factor for other chelonids during incubation period and few degree variation can lead to imbalance in sex-ratio resulting in production of individuals of only one sex. This aspect needs serious research for Gharial breeding/rehabilitation project. Investigation to monitor the breeding behaviour of released adult depending on suitable management of Gharial sanctuaries, is vitally needed. Further, habitats like Manas River flowing through Assam-Bhutan border may be selected for re-establish gharial in wild. Work in Nandankanan Biological Park in Orissa and Madras Crocodile Bank in Tamil Nadu can provide valuable data in the future. Seven project-areas in Orissa, Andhra Pradesh, Uttar Pradesh, Madhya Pradesh and Rajasthan for husbandry/rehabilitation purpose, set up between 1975-77 can be used as research centres for study of microclimatic and other requirements for successful hatching in captivity.

FRESH WATER TURTLES AND TORTOISES

India has a total of about 30 species of fresh water turtles and tortoises occurring in riverine areas, lakes and ponds. Of these 30 species, 20 belong to the group of hard-shelled turtle group (Family Emydidae), 6 belong to soft-shelled turtle group (Family Trionychidae) and 4 to Tortoises (Testudinidae) (Table-2). Fresh water turtles, although being used as major protein-food source in localised belts in eastern India and elsewhere, surprisingly remained a much neglected group.

Appearance and Size :

The order Testudines is defined from other reptiles by long rounded or oblong shells which show considerable variation. Most of the hard-shelled fresh water turtles are distinguished from land tortoises by the modification of hind limb for swimming instead of walking. The soft-shelled turtles (Trionychidae) are often large, such as *Chitra indica* which is largest of the Indian Trionychids, and its length of dorsal disc has been recorded to 800 mm, while the more smaller ones like *Lissymys punctata granosa* can hardly reach 30-33 mm. The largest Emydid is the *Batagur baska*, the size of its carapace, length being 590 mm, and smallest in the group is *Kachuga sylhetensis*, with recorded length of 180 mm.

Distribution :

Most of the species in Indian region are variably distributed in the Ganga, Jamuna, Mahanadi, Gandak, Gomati, Ghagra, Narmada, Cauvery river system and fresh water ponds and lakes in West Bengal, Bihar, Orissa, Andhra Pradesh, Tamil Nadu, Kerala, Madhya Pradesh and Uttar Pradesh. Some, like Indian spotted flat-shelled turtle and allies (*Lissemys punctata*), Ganges soft-shell turtle (*Kachuga tecta*), etc. are wide-spread and relatively common over majority of the range but are extensively exploited commercially, while others have restricted range but are relatively common within the range (*Heosemys silvatica*) or restricted and uncommon within the range (*Melanochelys tricarinata*) (Moll, E.O. 1983. Unpub. Rep.).

Habitat and Environment :

The fresh water turtles and tortoises inhabit fresh water rivers of the subcontinent forming major drainage system and their tributeries as also in large number of village ponds, lakes and other fresh water bodies, both in extreme rainfall areas and relatively low-rainfall area to dry areas. In many cases, these form a part of conventional rituals performed for worshipping dieties and as such remain protected in village ponds, specially the ones located near temples. In recent times, habitat alternations due to multipurpose River Valley projects with construction of dams, is believed to have indirect effect on decline of population by replacing their lotic habitats with lentic ones (Moll, E.O. 1983, Unpu. Rep.). The migratory species like *Batagur* is affected most seriously while some species like Ganges and Nagpur soft-shelled turtles appear to thrive well in large reservoirs

constructed for river-projects. The increasing clearance of forest for agricultural practices and continuous use of such areas along the river bank affects the nesting habitat; also the run-off water carrying pesticidal residues of non-degradable chemicals from the field, directly affects the aquatic habitat.

Status :

In recent times, it has been emphasised through several studies, that over exploitation of turtle-resources for food and medicine, has already pushed some of one common species to 'rare' or 'very rare' status either in part or whole of their distribution range. The Indian Wild Life (Protection) Act, 1972 list (i) Ganges Soft-Shelled Turtle (*T. gangeticus*), (ii) Indian Flapshelled Turtle (*L. punctata punctata*), (iii) Indian Tent Turtle (*K. tecta tecta*), (iv) Peacock marked or Soft-Shelled Turtle (*T. hurum*) under schedule and (i) Three keeled Turtle (*M. tricarinata*) and (ii) all Tortoises, under Schedule IV. On the other hand, IUCN Red Data Book (1982) dealt with four species from the region which are either insufficiently known or of indeterminate status; these are (i) Batagur (*Batagur baska*), (ii) Kavalai Forest Turtle (*Heosemys silvatica*), (iii) Travancore Tortoise (*Geochelons travancorica*), (iv) Burmese Brown Tortoise (*G. emys*). A recent status report (prepared by E.O. Moll, 1983, unpublished) suggested reconsideration regarding four species which have been included in schedule I of Indian Wildlife (Protection) Act, recommending their transfer to Schedule IV and inclusion of (i) Batagur (*Batagur baska*), (ii) Black Pond Turtle (*G. hamiltoni*), (iii) Kavalal Forest Turtle (*H. silvatica*), (iv) *K. kachuga* in Schedule I. Considering the present state of knowledge and depletion of population of commercially harvested species, while inclusion of additional 4 species is a welcome measure, deletion of any one of existing four species from Schedule I, will be most undersirable.

Biology :

Turtles and tortoises usually nest on banks of aquatic habitats and peak period for nesting of soft-shelled turtles has been determined to be between August-November while for hard-shelled turtles, it extends from January-May. Some of the hard-shelled turtles, (Emydid) lay large number of eggs in cluster of 20-30, measuring 60-70 mm in diameter and weighing 50-70 gms., while other like smaller *Kachuga* turtles lay eggs in cluster of 5-10, weighing 14-18 gms. Soft-shelled riverine species may lay 20-30 (*T. gangeticus*) to over hundred eggs (*Chitra indica*). The egg cluster in semi-aquatic and lentic turtles like Malayan Box Turtle (*Melanochelys trijuca*) is usually composed of 2-4 or 3-7 eggs and measure about 40-45 mm in diameter.

Behaviour :

The turtles and tortoises are usually sluggish in nature and become most vulnerable when out of their aquatic habitat, during nesting period. The fish-eating turtles often become a threat to the fisheries which have been specially developed in fresh water ponds but majority feed in aquatic vegetation and can act at primary consumer level but many can have a wider feed-range. Turtles also act as

scavengers in riverine system and clear out decomposed bodies. The population which are protected in religious sanctuaries are fed by devotees and even can respond to some calls.

Uses :

These animals are mostly utilised for cheap protein food, price ranging for Rs. 5/- to Rs. 15/- per kg. Besides, they are also used as medicine by preparation of a powder from shell and mixing it up with other ingredients for curing piles, sores, inflamed eyes, etc., or taken orally for colds, digestive problem, etc.; other localised uses include, introduction of turtles to clear well-water, of algae and insects, etc.

Potential advantages :

Turtles and tortoises form an important resources in aquatic eco-system of Indian region. At least three of the measures suggested (Moll, E.O. 1983 *op. cit*) recently can lead to a proper management of the group; these include use of closed-season ban, hatcheries and protection of nesting ground and captive breeding (specially flap-shelled or Indian soft-shelled species). These measures can yield substantial stock to be used for commercial utilisation without endangering the animal population in nature, specially to feed undernourished rural population. The use of shells for other purposes can also be much well planned through proper management of this utilizable resource.

Limitation :

The lack of data for detailed life-history, including critical temperature factor for sex determination for most of the utilisable species, remain the major limiting factor.

Research and Conservation needs :

To overcome the problem of depletion of natural stock one of the foremost step that is recommended is banning turtle fishery operation during reproductive season. After identification of individual species, specially between soft-shelled and hard-shelled species which have distinctly different nesting period, these bans can be effectively enforced. Egg hatcheries and protection of identified nesting sites from predators and man, are other areas where immediate measures can be initiated. Pilot-project study for captive-breeding of such species which are either rare and threatened or such species which can be utilised for commercial purposes should be designed to help conservation of wild population and/or utilisation. In some countries of south east Asia, soft shelled turtles are reared in ponds and feasibility of such project is recommended for State like West Bengal which has a highly potential market currently fed by shipments from all over India. Research work is also needed to formulate methodology to rear turtles along with fishes in ponds, as many ponds are cleared of turtles for fishing programme. Omnivorous species like Indian flap-shelled or Indian soft-shelled turtles are recommended for captive breeding programmes in the first phase along with enforcement of laws

of Indian Wildlife (P) Act, and CITES Act and other suggested measures for conservation and research.

Table-2 : List of fresh water species of turtles occurring in India

Scientific name	Common name
FAMILY : EMYDIDAE (HARD-SHELLED FRESH WATER TURTLES)	
<i>Batagur baska</i> (Gray)	The common Batagur or Tuntong
<i>Cuora amboinensis</i> (Daudin)	Ambona or Malayan box turtle
<i>Hardelle thurji</i> (Gray)	Brahminy river turtle
<i>Morenia peterisa</i> (Anderson)	
<i>Geoclemys hamiltoni</i> (Gray)	
<i>Kachuga tentoria</i> (Gray)	Black pound turtle
<i>Kachuga tentoria circumdata</i> Mertens	Indian roofed turtle
<i>Kachuga smithi</i> (Gray)	Brown river turtle
<i>Kachuga dhongoka</i> (Gray)	
<i>Kachuga kachuga</i> (Gray)	
<i>Kachuga sylhetensis</i> (Jerdon)	
<i>Heosemys silvatica</i> (Henderson)	
<i>Melanochelys tricarinata</i> (Blyth)	Three keeled turtle
<i>Melanochelys trifuga trifuga</i> (Schweigger)	Indian oil eating turtle
<i>Melanochelys t. indopenisularis</i> (Annandale)	
<i>Melanochelys t. thermalis</i> (Lesson)	Common hard-shelled terrapin or Ramnd pond turtle Malabar pond terrapin
<i>Melanochelys t. coronata</i> (Anderson)	
<i>Cyclemys mouthoti</i> (Gray)	
<i>Cyclemys dentate</i> (Gray)	
FAMILY : TESTUDINIDAE	
<i>Geochelone elegans</i> (Schoepff)	Indian star tortoise
<i>Gechelorne (Manouria) emys</i> (Schllg. & Nill)	Burmese brown tortoise
<i>Geochelone elongata</i> (Blyth)	Red nosed tortoise
<i>Geochelone travancorica</i> (Boulenger)	The Travancore tortoise

(FAMILY : TRIONYCHIDAE (SOFT SHELLED TURTOISE))

<i>Lissemys punctata punctata</i> (Bonater)	Indian spotted flat shelled
<i>Lissemys punctata granosa</i> (Schoepff)	Southern soft-shell turtle
<i>Chitra indica</i> (Gray)	Narrow headed soft-shelled turtle
<i>Trionyx gangeticus</i> Cuvier	Ganges soft-shell turtle
<i>Trionys leithi</i> Gray	Nagar soft-shell turtle
<i>Trionyx hyrum</i> Gray	Peacock marked soft-shell turtle

SEA TURTLES

Sea turtles are regarded as one of primitive reptile group, who have been surviving around last 150 million years. The giant land turtles entered the sea at a time when great dinosaurs lived on this earth and the first sea turtles have their ancestors in the giant land-turtles. Sea turtles, through millions of years, changed from bulky bodies to flatten into lighter streamlined shape and changed the legs into paddle shaped flippers. Seven different species of sea turtles are known from warm and temperate ocean around the globe. Sea turtles spend most period of their lives in the water but egg laying females travel miles and move to land for nest building and laying of eggs.

In India region, five species of Sea Turtles, viz., (1) Leatherback, (2) Hawksbill, (3) Green, (4) Olive Ridley, (5) Loggerhead occur; of these first 4 species have been included in IUCN Red Data Book as "Endangered" on a World Scale.

LEATHERBACK : *Dermochelys coriada* (Linn.)

Leatherback turtle, longest of extant sea turtles, nest on the beaches of tropical seas and forage in temperate waters. It was considered to be on the verge of extinction but systematic survey around the globe revealed new nesting sites and a 1981 estimate puts the breeding female population to over 100,000.

Appearance and Size :

The carapace is smooth slaty black and is provided with number of longitudinal ridges. No sharp angle can be viewed between the carapace and plastron. Head is large and neck is massive, lower jaws with a massive hook. Limbs paddle shaped, clawless, the anterior pair triangular and much enlarged. Length of carapace varies between 140-180 cm and average weight is estimated at 400 kg., reaching to a record of 725 kg.

Distribution :

This species is distributed in tropical area of Atlantic, Indian and Pacific oceans but may be occasionally found in subtropical oceans and Mediterranean. Most

sites are recorded between 30°N and 20°S (IUCN Red Data Book 1982). It has been reported from Lakshadweep and Andaman Islands, Kerala, Tamil Nadu and Andhra Coast in Indian region (CMFRI : MFIS No. 50, 1983).

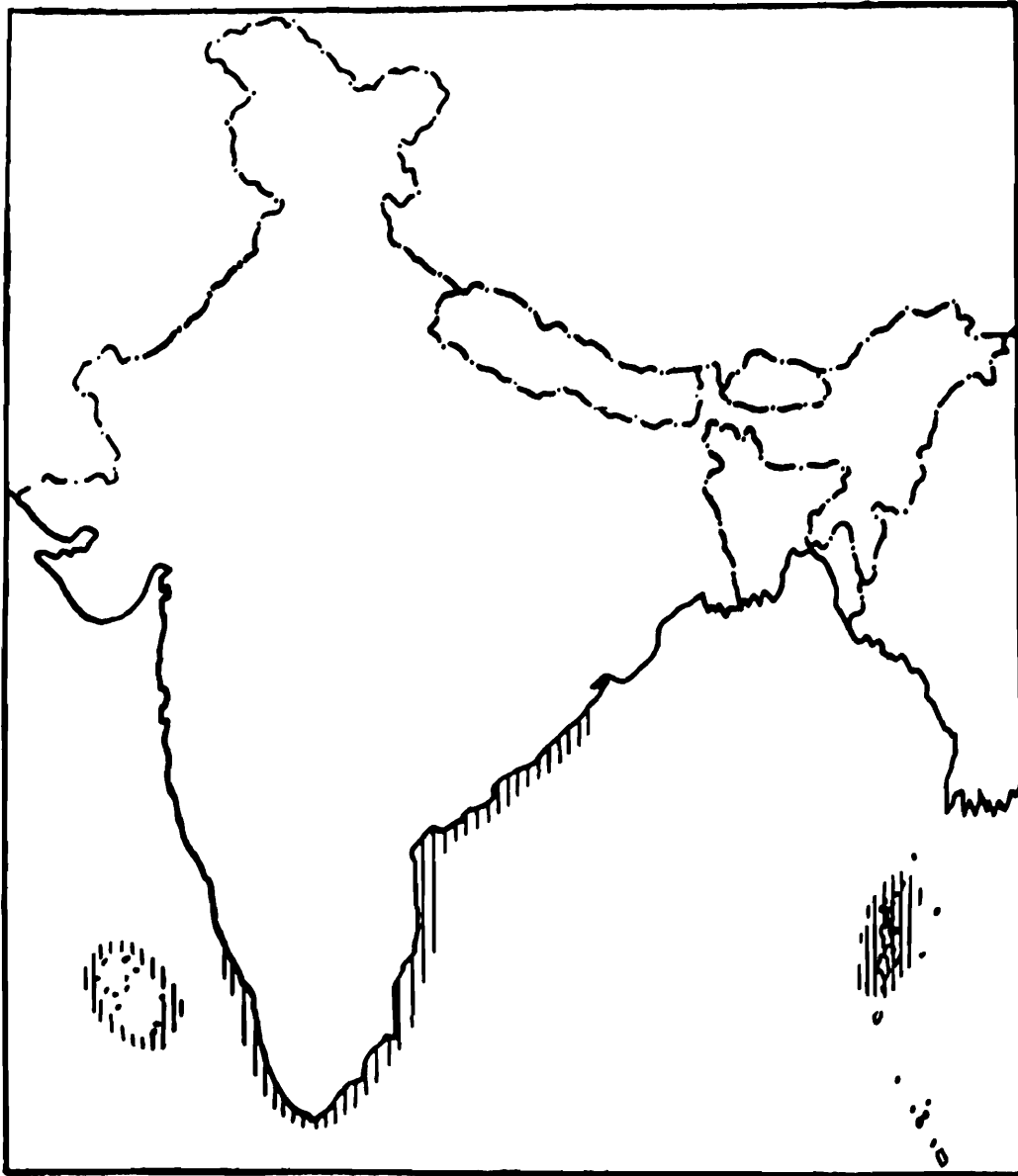


Fig. 13 : Approx. distribution of Leatherback in India

Habitat and Environment :

Leatherback turtles are pelagic but built nest on land. It feeds almost entirely on jellyfish and planktonic tunicates, fishes, etc. At least four areas of temperate zones are also recorded as their area of concentration and this is attributed to their ability to maintain body temperature up to 180°C above, that of surrounding water. Nesting is seasonal and they prefer to nest in such areas where presence of deep water close to inshore is assured. A number of nests are laid below high tide mark and account for the loss during flooding.

Status :

The species has been classified as "Endangered" in IUCN Red Data Book and listed in CITES Appendix-I, and is included under Schedule-I, Part-II of Indian Wild Life (Protection) Act, 1972 as amended in 1980. It is considered rare in Indian region (Tikader, 1983).

Biology :

Nesting, as already mentioned, is seasonal during the months of April-July in North Atlantic region and November-January in East Pacific. In Andaman and Nicobar Islands nesting is recorded during January-April. The age of sexual maturity remains unknown. Egg laying females move to beaches at night and excavate nest cavity with hind limbs and cover up the nests, after eggs are laid, with sand. Typical clutch size is approximated at 85; eggs are large, white, spherical and undergo incubation for about 55-65 days. News born hatchlings measure 55-63 mm in length.

Behaviour :

Due to their pelagic habit, adults may fall prey to shark or large feline species at nesting time. Egg laying females also may become entangled in dead mangrove roots and die. Some females may show a tendency of re-nesting during the same season. Many leatherbacks move long distance up to 5,000 km. The behaviour of foraging in cool water is not fully known. Often feeding on jellyfish, they may devour plastic bodies leading to their mortality.

Uses :

Adult turtles are used for meat; eggs are harvested exclusively for food. Decline in population in Indian region is said to be due to excessive harvest of eggs.

Potential advantages :

The advantages of conservation and planned utilisation is same as for all sea-turtles, which supply one of the cheaper animal protein to human population, specially in developing countries. A female has only to nest two seasons for monetary value of her eggs to exceed that of her meat.

Limitation :

Farming of Leatherback appears to be a distant theme at this stage. This is largely due to non availability of any data on such effort. IUCN Red Data Book (1982) records no captive breeding and stages that is "probably not feasible; hatchings are difficult to riase in captivity' Rearing of Leatherback at Sea-aquarium at Miami, USA and Japan have, however shown some feasibility of such trials.

Research and Conservation needs :

Data on life history parameters are inadequate. Research is needed to plan a strategy to decide permissible number of eggs that may be harvested annually

from natural nesting sites, without affecting the population. The Leatherback hatchery scheme in Malayasia set up in 1961 protect the species and allow licenced egg collectors to harvest part of eggs laid, while the others are transplanted in hatcheries for incubation, of which 50% recorded hatching success. This model of harvesting and hatchery with adequate data on life history parameters may be the most practical conservation measure that can be suggested. More protection by law without enough funding or personnel for enforcement of law, often yield unsatisfactory result in conservation programme. The recommendations of World Conference on Conservation of sea turtles, held in 1979 at Washington underlines the benefits of life-history and role of optimum temperature level so vital for sex determination. While conservation is strongly advocated on a world scale, in-depth research is urgently needed in all biological aspects.

OLIVE RIDLEY : *Lepidochelys olivacea* (Eschschotz)

This is a circumglobal species, occurring at least in coasts of 25 different countries around tropical regions of Atlantic, Indian and Pacific Oceans. In Indian region, Olive Ridley has been recorded both from sites along east and west coasts; its mass emergence along North Orissa Coast, the largest rookery of Olive Ridley in India, has been described as one of the most spectacular sea turtle activity. Mass capture and exploitation of Olive Ridley along coast of West Bengal and Orissa has been given wide publicity in recent years and Central Marine Fisheries Research Institute has developed a national programme for conservation & rehabilitation of Olive Ridley (in 1983).

Appearance and Size :

Body broad flattened with a carapace measuring between 65-72 cm. Head large with wide beaks; shells, head and flippers covered with scutes and without any longitudinal ridges as in Leatherbacks and lateral scuts number 6-7. The Carapace is olive grey and shields are yellow white in colour. The limbs are provided with 1-2 claws. Fully grown female may weigh up to 40-55 kgs.

Distribution :

The Olive Ridley is widely distributed in tropical waters along coastal lines of Atlantic, Indian and Pacific Oceans but major centres for populations are located in India, Sri Lanka, East Pacific and equatorial South Atlantic. Most nesting sites however support up to around 1,000 females per year.

In Indian region Olive Ridley nests along west coast, in the beaches south of Madras, Orissa, West Bengal, Andaman & Nicobar Islands and Lakshadweep. It is estimated that about 300,000 Olive Ridley annually nest in Orissa. (Kar, C.S. 1981 unpub. data). Report on Olive Ridley in Bay of Bengal (Biswas, S., 1982), Orissa and West Bengal (*CMFRI Tech. Bull.* 50, 1983) and West Coast (Frazier, 1982) are available for detailed information.

Habitat and Environment :

This species rests on beaches of mainland but hardly on island beaches. Tagging has provided data for habitat during post-nesting season. While migration to sea water and dispersal is evident, in some cases individuals do not move out far from their nesting site. Biswas (1982) mentioned beach condition as an

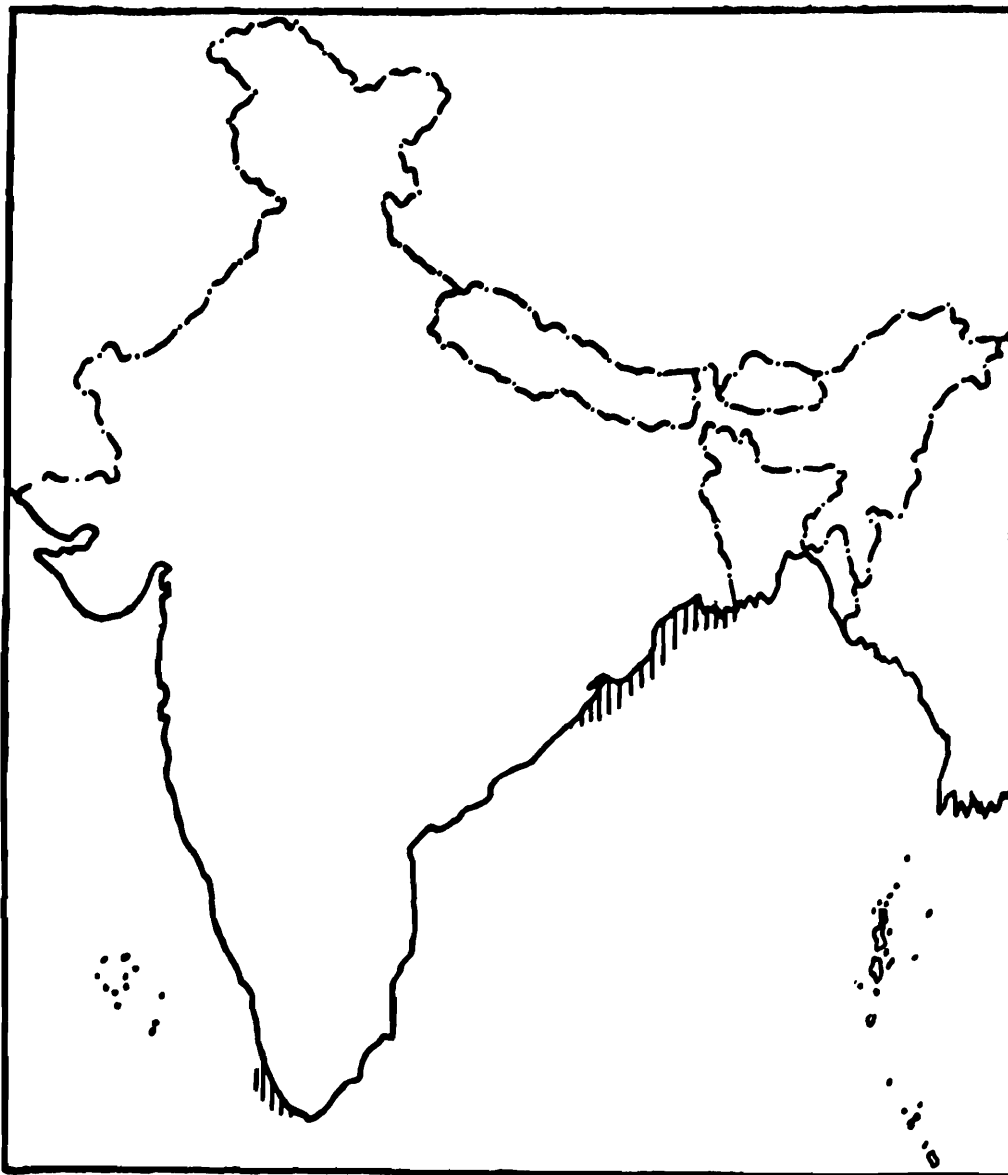


Fig. 14 : Approx. distribution of Olive Ridley in India

important factor in selection of nesting site by Olive Ridley; in the areas of Bay of Bengal, beaches with shallow seas, resulting in wide spread exposure of bed in low-tide and consequent hardening of surface, appears to be unsuitable (as in Chandipur & Digha in West Bengal) and sandy beaches are always preferred. During the month of December-January, in the turtle-fishing area of Orissa, rainfall remain minimum (0.3-8.3), salinity (%) at 22.8-25.0 and there is an

overlapping of cold water current from north and warm current from southernly direction in Indian Ocean.

Status :

On a world scale, it has been classified as 'Endangered', as most population are known or presumed to be depleted moderately to severely, or even extinct. Nesting females concentrate in largest number only in beaches of Orissa and Costa Rica.

Biology :

Sexual maturity is usually attained between 7-9 years of age. Females show tendency of emerging to nest in a synchronized manner, which is known as "arribadas" (or arrival) and mass concentration of adults and mass emergence of hatchlings, present an unique biological sight. In Orissa Coast, this is evidenced between January to March. Nesting season is however variable in different geographical areas of distribution, viz., August-November in East Pacific Ocean, September-January in Sri Lanka, March-April in Burma and January to April in India region. Eggs measures 34-35 mm in diameter and weigh between 25-33 gms., and remain in clusture of 40-140; about 50-60 days are required for the eggs to hatch (Biswas, 1982) in Indian region. Hatchlings measure between 34-42 mm (length of carapace) and weigh 12-16 gms. In general, hatch-rate of undisturbed eggs is very low. Eggs and hatchlings are predated upon by hawks, vultures and small mammals besides human beings. Egg from one "arribada" do not hatch before nest and a large number of eggs are destroyed as the later females from subsequent "arribada" excavate nests.

Behaviour :

The synchronised aggregation of nesting females (arribadas) whenever population density is high, is a interesting behaviour of Olive Ridley. The species forage in tropical neretic water where feeding on crustaceans, plankton can be effective through diving deep into the water (80-110 m). The food items include crabs, shrimps, jellyfishes, etc. Many individuals do not prefer to move away great distance from the nest site. During mating season, turtles remain very sluggish and are often caught by fisherman.

Uses :

The species has already been identified as one of the most economically important sea turtle in West Bengal-Orissa Coast in India and also in Mexico. Turtle meat and eggs worth crores of rupees is sold in Calcutta, the largest metropolis in eastern India and is also exported abroad. Trawlers, country boats and nets are used and a large fishermen community depend for their livelihood on turtle fishery. Turtle leather is used by European and Japanese leather manufacturer in a large scale, but major use remain in the cheap-protein-food source that is exploited by commercial harvesting scheme.

Potential advantages :

Conservation measures, if strictly imposed, may easily lead to high potentiality of rational utilisation of Olive Ridley both for food and leather; in India, unplanned exploitation of egg-laying females has already done considerable damage but strict enforcement of legal acts may help to utilise this animal resource by formulating a hatchery programme and later rearing of hatchlings under captive condition.

Limitation :

No information on captive breeding is available and pilot-project study is essential before any large-scale programme.

Research and Conservation needs :

The existing legal measures need to be most strictly enforced in the eastern coastal areas to ensure conservation. Added to this, fishing operation in areas of high turtle concentration, as in selected sites of Orissa, should be most restricted or stopped. Breeding beaches may be declared as reserves and provided status or notified conservation areas. A pilot project study for research on biology in captivity is most urgently needed.

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AMPHIBIA

Amphibians bridge the aquatic fishes on one side with predominantly land dwelling reptilia at the other end. Of the amphibians, the family Ranidae which includes "True Frogs" is considered the most widely distributed group after the family "Bufonidae" which include Toads, occurring in all zoogeographical region of the World, except in Australian region. Most of the members of Ranidae prefer Tropical environs, living in the aquatic or semiterrestrial habitats and sometimes exhibiting semi-arboreal habits. In India, about 106 species of frogs are known to occur, of which Indian Bull Frog, *Rana tigerina* (Daudin) and Jerdon's Bull Frog, *Rana crassa* Jerdon, Indian Pond Frog, *Rana hexadactyla* Lesson are the most exploited species but cricket or Paddy Frog, *Rana limnocharis* Boid, appear to be another potential resource for utilisation (Whitekar, R. 1982).

INDIAN BULL FROG : *Rana tigerina* (Daudin) (For *Rana crassa* Jerdon, pl. see note)

Appearance and Size :

Size large, male smaller than female which can reach over 160 mm in length. Skin smooth or granulated above with distinct longitudinal glandular folds. A fold extend from behind the eye to the shoulder. Ventrally, skin always smooth. Snout obtusely pointed, Tympanum distinct. Toes completely webbed. This species appear olive green or brown on the top with darker markings, often with a light coloured vertebral streak from snout to vent. Limbs appear barred or spotted. Youngs appear dark green above with darker brown makings and a black line along side of the head (Daniel, 1975).

Distribution :

This species is widely distributed over Indian subregion, Sri Lanka, Burma, Indo-China, South China and Formosa.

Habitat and Environment :

Bull frogs inhabit semi-arid areas to elevation of c 2000 m. in the hills. Normally this species inhabits grass and other fringe areas near water bodies and blend in an excellent manner with the habitat. In absence of water, the species can hibernate singly or in groups under the soil, even up to a depth of 6-9 meters, specially in sandy area during receding water-table.

Status :

Common. But since the commercial export of frog legs has been started at massive scale, the situation is changing fast. A recent study by a team from Bombay Natural History Society, revealed that numer of frogs in most part of Bombay-Kankar area has declined greatly due to their capture and removal for export ; the study recommended that capture of frogs from wild for commercial

purposes should be banned to avoid ecological disturbances in agricultural fields. In a recent meeting of IBWL (held October 13, 1983), demand for complete ban on the export of frog legs was made by a member, stating that reduction of frog in the wild has reached alarming proportion. A 1977 figure shows export of 300 tons of frog legs for which 9000 tons of frogs are known to have been killed. For the current years (1983-84) quota, a total of 3069 tons has been fixed as against 4066 tons of actual export in 1981-82, reducing the figure by 10% according to Ministry of Commerce of Government of India. Figures from adjoining Bangladesh, indicate an ever increasing export rate of frog leg with an average of 2,270,000 lbs during 1977-1978 to 1980-81 and this estimated annual exports of legs equals to over 18 million frogs and with the wastage at conservative rate of 2 million or 10%, makes it a total of 20 million frogs (Whitekar, 1982). In terms of number of frogs involved in a single year from India, it is estimated that at least 70 million frogs were used for export of frog legs to the west in 1981 (Whitekar, 1982). For all these operations *Rana tigerina* is undoubtedly the major victim, both in India and Bangladesh.

Biology :

The Bull frog breeds during monsoon. Males, brightly coloured in lemon yellow, congregate in pools and ditches and start croaking loudly till the arrival of female. Males usually become aggressive in case of competition for mating. Female lay spawn in rain-water pool or other semi-permanent water bodies; eggs, floating when laid, gradually sink to the bottom, where they hatch (Mc Cann, 1932). Tadpoles are omnivorous and bottom feeders. The life cycle has not been worked out in details.

Behaviour :

Frogs in general are slow in movement. Males remain silent during non-breeding season unless caught by a predator, when alarming scream is raised. During breeding season, rival males produce deep-toned sound *oongawang*, and the male which succeeds in winning the female fend off the other competitors by kicking with hind legs. It also produce a peculiar chuckle like *Kut Kut Kut* when caught by hand (Daniel, 1975).

Uses :

Wild-caught Bull frogs, as already stated are used for export of frog legs to countries like USA, Canada, Netherlands Belgium, France, West Germany for earning foreign exchange. The business is reported to be so lucrative that many large commercial houses are becoming involved (notes of Arjan Singh in IBWL meeting 13.10.83). On the other hand, natural population of frogs play a major role in protecting agricultural field from land-crabs and insect pests and decline in wild population, in recent years has led to large scale disturbance in ecological balance.

Potential advantages :

The uses being established, frog-farming can be considered as a potential area of work. The fresh water frogs-*Rana* species, have been included in Schedule-IV of wildlife (Protection) Act, 1972. At present trapping of frogs between 15th April-15th August of each year has been banned by Department of Environment, Govt. of India and processing and export of frog legs is banned during 15th June-15th August. Trappers, dealers and processors of frog legs are already required to obtain licenses under Wild Life (Protection) Act. A research centre has been set up by Central Inland Fishery Research Institute at Kalyani, West Bengal for production of frog-seeds. The Kerala Agricultural University has started a frog-breeding centre at Kumarakan near Kottayam. Ministry of Commerce, Govt. of India informs that a similar centre will also be set up in the state of Maharashtra. Frog-rearing technology developed by CIFRI has considerable significance for establishing frog-culture farms and once the technology is established, trapping of wild frogs may be controlled.

Limitation :

The utilisation of frog-legs through captive breeding and seed bank operation may have limitation in establishing standard technology or breeding. However, induced breeding is known to reduce the life cycle and if properly used, limitations of biotic and abiotic factors can be overcome.

Research and conservation needs :

The most urgent need is to initiate detailed study of life history and biology in the field, results of which can be utilised in farming centres. The status of the species in its major distribution area during monsoon season should be clearly ascertained and any report of large-scale increase of pest infestation from fields, where trapping operations are regularly undertaken, should be documented. Till farming techniques are utilised in more than one centre, the export quota should be reduced by at least 50%. A size limit, banning the use of frogs in the 4-6 pairs per pond range and thereby protecting the breeding adults, is urgently needed. In Bangladesh 75% of export was in range of 6-8 pair per pond and FAO experts have initiated assessing the situation and possible use of closed season, closed areas as also planned frog-farming. The target must be aimed at working of proper breeding farms which can replenish depleted wild stock and meet the demand of export quota.

Note :

Another closely related species, Jerdon's Bull Frog, *Rana crassa* Jerdon, is grey brown or green in colour with darker marking. The species is distributed over peninsular India and gangetic plain, extending to West Bengal (Calcutta) in the east and Malabar Coast in the West ; besides India, It is known from Sri Lanka. Status of this species is poorly known but it appears to be common and often confused with *tigerina*. Rain water pools are recorded as one of the habitats and data on breeding habit and biology is lacking. Apart from the fact that this species

is an excellent burrower, no other information on habits which can be used to separate this from sympatric species *tigerina*, is available (Daniel, 1975). A

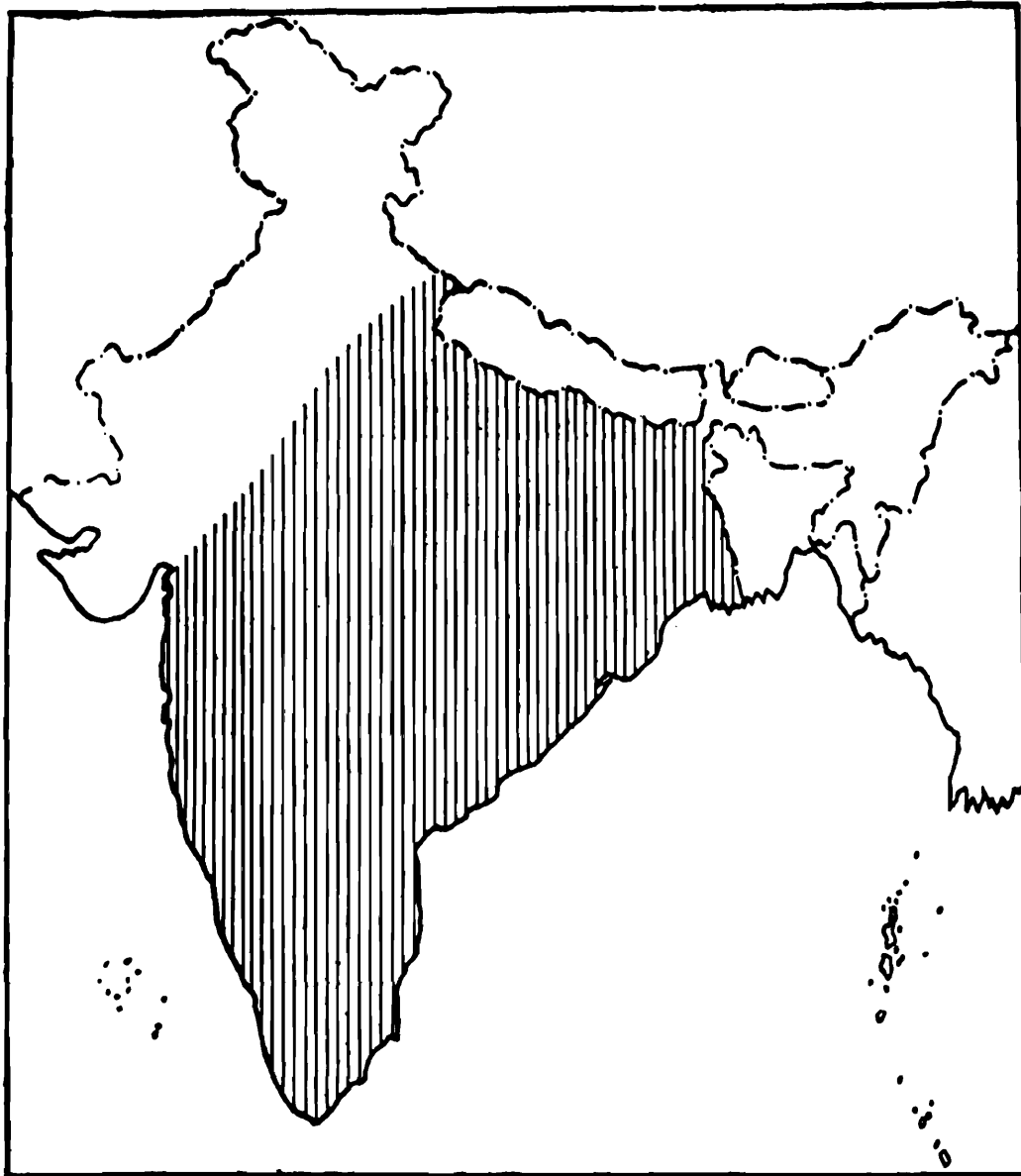


Fig. 15 : Approx. distribution of Bull Frog in India

Ministry of Commerce report (1983) however mentions that *Rana tigerina*, *Rana hexadactyla*, *Rana crassa* are the only three species used for export.

INDIAN POND FROG : *Rana hexadactyla* Lesson

The Indian Pond Frog is an endemic species living in dense aquatic vegetation of ponds, away from open water. One of the large sized frog, it has become a major target of frog leg exporters during last two decades in the Indian region.

Appearance and Size :

Size large, with flat snout, smooth skin above and warts on the flanks, and around throat. A glandular fold extends from behind the eye to the shoulder and two rows of porous warts extend from behind shoulder to groin. Tympanum distinct. Toes completely webbed. Females may reach up to 130 mm in length. Frogs appear bright grass green or olive green above, may be with a pale area up to the shoulder fold. Under-surface white or yellowish white in colour. Legs coloured with black and white or yellow behind the thighs.

Distribution :

This species is recorded from east in Calcutta, West Bengal to the south along east coast and also along west coast in Bombay-Goa region. Northern limit of distribution is not definitely known but a record from Punjab is available (Daniel, 1975).

Habitat and Environments :

Daniel (*op. cit*) noted that preferred habitat of this species at least in western India are the ponds with dense aquatic vegetation and also recorded these frogs resting on brown dying weeds. Normally, the species is common in the ponds and weed infested areas of water along east coast.

Status :

Fairly common but actual estimated population is difficult to be ascertained. During last 25 years an ever increasing export of the species has been noted. For other details, comments under Indian Bull Frog may be consulted.

Biology :

The breeding season starts in the monsoon and premonsoon shower may perhaps initiate spawning. It is reported to have two broods in areas which receive both the southeast and northeast monsoon rains. Eggs are laid in paddy field (Ferguson, 1904) but juvenile have also been collected from decaying vegetation of pond (Daniel, *op.cit*); gravid females may contain more than 2000 eggs, each of less than a millimeter size. Tadpoles appears as olive green above with dark blotches and whitish below. These frogs feed on insects and snails and have both aquatic and aerial predators.

Behaviour :

The call of male is not properly recorded although external vocal sacs distinct. It normally stays clear of open water perhaps to avoid predation and its green colour conceals it admirably in green aquatic vegetation.

Uses :

Annandale (*In Boulenger, 1920*) noted that in Madras this frog was eaten by Frenchmen, being captured by means of hook baited with red rag pulled on a line through the weeds. During last 25 years, this species formed the major

component (along with Bull frogs) of the frogs captured from the nature for export of frog-legs. The possibility of frog farming (Pl. see "uses" under Bull Frog) is equally applicable to Pond Frog as in the case of Bull Frog, for proper utilisation

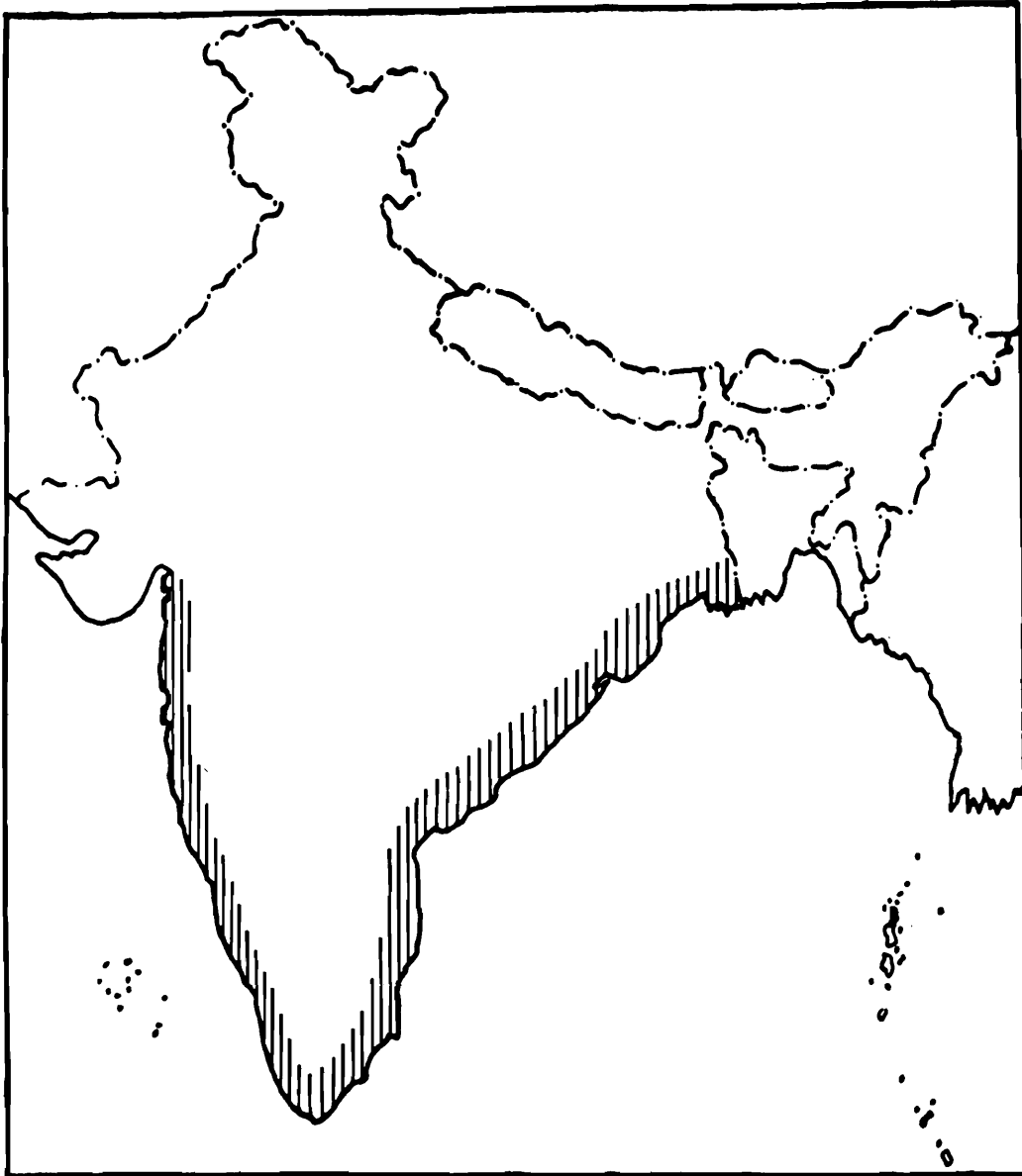


Fig. 16 : Approx. distribution of Indian Pond Frog

and also for conservation of natural population. The market potential of frog-legs is already well established.

Potential Advantages :

Frog, as it appears from available information, can be cultured by captive breeding and even the breeding cycle may be shortened. Seed-farms for frog-breeding, may in the long run, offer assistance in introduction of the species in similar environmental condition in open enclosures for captive breeding.

Limitation :

The disease *Salmonella* and others remain a limiting factor in frog-leg export technology. But lack of established methodology for a successful farming, remains the single limiting factor, which however can be overcome in a reasonable time and with concerted efforts.

Research and Conservation need :

The comments as mentioned in "Bull Frog", should be equally applicable in its totality in the case of "Indian Pond Frog"

THE STREAKED FROG / THE PADDY FROG

Rana limnocharis Weigmann

Appearance and Size :

Small sized frog, hardly exceeding 30-35 mm in snout to vent length; usually grey or brown in colour with black spots on the back and also on the limbs, hips and legs often with complete and incomplete bars. Skin warty above, often with longitudinal glandular folds. A mid-dorsal white line present or absent. When present it may be thin and faint or broad and conspicuous. Similar white lines have been seen to run along the thighs and in some right up to the heel. First finger longer than the second.

Distribution :

All over India, from the base of the Himalayas to the southern part of the country; Sri Lanka; Burma; China and as far as Malaysia and eastwards to Philippines, Borneo and Lombok.

Habitat and Environment :

Abundantly found in the vicinity of tanks, streams, cultivated fields specially in the paddy fields and generally frequents the edges of ponds and marshes. During the day time specially the dry season most of these frogs prefer to stay under crevices of rocks, under stones, under dead and decaying logs, in damp places near ponds from where they come out at night. During monsoon, a large number of them come out in open areas and are found both during day and night and during this period they prefer perennial streams for laying eggs.

Status :

Common but reports are available of depletion of population in localised areas in eastern India. All freshwater frogs have been included in Schedule IV of Indian Wild Life (Protection) Act 1972 amended 1980.

Biology :

The breeding season of this species usually coincides with the monsoon rains. However, this species does not have any fixed breeding season and can also breed

throughout the year, in conditions, suitable for breeding season. Strong pad appears on the inner aspect of the first finger of the breeding male. During monsoon, a large number of these frogs appear in quiet waters, such as that of flooded fields and after pairing off, float about on the surface. At intervals, the females duck their heads and as their vents reach the surface of the water, eject the ova upon it. As a result, a large area becomes covered with floating eggs which extends in a single layer and appear barely adherent in small groups. Each egg remains enclosed in a spherical, transparent mass about the size of a buckshot and ultimately all the eggs sink to the bottom. The larval *limnocharis* reaches maturity within 28 days.

Behaviour :

This species is not fully aquatic but are found abundantly in the vicinity of streams, near the edge of ponds and marshes, in the cultivated field specially in paddy fields. Normally, they do not float on the surface of the water but only rest on the surface, with the legs hanging down below the surface of water. In hilly areas it is said to undergo prolonged hibernation. Large number of this species aestivate in crevices of rocks and under large stones during the summer.

Uses :

Hind limbs are considered as a delicious dish. A large number of this frog are sacrificed for earning foreign exchange.

Potential advantages :

In a natural agricultural ecosystem, this species plays an important role by preying upon insect pests and keeping down the pest population. Catches from the wild have already caused disbalance in some areas of India. An established farming operation can meet the demand for export and restocking of this species in identified areas where depletion is reported.

Limitation :

No detailed information about biology, life history and microclimatic requirement for a successful breeding operation is available.

Research and Conservation needs :

A detailed study is required to investigate into biology and life history of this species. Research on induced breeding is also very essential for shortening the life cycle period as well as to increase the fecundity rate of the species. Further, as large number of this species are being currently utilised for earning foreign exchange every year resulting the decline of population, it has become essential to adopt conservation measure as suggested under "Indian Bull Frog"

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BUTTERFLIES

Butterflies and moths belong to the Insect Order Lepidoptera; out of a total 1,40,000 species of lepidopteran insects, about 12,000 species and subspecies are referable to butterflies. A total of about 2,500 species and subspecies belonging to 10 different families are known from Indian region. These include "Swallowtails", "Tree Nymphs", "Skippers", "Bird Wing" and host of other butterflies. The food plants of larvae include an wide array of families, viz., Aristolachiaceae (*Aristolia*), Anonaceae (*Anona*), Berberidaceae (*Berberas*), Apocynaceae, Acanthaceae (*Strobilanthes*), Anacardiaceae (*Anacardum*), Capparidaceae (*Capparis*), Euphorbiaceae, Cruciferae (*Brassica*), Compositae (*Blumea*), Cuberbitaceae (*Bryonia*), Leguminosae (*Acacia*, *Albizia*, *Vigna*), Lauraceae (*Machilus*, *Litsaea*), Loranthaceae (*Loranthus*), Malvaceae (*Hibiscus*, *Sida*), Rutaceae (*Citrus*) Cyperaceae, Graminae and several others.

Considerable variation is known in the size and appearance. Some are large and sombre coloured as in members of Amathusiidae (total spp. 55) popularly known as Jungle Queen, Jungle King, Palm Kings, others may be small or very large, like beautiful birdwings in Papilionidae (total spp. 217); some may be predominantly white and yellow in colour as in Pieridae (total spp. 182), and some predominately brown as in Satyridae (total spp. 335) or blue as in Lychnidae (total spp. 650); all the members of the family Hesperidae (total spp. 480) look like moth and appear very tough and may be brown, orange, green or metallic green.

Butterflies are distributed over wide biogeographical areas of Indian region but maximum concentration of species can be noted in north-eastern Himalayan region, specially the rare ones. Faunal characteristic in N.E. Himalaya, N.W. Himalaya, Peninsular India and Islands of Andaman & Nicobar have been noted by both professional and amateur lepidopterists in a series of papers over last 100 years.

The butterflies in Indian region is broadly grouped as (i) fauna of plains but actually include some material from hills, (ii) fauna of northern montane region from Assam to Punjab which include both Oriental and Palaeartic species and (iii) fauna of Island groups. Each of these group inhabit different environmental conditions; specially the montane species in N.E. region have maximum rainfall, high humidity, short day length period and extreme cold during winter months while those in N. W. region have differential level of temperature gradient, humidity and rainfall. The peninsular fauna on the other hand mostly inhabit region with sharp seasonal demarcation of summer, monsoon, winter and spring, except the one in semiarid and arid zone as in the state of Gujrat and Rajasthan, where only extremes of summer and winter could be evidenced. The island fauna with typical environmental condition offer a number of endemic forms.

The habitats largely include wild vegetation including bamboo, grasses and mostly angiosperms but larvae of a number of butterflies have become pests on

cultivated crucifers, cucurbits, cereals and grasses, fruits and fibre crops and inhabit agricultural crop-lands, during breeding season. Some restrict themselves to thickly wooded country (*Erycinidus*).

Some butterflies can often be seen congregating near puddles and along streams (e.g. *Pieridae*). Some due to their unpalatability to the predator have been mimicked by other, specially by acquiring changes in colouration of larvae and adult (e.g. *Danaidae*). Members of *Satyridae* prefer shady areas than sunlight and confine themselves to palms, grasses and bamboos and can differ in shape, colour and pattern between dry season and wet season. While members of *Satyrids* and *Amathusid* are not fond of visiting flowers, those of *Nymphilidae* love visiting flowers and open sunshine. *Nymphilids* are well known for their beautiful colouration and some even mimic unpalatable *Danaids* for protection, while many species are slow movers, members of *Hesperid* butterflies are very fast fliers.

The butterfly fauna of India, though well documented yet informations on their food-plant and larval biology remain inadequate. The works of T.R. Bell (1909-1921) on the common butterflies of plains of India appear to be the only worthwhile publication containing biological data of larger Indian species. A total of 20 species of *Papilionids* were bred by Bell (*op. cit*) on their respective hosts.

It is now realised that butterfly wealth in India is rapidly depleting at an alarming rate (Khoshoo, 1983) and it is estimated that at least 520 species, subspecies, and races recorded earlier by Talbot (1939, 1947) and Wynter-Blyth (1957) have become rare or very rare.

This amounts to 20% of the known species from Indian region and recent surveys indicate that a number of large and beautiful species of *Papilionidae* and *Nymphalidae* in areas of Northeast India, Western Himalaya, Western Ghats have become rare.

The causes of depletion may be attributed to habitat destruction during developmental projects on urban settlements, industries, multipurpose river valley projects, changing land-use pattern, etc. resulting in the change of ecological conditions. The other most important factor is indiscriminate collections, specially by private/commercial collectors. The Govt. of India has however already enlisted 108, 304 and 10 species of butterflies under Schedules, I, II, IV of Wild Life (Protection) Act, 1972 as amended in 1980.

Family PAPILIONADAE : THE BIRDWINGS

Appearance and Size :

Giants among all the Indian butterflies, the Birdwings have the wing expanse varying from 120 to 190 mm. They have thorax laterally red, bearing non-iridescent fore wings and tailless hind wings, latter being black and yellow in females and magnificently bright golden, and sex marked over and above the usually prominent dorso-abdominal wooly stripe, in males.

Distribution :

Out of 24 species of the Birdwings of five groups from the East Palaearctic, Oriental and Australo-Papuan regions, only the *helena*-groups is represented by a dozen of species from Sino-Indo-Australia, of which three occur in India proper. *Troides minos* (Cramer) is endemic in Peninsular India up to an altitude of c 200 metres, while *T. aeacus* (C & R. Felder) is found in the Garhwal Himalayas; *T. helena* (Linnaeus) has three subspecies, one distributed from Sikkim to Orissa, the second in the Andaman and the third from Great Nicobar Islands.

Habitat and Environment :

The Birdwings are generally found in hot and heavily forested valleys, open plains, shady walks and glades bedecked with flowering plants.

Status :

The Birdwings are locally very common from spring to autumn.

Biology :

No comprehensive account on biology of the Birdwings is available, though certain information on the subject related to *Troides minor* has been imparted by Davidson & Aitken (1890) and Bell (1911). In this case, oviposition takes place singly on the dorsal side of leaves or stems after the site-selection is over by wandering females on larval food-plants. After hatching, the young larvae, which are velvety rosy-black with segmentally arranged fleshy tubercles, move on to the ventral side of leaves and afterwards on the stems or stalks. These pass over to the next instars of growth leading to the formation of pupal stage. The pupae are pink-brown or green, saddled and with abdomen dorsally orange or yellow. When disturbed, these produce a distinct hissing sound caused by the mutual friction of abdominal segments. The larvae in particular are subject to the attack of numerous minute eggs of the hymenopteran braconid parasites.

Behaviour :

These butterflies fly gracefully atop tall trees at day time and frequent the flowers at dawn and night. They display bright yellow warning signals as protective measure against their natural enemies. The foodplants belong to the Aristolochiaceae.

Uses :

Butterflies are traditionally studied for aesthetic purpose besides for scientific study and research. In recent years, butterfly farming has been practiced by "Insect Farming and Trading agency in Papua New Guinea" In India, silk works (months)—mulberry and non-mulberry feeders are being bred over years but no concerted effort has been made for butterfly-farming which may cater to the need of three distinct areas (M.G. Morris, *in litt.* 1983), viz., (I) decorative market—already much in demand and supplied by commercial enterprenuers on the basis of collections from the wild. The specimens are used in decorative wall-plates,

mats, lamp-shades, etc., (II) Specialist market for supply to collectors, scientists and experts; the volume of trade may be discreet and low but quality and value remain high, (III) Liver-market—to meet growing demand for living butterflies for display in "Butterfly Centres" and "Zoos" In United Kingdom, several such living displays have been established during last five years (Morris, M.G. *in litt.*, 1983). As such, uses of butterflies, are manifold but so far has hardly been properly managed through conservation, breeding and utilisation programme.

Potential Advantages :

Butterfly farming has been considered as an ecologically sound activity which can replenish wild, rare populations and also discourage uncontrolled exploitation through supply of captive-bred species. The potential uses in three different areas and the outlets in USA., Canada, U.K., West Germany, Japan may prove to be a most advantageous trade. The villagers can be used through training as farmers and in the long run can earn additional income. Through a project in temperate zone of hills in Eastern and N.W. India, at least 28 Papilionid species, for which biological informations are fairly known (list enclosed), can be farmed and subsequently other groups can be brought under the purview of farming, specially the rare and beautiful ones.

Limitation :

There are several limiting factors, most of which, if not all, can be overcome with care. Technical problems of parasites, predators and disease, problems resulting out of use of pesticides by non-farmers, lack of strategy of maintenance of wild population and above all development of expertise for collections and handling, both food-plants and insects, can be envisaged as major limiting factors. However, as already mentioned, proper planning, care and training can solve most of the limitations.

Research and Conservation needs :

In India there is special need to support the effort of the Government to conserve butterfly resources through appropriate legislative measures. Research is most urgently needed to collect biological information on a number of rare, endangered and beautiful species and to utilise appropriate techniques in Butterfly farming including establishing food-plants and colonising and breeding wild caught species. A pilot project study is needed before launching any major operation over wider areas in Western Ghat, Andamans and other region. This has already been drawn up as an All India Coordinated Project, with possible involvement of Botanical Survey of India, Forest Research Institute, Zoological Survey of India, Wildlife Directorate and State Governments besides NGO bodies and individuals and with assistance from Commonwealth Institute of Entomology, London, U.K., and Institute of Terrestrial Ecology, Fuzzebook Research Station, U.K.

Family PAPILIONADAE : THE SWALLOWTAILS

Appearance and Size :

The Swallowtails have primitive or mimetic or specialised pattern. Their body is usually black, being spotted red or marked white to yellow or cream striped or tinged glossy green or with patches or bands; forewings are falcate or normal with variously oriented bars or dusted yellow, often sex-branded in males; hind wings are blue-scaled or red or orange cum blue spotted and usually tailed spatulate, petiolate, sword-or tooth-like; both wings are coloured bright metallic blue, green or otherwise, with or without male scent-organ and abdominal fold and may be curly broad to extremely ill-developed. The wing expanse varies from 60-160 mm.

Distribution

The Swallowtails comprise the Hooked or Gorgon, Kite, Red-bodied Yellow and Malabar Banded cum Black-bodied categories in 23 groups of 176 species under five genera from the East Palaearctic, Oriental and Australo-Papuan regions besides many others from elsewhere in the globe, of which 62 species are known from India. A couple of the Hooked Swallow tails or Gorgons of the genus *Meandrusa* Moore, the Common Yellow Swallowtail *Papilio machaon* Linnaeus (which is allied to the very rare Baluchi Yellow Swallowtail *P. alexanor* Esper from Baluchistan) are Himalayan in distribution; *P. machaon* shows an extreme range of geographical variations in as many as 35 subspecies including five occurring between c 650 and 5000 metres in India alone. Majority of the other elements, viz., the Swordtails, Zebras, Jays and Bluebottles amongst the Kite Swallowtails (19 spp.) of the genus *Graphium* Scopoli, the Windmills, Batwings, Clubtails and Roses amongst the Red-bodied Swallowtails (17 spp.) of the genus *Atrophaneura* Reakirt, and the Spangles, Redbreasts, Mormons, Helens, Revens, lime Butterfly and Peacocks or "Glass Papilios" amongst the Black-bodied Swallowtails (23 spp.) of the genus *Princeps* Hubner, occur from the Himalayas to the peninsular and several in the insular areas, up to a range of moderate elevations. Certain species, like the Yellow Crested Spangle *Princeps elephenor* (Doubleday), from the Assam Hills, the Malabar Banded Swallowtail *P. lioedon* (Moore), etc. from South India and the Mormon *P. mayo* (Atkinson), etc. from the Andamans are endemic, while a few, like the Lime Butterfly *P. demoleus* (Linnaeus), etc. are widely distributed besides in India.

Habitat and Environment :

The Swallowtails are generally confined to the wooded mountain districts or hilly jungles, though quite a many are found in the open plains or flowering gardens or along the moist sandy river banks or even roadside. The Common Yellow Swallowtail shows more alpine than tropical affinities.

Status :

Quite a many of the Swallowtails are locally very common in their niches during different seasons of the year, though others like the ChainSwordtail, Lesser Jay,

Spotted Jay, Spotted Zebra, a few Windmills, Malabar Banded Swallow tail, Malabar Raven, Common Banded Peacock, Malabar Banded Peacock, Yellow Crested Spangle, etc., can be categorised as "rare" to "very rare" in status.

Biology :

While the biology of the Hooked Swallowtails or Gorgons is unknown, that of other allies is rather quite variable depending on the different food plants, as already cited. Notes on biology of quite a many species have been provided by several authors including Westwood (1845), Horsefield & Moore (1857), Moore (1881, 1903), Davidson & Aitken (1890), Robson (1895), Davidson, Bell & Aitken (1897), Jordan (1909), Hannington (1910, 1911), Bell (1911, 1912), Ghosh (1914), Piele (1921, 1937), Talbot (1939) and Wynter-Blyth (1957). In general, eggs, which are spherical, smooth or minutely pitted and with white, green or blotched ground-colour, are laid singly on upper or undersurface of young or mature leaves or shoots about 1.5 to 3 metres from the ground. It is only the Malabar Banded Swallow-tail whole females oviposit in a batch of ten, one above another in a vertical row against sticks. After hatching, the tiny larvae find egg-shells as their first meal. They form silkbeds near leaf margins and later shift to mid-ribs, along which they lie stretched. They are often spiny or tuberculate or sometimes horny, with variegated warning signals and also bi-forked cylindrical and protrusible defensive head-organ, the "osmeterium", disseminating pungent odour toward off their enemies. They are voracious feeders during their earlier phases and with the approach of the advanced one, i.e., usually the 5th instar, they gradually stop feeding until they enter the quiescent stage of pupa. Before pupating, however, they wander, sometimes, too far, from the original plant, to find twigs or other suitable substrata including dead or dry sticks, as in the case of Malabar Rose (*Atrophaneura pandiyana* (Moore)), or stones, crevices and underground roots, as in the case of Spot Swordtail (*Graphium nomius* (Esper)). Pupation may be in a suspended manner by the long body-loop, with head upwards, or may be hidden by overhanging leaves. Pupae may have some form of defence, as depicted by their vigorously wriggling movement, when disturbed. Emergence of adults may take days, weeks or even months, as the case may be. Eggs and larvae are very often much susceptible to the ravages of the parasitic hymenopteran ichneumons.

Behaviour :

While the Kite Swallowtail are rapid skippers, the Red-bodied Swallowtails fly in a leisurely manner, the speed being accelerated only when the insects are frightened; other species, including the common yellow Swallowtail usually fly rapidly around hill-tops on their very powerful wings. Some members, like the Common Blue Bottle, Lime Butterfly etc., are migratory and the some like Crimson Rose, roost in a flock. The Jays, etc., are often observed to have with gregarious habit. The males in majority of the species appear to be very fond of flowers and of bathing in the sun as well, while the females of the Gorgon, *Meandrusa payeni evan* (Doubleday), is rarely found in the open. All the Zebras

and some of the Black-bodied Swallowtails strongly mimick the Danaines and the Birdwings respectively adopting their pattern against the predatory birds and lizards. The Common Windmill, on the other hand, serve as an ideal model of the day-flying moth, *Epicopis polydorus*. The Fivebar Swordtail, Glassy Bluebottle and Great Jay have seasonal dimorphism. The sexes in many species are similar in appearance but exception to this may not be ruled out. For example, the Gorgons are sexually dimorphic, while the Mormons like *Princeps memnon agenor* (Linnaeus), *P. polytes romulus* (Cramer) exhibit extreme polymorphism, either in both sexes as in the former species or only females as in the latter. The Blue Peacock, *Princeps arcturus* (Westwood), is perhaps the prettiest of all the Indian butterflies in so far as the aesthetic point of view is concerned. While majority of the adult butterflies are principally beneficial as pollinators of the Angiospermic plant world, larvae of some like the Lime Butterfly and Common Mormon are rather seriously injurious to the *Citrus* plantations. While the food plants of the Hooked Swallowtails or Gorgons are unrecorded, those of the other categories appear like very variable. Amongst the Kite Swallowtails, the Swordtails feed on Lauraceae, Annonaceae, the Zebras on Aquifoliaceae, etc., the Jays on Annonaceae/Magnoliaceae/Lauraceae and the Bluebottles on Winteraceae/Monimiaceae/Lauraceae/Hernandiaceae, etc. The Red-bodied Swallowtails live on Aristolochiaceae in particular and rarely on Combretaceae, Nepenthaceae, Piperaceae or Menospermaceae; the Common Yellow Swallowtail visit Umbelliferae and sometimes on Compositae or Rutaceae and the Malabar banded & Black-bodied Swallowtails prefer Rutaceae or very rarely Papilionaceae.

Uses, Potential Advantages, Limitations, Research and Conservation needs :

As under "The Birdwings"

TABLE - 3

Papilionid species, their host records and distribution

Scientific Name of species	Common name of species	Host-Plants	Distribution of species
FAM. PAPILIONIDAE			
1. SUB.FAM.PAPILIONINAE			
(1) Tribe LEPTOCERCINI			
Genus <i>Graphium</i>			
Scopoli			
I. <i>G.cloanthus</i> (West-wood)	GLOSSY BLUEBOTTLE	<i>Machilus odoratissima</i>	Kashmir to Assam and Burma.

TABLE - 3 (contd.)

Scientific Name of species	Common name of species	Host-Plants	Distribution of species
2. <i>G. sarpelon</i> (Linn.)	COMMON BLUEBOTTLE	<i>M. micrantha</i> <i>Geijera salcifolia</i> <i>Litsea chinensis</i> <i>Alseodaphne semicarpifolia</i> <i>Cinnamomum zeylonicum</i> <i>Camphora officinalis</i>	Kashmir to Assam and S. India, Sri Lanka and Burma.
3. <i>G. doson</i> (C. & R. Felder)	COMMON JAY	<i>Cinnamomum zeylonicum</i> <i>Polyanthia longifolia</i> <i>Anona lawii</i>	Kashmir to Assam S. India to Bengal. Sri Lanka and Burma.
4. <i>G. agamemnon</i>	TAILED JAY	<i>Saccopetalum gaultheris</i> <i>S. tomentosum</i> <i>Anona muricata</i> <i>A. squamosa</i> <i>A. discolor</i> <i>A. reticulata</i>	Sri Lanka, Burma, S. India to Saurashtra Kumaon to Assam and Burma.
5. <i>G. nomius</i> (Esper)	SPOT SWORDTAIL	<i>Polyanthia longifolia</i>	Peninsular India to S. Bihar, M.P., U.P., Simla Sikkim and Assam. Sri Lanka and Burma.
6. <i>G. antiphates</i> (Cr.)	FIVEBAR SWORDTAIL	<i>Anona lawii</i> <i>A. elegans</i> <i>A. zeylonica</i>	Peninsular India, Sikkim to Assam. Burma.

TABLE - 3 (contd.)

Scientific Name of species	Common name of species	Host-Plants	Distribution of species
7 <i>G. eurous</i> (Leech)	SIXBAR SWORDTAIL	<i>Machilus odoratissima</i>	Kashmir to Sikkim and Assam.
(2) Tribe PAPILIONINI Genus PAPILIO Linn.			
8. <i>S. P. agestor</i> (Gray)	TAWNY MIME	<i>Machilus odoratissima</i>	Western Kashmir to Sikkim, Assam and Burma.
9. <i>P. clytia</i> Linn.	COMMON MIME	<i>Litsea sebifera</i> <i>L. tomentosa</i> <i>Alseodaphne semicarpifolia</i> <i>Cinnamomum zeylonicum</i>	Kashmir to Assam and Burma. S. India. M.P., Sri Lanka.
10. <i>P. dravidarum</i> Wood-Manson	MALABAR RAVEN	<i>Glycosmis pentaphylla</i>	Western Ghats.
11. <i>P. polytes</i> Linn.	COMMON MORMON	<i>Citrus medica</i> <i>Glycosmis pentaphylla</i> <i>Zanthoxylum rhetsa</i> <i>Aegle marmos</i> <i>Murraya koenigii</i>	India, Sri Lanka, Burma.
12. <i>P. helenus</i> Linn.	RED HEN	<i>Citrus medica</i> <i>Glycosmis pentaphylla</i> <i>Zanthoxylum rhetsa</i> <i>Zanthoxylum rhetsa</i>	Western Ghats, Nilgiris, Palnis, Shevoroyoys, Coorg, Bangalore, Massoorie to Assam. Sri Lanka.

TABLE - 3 (contd.)

Scientific Name of species	Common name of species	Host-Plants	Distribution of species
13. <i>P. polymnestor</i> (Cr.)	BLUE MORMON	<i>Atalantia</i> <i>Citrus decumana</i> <i>Glycosmis pentaphylla</i>	S. India, M. P., S. Bihar, Bengal, W. Ghats, Bombay, Sikkim. Sri Lanka.
14. <i>P. memnon</i> Linn.	GREAT MORMON	<i>Citrus decumana</i>	Sikkim to Assam.
15. <i>P. protenor</i> Cr.	SPANGLE	<i>Zanthoxylon alatum</i>	Kashmir to Sikkim, Assam and Burma.
16. <i>P. liomedon</i> Moore	MALABAR BANDED SWALLOW-TAIL	<i>Acronychia laurifolia</i>	Western Ghats.
17. <i>P. demoleus</i>	LIME BUTTERFLY	<i>Citrus decumana</i> <i>Glycosmis pentaphylla</i> <i>Chloroxylon swietenia</i> <i>Ruta graveolus</i> <i>Aegle marmelos</i>	India, Sri Lanka, Burma.
18. <i>P. machaon</i> Linn.		<i>Daccus</i> sp. <i>Foeniculum vulgare</i> <i>Heracleum</i> sp.	Baluchistan, N.W.F.P., Chitral to Sikkim, Assam. and N. Burma.
19. <i>P. polyctor</i> Boisduval	COMMON PEACOCK	<i>Zanthaxylon alatum</i>	Chitral to Sikkim, Assam and Burma.
20. <i>P. paris</i> Linn.	PARIS PEACOCK	<i>Eyodia roxburghiana</i>	S. India, Orissa, Kashmir to Assam and Burma.

TABLE - 3 (contd.)

Scientific Name of species	Common name of species	Host-Plants	Distribution of species
21. <i>P. crino</i> Fabr.	COMMON BANDED PEACOCK	<i>Chloraxylon swietenia</i>	Parts of S. India, Bengal, Sri Lanka.
22. <i>P. buddha</i> Westwood	MALABAR BANDED PEACOCK	<i>Zanthoxylon rhetsa</i>	Western Ghats.
Genus PARIDES Hubner			
23. <i>Parides philoxenus</i> (Gray)	COMMON WINDMILL	<i>Nepenthes</i>	Kashmir to Assam and Burma.
24. <i>Parides dasarada</i> (Moore)	GREAT WINDMILL	<i>Aristolochia indica</i>	Kashmir to Assam and Burma.
Genus PACHLIOPTA Reakirt			
25. <i>Pachilopta hector</i> (Linn.)	CRIMSON ROSE	<i>Aristolochia Indica</i>	Bengal, Bihar, Orissa and S. India.
26. <i>P. jophon</i>	MALABAR (OR CEYLON) ROSE	<i>Baragantia wallichii</i>	Sri Lanka, Western Ghats.
27. <i>P. aristolochiae</i> (Fabr.)	COMMON ROSE	<i>Aristolochiae indica</i>	Sikkim to Orissa, S. India, Sri Lanka, Burma.
Genus TROIDES Hubner			
28. <i>Troides helena</i> (Linn.)	COMMON BIRDWING	<i>Bragantia wallichii</i>	Sri Lank.

TABLE - 4
HOST-WISE RECORDS OF THE PAPILIONIDAE

Host-Plants Scientific Names	Butterflies Scientific Names	Distribution Range of Butterflies
1. <i>Aristolochia indica</i>	<i>Troides helena</i> (Linn.)	S. India, Sikkim to Assam to Burma, Sri Lanka.
	<i>Pachliopta hector</i> (Linn.)	Bengal, S. Bihar, Orissa and S. India.
	<i>P. aristolochiae</i> (Fabr.)	India, Sri Lanka and Burma.
	<i>Parides dasarada</i> (Moore)	Kashmir to Assam and Burma.
2. <i>Bragantia wallichii</i>	<i>Troides helena</i> (Linn.)	
	<i>Pachliopta jophon</i> (Grey)	Western Ghats, Sri Lanka.
	<i>Parides philoxenus</i> (Gray)	Kashmir to Assam & Burma.
3. <i>Nepenthes</i> '	<i>Parides philoxenus</i> (Gray)	
4. <i>Machilus odoratissima</i>	<i>Papilio agestor</i> (Gray)	Kashmir to Assam Burma.
	<i>Graphium cloanthus</i> Westw.	-do-
	<i>G.eurous</i> (Leech)	Kashmir to Assam.
	<i>G. sarpedon</i> (Linn.)	S. India to Assam, Sri Lanka.
5. <i>M. micrantha</i>	<i>G. sarpedon</i> (Linn.)	
6. <i>Geijera salcifolia</i>	<i>G. sarpedon</i> (Linn.)	
7. <i>Litsea chinensis</i>	<i>G. sarpedon</i> (Linn.)	
8. <i>Litsea sebifera</i>	<i>Papilio clytia</i> (Linn)	Kashmir to Assam & Burma. Bombay, M.P., S. India.
		Sri Lanka
9. <i>Litsea tomentosa</i> (<i>Tetranthera apetala</i>)	<i>Papilio clytia</i> Linn.	
10. <i>Alseodaphne semicarpifolia</i>	<i>Papilio clytia</i> Linn.	
	<i>Graphium sarpedon</i> (Linn.)	

TABLE - 4 (contd.)

Host-Plants Scientific Names	Butterflies Scientific Names	Distribution Range of Butterflies
11. <i>Cinnamomum zeylonicum</i>	<i>Graphium doson</i> (C. & R. Felder)	Kashmir to Assam, S. India to Bengal, Sri Lanka, Burma.
	<i>G. sarpedon</i> (Linn.)	
	<i>Papilio clytia</i> (Linn.)	
12. <i>Atalantia</i> sp.	<i>Papilio polymnestor</i> (Cr.)	Sri Lanka, S. India, M.P., S. Bihar, Bengal, W. Ghats, Bombay, Sikkim.
13. <i>Citrus decumana</i>	<i>Papilio polymnestor</i> (Cr.)	
	<i>P. memnon</i> Linn.	Sikkim to Assam & Bengal, Burma.
	<i>P. demoleus</i> Linn.	W. India, Sri Lanka, Burma.
14. <i>C. medica</i>	<i>P. helenus</i> Linn.	W. Ghats, Niligiris, Palnis, Shevoroy's Coorg, Bangalore, Mussoorie to Assam, Sri Lanka.
	<i>P. polytes</i> Linn.	India, Sri Lanka, Burma.
15. <i>Glycosmis pentaphylla</i>	<i>Papilio polymnestor</i> (Cr.)	
	<i>P. dravidarum</i> W.M.	Western Ghats.
	<i>P. helenus</i> Linn.	
	<i>P. demoleus</i> Linn.	
	<i>P. polytes</i> Linn.	
16. <i>Zanthaxylum rhetsa</i>	<i>P. polytes</i> Linn.	
	<i>P. helenus</i> Linn.	
	<i>P. buddha</i> Westwood	Western Ghats.
17. <i>Z. alatum</i>	<i>P. protenor</i> Cr.	Kashmir to Sikkim, Assam and Burma.
	<i>P. polyctor</i> Boisduval	Chitral to Sikkim, Assam and Burma.

TABLE - 4 (Contd.)

Host-Plants Scientific Names	Butterflies Scientific Names	Distribution Range of Butterflies
18. <i>Limonia acidissima</i>	<i>P. polyctor</i> Boisduval	
19. <i>Evodia roxburghiana</i>	<i>P. paris</i> Linn	S. India, Orissa, Kumaon to Sikkim, Assam & Burma.
20. <i>Chloraxylon swietenia</i>	<i>P. crino</i> Fabr. <i>P. demoleus</i> Linn.	Sri Lanka. Parts of S. India, Bengal.
21. <i>Ruta graveolus</i>	<i>P. demoleus</i> Linn.	
22. <i>Aegle marmelos</i>	<i>P. demoleus</i> Linn. <i>P. polytes</i> Linn.	
23. <i>Murraya koenigii</i>	<i>P. demoleus</i> Linn. <i>P. polytes</i>	
24. <i>Acronychia laurifolia</i>	<i>P. ilomedon</i> Moore	Western Ghats.
25. <i>Dacus</i> sp.	<i>P. machaon</i> Linn	Baluchistan, N.W.F. P., Chitral to Sikkim, Assam and N. Burma.
26. <i>Foeniculum vulgare</i>		
27. <i>Heracleum</i> sp.		
28. <i>Saccopstalum gaultheria</i>	<i>Graphium agamemnon</i> (Linn.)	Sri Lanka, S. India to Saurashtra Kum- aon to Assam and Burma.
29. <i>S. tomentosum</i>	<i>G. aganmemnon</i> (Linn.)	
30. <i>Polyanthia longifolia</i>	<i>G. nomius</i> (Esper) <i>G. doson</i> (C. & R. Felder)	Peninsular India to S. Bihar, M.P., U.P., Simla to Assam and Burma, Sri Lanka.

TABLE - 4 (Concl'd.)

Host-Plants Scientific Names	Butterflies Scientific Names	Distribution Range of Butterflies
31. <i>Anona lawii</i>	<i>G. dosen</i> (C. & R. Felder)	Sri Lanka, S. India to Bengal Kumaon to Assam & Burma.
	<i>G. antipathes</i> (Cr.)	
32. <i>A. elegans</i>	<i>G. antiphates</i> (Cr.)	Sikkim to Assam & Burma.
33. <i>A. zeylonica</i>		
34. <i>A. muricata</i>		
35. <i>A. squamosa</i>	<i>G. agamemnon</i>	
36. <i>A. discolor</i>		
37. <i>A. reticulata</i>		
38. <i>Camphora officinalis</i>		

Distribution of 28 spp.
given above.

Family DANAIIDAE : THE TREE NYMPHS

Appearance and Size :

The Tree Nymphs have long body and feeble fore legs in both males and females. Wings of tree nymphs are conspicuously semitransparent, with black and white pattern, of which the fore wings may be narrow or broad and the hind wings may be without androconina in males the latter only have four abdominal hairpencils of equal length. The wing expanse varies from 120 to 140 mm for the species found in India.

Distribution :

Represented by 11 species in the Oriental and Australo-Papuan regions, the Tree Nymphs occur endemically in India only in case of a couple of species, viz., *Idea agamarschana* (C & R Felder) and *I. malabarica* (Moore), amongst a total of four of the *lynceus* group. Out of three subspecies of the *agamarschana*, only

one is known from the Andamans, while both the subspecies of *malabarica* occur in South India, up to an average of c1,100 metres.

Habitat and Environment :

The tree Nymphs are essentially the butterflies of the woods in heavy rainfall area particularly along the costal areas where they may be seen to flutter rather awkwardly.

Status :

The tree Nymphs are locally common in India.

Biology :

Observations on the biology of at least one Indian species of the Tree Nymphs, i.e., *Idea malabarica*, [Macpherson (1887), Moore (1890) and Talbot(1947)] reveal that the eggs are white, oval and hexagonally indented in longitudinal rows. These are laid singly on the underside of a leaf where the young transparent pale yellow larvae with minute fleshy tentacles, are hatched out within a week. They eat holes in the centre of the leaf instead of from its margin. When mature, the larvae hide on the underside of leaf itself. They attain full size from 20-25 days, when their body is mostly white, smooth and glossy with long black tentacles. Pupae are initially golden yellow with metallic patches but after 12-13 days, they turn black and in about 24 hours give rise to the emergence of adults.

Behaviour :

Tree nymphs often resemble pieces of paper when on the wing, amidst the nature's dark background. They are usually gregarious and fond of following the course of rivers, floating up and down in the air very slowly and setting in the late afternoon mostly in pair on projecting twigs. The members exhibit neither sexual nor seasonal dimorphism. The larval food plants for the Indian species are unrecorded.

Uses, Potential advantages, Limitations, Research and Conservation needs :

As under "The Birdwings"

Family HESPERIIDAE : THE SKIPPERS

Appearance and Size :

The Skippers are normally very awkward looking but stout and strong butterflies. Their head appear quite broad, antennae wide apart at base and usually hooked at tip. Eyes are large and sometimes blood-red. Wings are dark-coloured, being spotted or banded semi-transparent white or yellow on dark-brown background and rarely beautifully orange or metallic green. Their size is generally small, with wing expanse varying from 20 to 75 mm.

Distribution :

The Skippers are represented by the Awls, Awlets, Awlkings, Flats, Angles, Bobs, Aces, Redeyes, Darts, Dartlets, Hoppers, Swifts, Wights, Demons, Tree Flitters, Coons, etc., in as many as 750 species of 13 generic groups in the Palaearctic and tropical belts of both the old and New World. Amongst a total of about 600 species in 10 generic groups known from the Oriental region, 300 species and their subspecies, belonging to 38 genera occur in India. Majority inhabit the north-eastern Himalaya, while others are found in the north-western Himalaya, almost throughout the peninsular and also the insular areas including the Andamans and Nicobars. The maximum known altitude attained by some of the species is 3,000 meters.

Habitat and Environment :

The Skippers are primarily inhabitants of forest, some species live in the hilly region up to a moderate elevation, some are found in the open plains while others exclusively keep to the grasslands.

Status :

Majority of the Skippers are locally common in their niches, while a few like the Orange-Tail Awl, *Bibasis sena* (Moore), etc., is known to be rare.

Biology :

As noted by certain authors including Winter-Blyth (1957), eggs are usually dome shaped, smooth or longitudinally ridged and red or white. These are laid in small number on the underside or apex of leaves. The larvae are barrel-shaped, naked or just clothed with short hairs and green or otherwise conspicuously coloured. They live in cells made of leaves and feed generally at night. Pupae are mostly naked, long and tapering, moth-like and suspended by tail and body-band with head downwards. They also occur in cells, either of larvae or more normally in those freshly constructed by themselves on the original entirely different plant.

Behaviour :

Many Skippers are crepuscular to nocturnal in habit, like the Golden Angle, *Caprona ransonnettil* (Felder), etc., while others are diurnal, of which a good number fly amidst the shady forests or in the open during cloudy weather and a few like the Grassdarts of the genus *Taractrocera* Butler, remain on wing in bright sunshine, Flight may be very slow in hovering style near the grasses, as in the case of small Grassdarts and Hoppers or quite rapid, powerful and often illusive, as in the case of the Awls. Majority are fond of sucking nectar from flowers and also of basking in the sun while others, like the flats and Aces, prefer damp patches and still others, like the Awlkings and Palm Bobs, are attracted to birds droppings. The insects settle on upper or undersurface of free/ or bush-leaves, or on the

ground. or amidst boulders or other hidden places, with wings spread flat, or closed erect, or held roof like over the abdomen like the moths. Sexes, apart from the secondary sexual features, are all alike in facies. The larval food-plants belong to Dicotyledons for the Awns, Awlets, Awlins, Flats and Angles and to the Monocotyledons for the rest.

Uses, Potential advantages, Limitations, Research and Conservation needs :

As under "The Birdwings"

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