CHAPTER ONE

INTRODUCTION

Birds originated in Mesozoic times from reptiles more than a hundred million years ago and slowly evolved into the systematic group as we recognise it today. They gradually dispersed as evolved into the geographic and ecological patterns they now present. The birds live a predominantly terrestrial or aquatic existence, and are able to lead a very active life in widely differing habitats.

Geographically birds are found on the most remote oceanic islands, in dry continental regions and in tropical and temperate areas where water is abundant. Indeed, there is scarcely a square mile of the earth's surface that some birds do not occupy or travel across, except to the interior of the Antarctic continent. Without them, much of our world would seem ominously lifeless and silent.

Of all the wild creatures with which we share this planet, birds are out most conspicuous, colourful and noisy neighbours. There are many things about birds that appeal to mankind. Among these are the aesthetic attraction of their colourful plumages, their welcome spring time songs, their fascinating habits, their strange behaviour and the fact that most are of great importance for science and of great value to mankind as food, as sport, as aesthetic sense of man, as cross pollinating and seed dispersing agents, as scavengers, as message-bearer and also as biological control of pest.

Birds and man have affected each other for thousands of years. The stone age cave drawings of birds in France,

Spain, Africa and elsewhere reveal that man was interested in birds at least twenty-two thousands years ago and probably long before that. Birds are frequent themes in religion, folklore and customs. Man has hunted, tamed and worshiped birds for millenia. In ancient civilization birds were symbols often raised to the rank of dieties.

The strongest diety of the Egyptian pantheon was 'Hours' a falcon. Sacred Ibis Threskiornis aethiopica remains as testinony to a bird now practically exterminated from land where it once was worshiped. The Babylonians and Hittets built temples to eagles. The ancient Egyptians also worshiped scavanger birds like Neophron percnopterus which is commonly called as Egyptian valture or "Pharoha's Chicken". In Indian mythology the 'Jatau' in Ramayana was an eagle according to some where as others considered the brave character as a vulture.

Birds still remain as evocative power in the form of symbols in many ways, such as seals, national emblems and postage stamps. Archaeological investigations show that prehistoric Red Indians made frequent use of birds for food, wearing appeal and ornaments. Among domesticated birds, hen, duck, geese and turkey are important economically as food to man. The Jungle fowl Gallus gallus is presumably domesticated by primitive people. There is evidence that the species was domisticated in China about 1500 B.C. and they have been kept in India as much as 1500 years before the early Neolithic man in Europe kept chickens.

Birds play an important part in many fundamental scientific discoveries. They are prefered material for certain specialized research, while many disciplines have benefited widely from conclusions arising out of their study. Embryology, endocrinology, ecology, ethology, social parasitism and the study of migration and of speciation have drawn largely upcn work on birds. These results have then been successfully applied to other zoological groups and have been accepted as general biological rules.

Their plumage react very obviously to hormonal conditions, faithfully interpreting the physiological state of subject and allowing measurements of the effects. The effect of light and of variations in photoperiod were first demonstrated on birds, before being confirmed on other animals.

Ecology also owes much to the study of birds. Their adaptations in general, and various types of birds in particular, provide a wide field for investigation. The fundamental concept of territory was developed for birds and then extended to other animals by comparative studies. Birds have long been used for studies on evolution.

Avifaunas have become accessible to scientific inquiry as a consequence of improved transportation and facilities in many parts of the world. Examples that come readily to mind include the use of radar in visualizing migration, of telemetry in studying the physiology of flying birds and of audio-spectrograph in analyzing bird sounds.

Because of the abundance of the basic emperical information on distribution, habitat requirements, life-cycles, breeding habits etc, it has been relatively easier to use birds instead of other animals in the study of the general aspects of ethology, ecology, population biology, evolutionary biology, physiological ecology and other fields of biology of contemporary interest. Model systems based on birds have played a prominent role in the development of these fields.

There are about 8600 living species of birds currently known in the world out of which about 2060 species of birds have been recorded from the Indian sub continent (Ripley, 1982).

In their relation to man all birds are divided into five groups ; first and foremost of which are those birds which serve man by destroying obnoxious insects. The great economic value to birds in the supression of destructive insects and other pests has long been realised. The second group of birds which serve man by destroying the seeds of weeds, waste grains, thus often been cited as farmer's friends, but of course the actual economic gain to farmers by the reduction of weed seeds is impossible to measure; the third group of birds consists of carnivores that get a large part of their food, from small mammals and assist man in his struggle to produce food by destroying small rodents, grasshoppers, ground squirrels. The 4th group of bird is game birds known to man from different habitats and are being

used for recreation and subsistance, and fifth group is of Scavenger bird which are directly and indirectly useful to man.

All over the world there are different species of birds which specialize in scavenging, from the ivory gulls that feed on the remains of polar bear's kills in the Arctic to the giant peterels, skuas and penguins in the Antarctic. The scavengers render an efficient service to mankind (Allen, 1961).

Best known of the carrion-feeders are the vultures or buzzards. Vultures clean up all carrion left exposed from rat to elephant. A number of raptors include carrion as a major component of their diet. Kites are especially well known as scavengers and have an important role in clearning up refuse in parts of Towns and Villages where waste disposal in human settlements is inefficient.

A scavenger makes use of a source of food that is normally limited and scattered and is mainly the result of human activities. The ability to roam widely and survey a large area for the chance of a meal is therefore a necessary part of a true scanvenger's way of life. The kites and vultures are most adapt to this.

These days birds of different species are involved in collision with aircrafts at different altitudes and they range in size from smaller than a sparrow to larger than a vulture. However, the problem bird varies from country to country and often from one aerodrome to another. Most of the North

American and European air-ports have gull as the number one problem birds.

Birds are known to cause slight to severe damage to aircraft and occupants through accidental encounters. Bird hazzards have become a significant problem to aviation in modern times throughout the world. With the advent of faster planes with lesser preceding noise, bird strikes have increased. This has resulted in increased hazzard to safe operation of aircraft besides heavy financial losses and fatal accidents since 1910. In 1960, a turbine engined aircraft crashed at Boston, Masschusetts, USA after a bird strike by starlings, over 60 lives were lost (Solman 1966).

In India bird hazards have caused severe damage to aviation industry in the recent years. The bird hazard record from 1979 to 1982 reveals that in all there were 868 reports of bird strikes of different magnitudes. Between 1980-82 bird strikes have taken a toll of as many as 6 lives and 12 defence aircraft, causing a great damage of highly skilled manpower and expensive sophisticated equipment. The following table gives an idea about the severity of damage due to the bird strikes in the Indian aviation.

	Type of Aircraft	
Year	Civil	Military
1979	160	not available
1980	174	56
1981	186	50
1982	185	57

Data gathered from DGCA, Air Head Quarters and Commercial airlines (Ali and Grubh, 1984).

Apart from total write-off of aircraft there have also been heavy financial losses through partial damages to aircrafts besides the high costs involved in aborting and rescheduling of passanger flights and the passanger inconvenience. Although 12 species of birds have been found responsible in the bird strike incidences in the country (Ali and Grubh, 1984). The vultures and kites continue to dominate amounting to 75 % of the bird species reported to have been involved in bird strikes (i.e. Pariah kite 36 % and white back and scavanger Vultures 39 %). According to the Director General of Civil Aviation bird strike incidents are on increase in the country. This is attributed to the poor hygenic conditions in the society and inefficient disposal of waste in the cities. Therefore the studies on the scavanger species of birds have tremendous applied significance in the recent years.

Complaints of birds of prey and raptors including eagles hawks, vulture and falcons have been received from all parts of the country regarding the major damage caused by them to the aircrafts.

The Birds of prey constitute the end of the food chain, therefore along with carnivore among mammals, they are highly vulnerable to adverse factors affecting their prey species. These birds are the outward symbol of a healthy biological environment and their catastrophic decrease every where is thus a cause for grave concern to conservationists and the general public alike. However, there is no doubt that many of the

species are rapidly disappearing from the surrounding (Ali, 1978).

Many countries and aircraft manufacturers have been trying to devise effective measures to redue the bird hazards. The Aeronautics Research and Development Board has been making concerted efforts to promote coordinated Research programmes and find ways and means to reduce bird strikes. Many ornithologists and ethologists are trying to study the various aspects of peculiar behaviour of these bird species particularly roosting, resting and feeding.

There has always been considerable speculation, especially among layman, about where birds go at night and where and how birds spend their night. A "roost" may be defined simply as a place where a bird rests during a long inactive period and a "communal roost", is the one where many birds converge which have been feeding solitarily or in flocks which are not of constant composition. The joint resting place of a single coherent group such as the holders of a group territory or a family party, is excluded by this defination. Many species which are diurnally active assemble for the night in communal roosts, and a few nocturnal feeders do so during the day.

A number of bird species of diverse orders and families and with a diversity of habitats roost together for atleast a part of the year. In a few cases such social roosting may be a simple consequences of the paucity of suitable roosting sites forcing the birds to crowd together. However, in a

majority of cases of communal roosting the birds associate together through some social attraction and do not disperse even if alternative roosting sites are available. Some of these social groups merely comprise feeding or migratory flocks which remain together outside the roosting time as well. Leaving aside these cases, there are a number of bird species which voluntarily form new social groups specifically at the time of roosting.

A number of bird species which roost communally clearly includes species with very diverse habits. It includes birds of marshes and Jheels, open grasslands, cultivation, scrub and forests; birds which are purely graminivorous, insectivorous as well as omnivorous, predators and scavengers. Not only do birds of such diverse habits share in common the habit of communal roosting, but birds with very similar habits may differ from each other in this regard. The proportion of birds of more open terrestrial habitats such as grass lands, scrubland and cultivation is markedly greater and the portion of bird species of more wooded habitats markedly smaller amongst the communal roosting birds (Gadgil & Ali, 1975).

There is no obvious correlation between general food-type and roosting habit, examples may be found of communally and solitarily roosting insect, fruit, seed, meat, fish and carrion-eaters. Nor is there any restriction of communal roosting behaviour to particular habitats or regions of the world. There is, however, a correlation between roosting habit and feeding dispersion. Species which feed in flocks upon an

unevenly distributed food supply, tend to roost communally, and birds which feed solitarily generally roost alone. Some flock feeders roost solitarily or some solitary feeders with communal roost (Ward and Zahavi, 1973).

Many species of birds roost communally all the year round and breed in colonies; some use communal roost only in the non-breeding season and bread solitarily; while others probably the majority are solitary at all times. Some species have communal roosts which rarely include members of another species, but others frequently form mixed species roosts or mixed roost.

Studies on roosting behaviour in different birds are carried out by many workers namely Moffat (1931), Brown (1946), Rudebeak (1955), Meinertzhagen (1956), Ripley (1961), Thompson & Coutlee (1963), Spencer (1966), Schreiber (1967), Zahavi (1971), Siegfried (1972), Birkhead (1973), Broom et al. (1976), Feare (1976), Swingland (1976), Gyllin et al. (1977), Good (1979), Loman & Tamm (1980) and Weatherhead (1981). Gadgil and Ali (1975) have given a detail account on communal roosting in Indian birds.

At least the fiftynine species of common Indian birds definitely form communal roosts in groups larger than feeding or migratory flocks without being forced to crowd together by a paucity of roosting sites. Thirty-five out of them form communal roosts constantly throughout the year, another nine are migrants that roost communally during winter in India, and the rest of the species roost in a communal fashion only in

the non-breeding season. Twenty species form small roosts of several individuals, twenty medium sized roosts of tens of individuals, nine large roosts with hundreds of individuals and ten enormous roosts of thousands of individuals of the given species. Twentysix of these form mixed communal roosts of more than one species and birds of similar and dissimilar feeding habits are almost equally represented amongst the associates at a mixed communal roosts. All of the species that form roosts of thousands of individuals have some other species roosting in company with them. Birds of open habitats; and birds which feed in flocks represented to a much greater extent amongst communal roosters in comparison with the bird fauna as a whole, while birds which feed in pairs are represented very poorly. The Pariah kite Milvus migrans and the whitebacked vulture Gyps bengalensis are both known to be roosting species. Usually the kite roosts are mixed but the vulture roosts are normally pure.

The communal activities associated with sleep have been popular subjects for research for many years. However ornithologists have been concerned primarily with discriptions and times of events. Previous studies of avian roosting have considered such aspects as the synchrony of movements (Hamilton et al., 1967; Hamilton & Gilbert, 1969), group size on the timing of movements to and from the roost (Broom et al., 1976; Greig-Smith, 1982). Studies on the behaviour of birds entering and leaving communal roosts have concentrated either on the numbers of individuals involved (e.g. Ward, 1965; Siegfried,1971;

Broom et al., 1976; de Visscher, 1978) or on the timing of roosting flights relative to sunrise and sunset (Wynne, 1929; Davis, 1955; Hubalek, 1978). This daily regularity of crepuscular roosting flights of many bird species is probably the most easily witnessed expression of such a rhythmicity (Wynne Edwards, 1962). This variation in daily roosting time is not random but rather seems to occur in response to concurrent variations in physical conditions of the environment. The studies on effect of different physical factors and the roosting time has been carried out by many workers.

The effect of light intensity on timing of movements to and the roost is most studied parameter (Seibert, 1951; Krantz and Gauthreaux, 1975; Swingland, 1976). Many believe that light is the most important proximate factor influencing roosting in birds (e.g. Hinde, 1952; Nice, 1935; Elliot, 1932). Some infact have claimed no correlation between intensity of light and roosting (Radford, 1955; Shaver & Walker, 1931) but Davis & Lussenhop (1970) claimed to be the first to demonstrate statistically a relation between times and intensity. Counsilman (1974) also showed significant correlation of light intensity and arrival of half birds at the roost. The effect of another light-related factor, day-length is also well studied (Martin & Haugen, 1960; Schreiber, 1967; Brodie, 1980). However, less is known, about the effect of environmental factor not directly related to light.

One of the weather factors, is temperature, which is known to affect the general behaviour of birds living under

harsh winter conditions (Terres, 1982). The effect of temperature on the timing of movements is carried out by Potts (1967). To cope with cold, birds can conceivably alter their total activity time, also affect the timing of roosting flights (Morse, 1980). During cold weather late arrivals at the roost and early departure has been reported by Brooks (1968) and Pohl (1971). But late departures, early arrivals and general inactivity at the roost under low temperatures have been reported in a number of studies (Jumber, 1956; Raveling et al., 1972; Kessel, 1976; Pitts, 1976; Brodsky & Weatherhead, 1984). Unfortunately, however, some of these studies failed to separate the effect of temperature from that of concurrent changes in other physical factors, whether the effect of temperature would persist under more natural conditions is not well known.

Wynne-Edwards (1962) made extensive observations on the behaviour of birds prior to their occupation of communal roosts. He classified this behaviour with others as epideictic display, suggesting for it a function in the regulation of population size in the roost in relation to local food supply.

However, the spectacular and often noisy display flights of preroosting assemblies of communally roosting birds, have been described for several species (Gurr, 1968; Swingland, 1976; Post, 1982). The birds received a disproportionate amount of attention from biologists studying this behaviour. There has been no adequate explanation of the function of the remarkable behaviour involved in the pre-roost gatherings which

occur among many birds which roost communally. The biological significance of the communal sleeping habit itself has been considered in detail for few bird species (e.g. Wynne-Edwards, 1929, 1962; Ward, 1965; Crook , 1965; Zahavi, 1971a; Gadgil, 1972).

However, the adaptive significance of avian communal roosting behaviour has been the subject of considerable speculation. Foremost among the ideas put forth to explain communal roosting are the predation avoidance (Lack, 1968) and information centre (Ward and Zahavi, 1973) hypothesis. This information hypothesis is built on the reasonable premise that on any given day not all roost members will be equally successful at foraging. Recent evidence from the study by Weatherhead and Greenwood (1981), indicates that this assymetries in forageing ability exist among roost members.

There is a strong evidence that roosts are not amorphous mixtures of birds but rather are structured assemblages. In a study of roosting roots, (Corvus frugilegus), Swingland (1977) found that older dominant birds usually occupied position higher in trees than younger subordinate birds, although these positions are thermally suboptimal.

Proponents of both hypotheses are in agreement with Crook's (1965) assertion that communal roosts are unlikely to provide the participants a single benefit. They also assume, however, that of the benefits derived, one is the driving force behind the evolution of roosting behaviour while all others are secondarily derived.

Plate 1 : Closer look of the Pariah kite,
Milvus migrans govinda (Beddaert).

Some of the workers who have done work abroad on various aspects of ecology of Black kite (Milvus migrans) are Meyburg (1968, 1971), Thollay (1976), Brooke (1974), Rome and Giuseppe (1978), Burton (1978), Mirabelli (1978), Nore (1979), Fiuczynski (1979), Detlef (1983), Petretti (1983), Brandl et al. (1985), Grimm (1985), and Sylven and Magnus (1987).

Studies on the ecology of other scavengers like white-backed vulture (Gyps bengalensis) and Scavenger vultures Neophron perenopterus have been carried out by Dendaletche (1970), Szcrepski (1974), Congost (1974), Smeenk (1976), Houston (1976), Mundy (1979), Michev et al. (1982), Bergier (1982), Petretti (1983), Genero (1986) and Richardson (1986).

In India very scanty work has been done on the ecology and the roosting habits of scavenger birds like Pariah kite Milvus migrans govinda, whitebacked vulture Gyps bengalensis and scavanger vulture Nephron percnopterus. Some of the workers who have contributed in the knowledge of roosting and feeding behaviour of these scavenger species in India are Dover et al. (1920), Ali (1926), Whistler (1935), Ali and Ripley (1968), Gallushin (1971), Grubh (1973, 74, 78) and Mahabal and Bastawade (1985).

The Pariah kite Milvus migrans is one of the commoner birds of prey in India. Several authors have given details of the nest, clutch size and measurements of the eggs (Donald, 1918; Ali, 1926; Baker, 1928; Dharamkumarsingji, 1954; Meyburg, 1968, 1971). But in spite of its abundance and importance, the species has not been thoroughly studied in India. In Delhi

most of studies done are on breeding biology by Gallushin (1971), Desai & Malhotra (1978).

Considering the importance of the Scavanger birds the behavioural studies particularly roosting, feeding and nesting in Pariah kite Milvus migrans, whitebacked Vulture Gyps bengalensis and Scavenger Vulture Neophron perenoptrus were undertaken in present investigations. Three important applied factors were kept in mind while designing the study.

1) Kolhapur being a rapidly growing industrial city has expanding municipal corporation limits to including many peripheral settlements. There is an accute stress on the waste disphosal system and at many sites garbage dumps are not cleared regularly. These sites invite large populations of scavanger birds from the neighbouring areas to the city. Due to the increased demand of meat at many places in the city goats are slaughtered for meat. Also there is a new slaughter house started on the outskirts of the city. Kolhapur is well known for its 'Chappals' and there are certain sites where the cattle and buffalo skins are dried up which provide feeding grounds for the scavenger birds.
2) Kolhapur city was also known for the excellent tree growth on the roads and many of its old and beautiful gardens since the early princly state hood days. With the road widening activities and new constructions a large number of excellent huge trees have been cut down in the recent years. This appears to have made significant impact on the

Plate 2 : Typical pre-roosting behaviour of kites in Kolhapur city.

roosting and nesting sites of birds in the city.

3) The old airstrip named 'Ujwala' is being converted into a regular airdrome which is on the outskirts of the city and is in straight line from the new slaughter house. It could cause bird strikes as in the case of many other airstrips in different cities.

There are no earlier reports on scavanger birds from Kolhapur City. Therefore considering the scope of the undertaken research and funds, other resources and time available it was decided to concentrate on Pariah kite and collect marginal necessary information on whitebacked and scanvenger vultures from Kolhapur city.

The monthly fluctuations in the populations of Pariah kite and whitebacked vulture were studied in detail. During the studies mainly pre-roosting, roosting, nesting and feeding activities were studied for all the possible roosts from the city from November 1986 till March 1988 at fortnightly intervals. The studies were concentrated on timings of arrival, roosting pattern and movements in relation to the sunset time, day length at different roosts. The effects of physical factors like air temperature, humidity, hours of sunshine, wind speed etc. on the period of assembly of the bird species were investigated.

The data thus generated was analysed on computer for correlation studies and is presented graphically and with the help of Scatterplots. The undertaken studies are expected to give knowledge for the first time, about the various activities, behaviour and population ecology of the scavenger birds, particularly Pariah kite Milvus migrans from Kolhapur city.