

**ECOLOGICAL STUDIES OF
WETLAND BIRDS IN KUTTANAD-
CENTRAL KERALA**

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BY

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TO THE SACRED MEMORY OF

MY BELOVED PARENTS

CERTIFICATE

The researches embodied in this dissertation entitled
ECOLOGICAL STUDIES OF WETLAND BIRDS IN
KUTTANAD-CENTRAL KERALA *were conducted by*
Mr. Babukutty Mathew under my guidance and supervision.
It is hereby certified that the thesis submitted is a bona fide
record of research done by the candidate and that the thesis has
not previously formed the basis for the award to the candidate of
any Degree, Diploma, Associateship, Fellowship or other similar
title of any other University or Society.


Dr. V. J. ZACHARIAS

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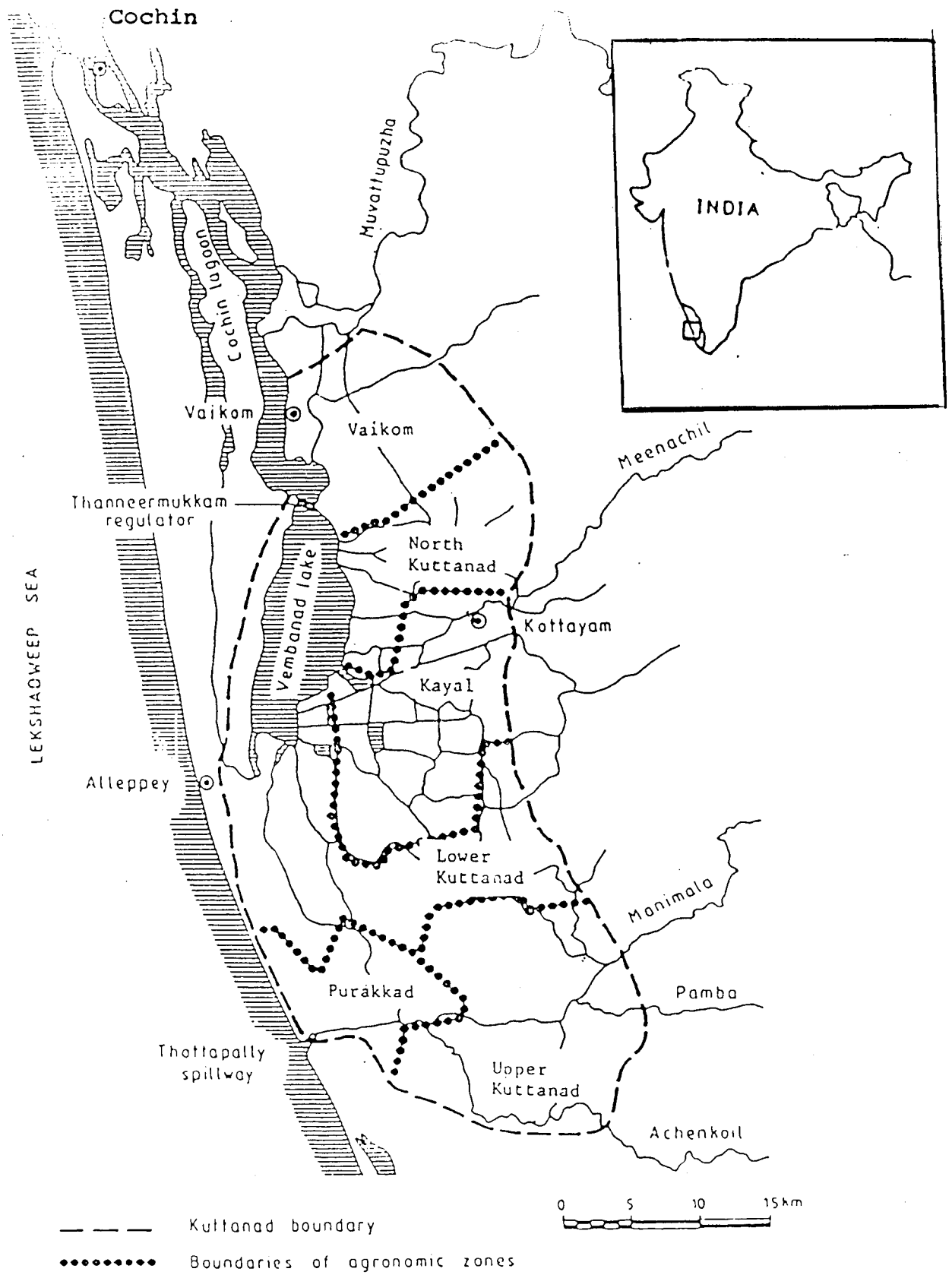
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MAP OF STUDY AREA

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Chapter 1

INTRODUCTION AND REVIEW OF LITERATURE

1.1. Introduction

Kerala, in South-West India, has an extensive coastal line, a large number of inland water bodies, swampy low-lands and rivers which are directly or indirectly connected to the sea and wet land habitats such as jheels, marshes and wet meadows have been developed in association with water bodies. Despite the human efforts to tamper with the natural wet lands for agriculture, navigation and other purposes, wetlands continue to be a major life supporting system of Kerala. Man has modified extensive areas of wetland habitats into paddy fields which also support a variety of fauna and flora.

Kuttanad of Central Kerala is a large wetland habitat comprising of paddy fields, marshes, lakes and rivers. On one hand it receives its life blood in the form of nutrient rich water and deposits (detritus) from several rivers arising from Western Ghats and on the other hand it is intimately associated with the Vembanad lake into which it flushes its wastes and sewages. Kuttanad and Vembanad lake together form a suitable habitat for diverse birds and plants. Baker Estate in Kumarakom (Kavanattinkara) on the eastern banks of

Vembanad is a refuge for water birds such as cormorants, Darters and Night Herons. It has been a protected area for about a century. This place has marshes with trees around. Presently Kerala Tourism Development Corporation (KTDC) is maintaining this place as a bird sanctuary. Many wetland birds use this area as a feeding and breeding ground.

Kuttanad, popularly known as the 'rice bowl' of Kerala is a feeding trough of innumerable birds also. The natural food supply is almost inexhaustible. Microorganisms, worms, crustaceans, molluscs, fishes and amphibians flourish well and form excellent food web system. Different species of fishes occurring here form prey items for a large number of wet land birds. In the absence of major natural predators, birds almost occupy the top position of the food chain.

Kuttanad and the Vembanad lake premises are areas of hectic human activities. Farmers and farm labourers reside and work in this area. Vembanad lake is frequented by fishermen and shell collectors collecting shells for cement and lime factories.

The resident bird fauna includes different species of herons, bitterns, egrets, rails, waterhens, coots, moor hens and teals. A number of teals and ducks arrive here as winter visitors.

As the area is primarily an agricultural zone of Kerala, intense cultivation is promoted through the use of chemical fertilizers and pesticides. Indiscrete use of these toxic chemicals has polluted the environment considerably. Magnified through the biological systems, the poison seems to affect the avian fauna much. Sometimes the birds are met with the hostile attitude of the farmers who often consider them as pests of crops. There are instances of massive killing of birds, especially teals, with grains soaked in poison.

This rich habitat needs protection and effective management which should be supported by indepth research. The objective of this study is to assess the frequency and numerical data of the resident and migratory water birds of the Vembanad and Kuttanad region and to review the ecological requirements, movement pattern and the biotic influence affecting the size of population of these birds in the area.

1.2. Review of Literature

Extensive studies on wetlands and their avifauna have been carried out in Europe and North America in recent years. These include ecosystem studies, food and feeding habits of birds and their behaviour, breeding biology and population studies. (Lack 1971, Kushlan 1979, Mock 1980, Hafner et al. 1986, Fasola 1986, Hafner and Fasola 1992, Hafner et al. 1993, Fasola and Canova 1993).

Only very few studies have been done in India on the topic. Studies conducted by Ali and Vijayan (1983, 1986) in Bharatpur, Ali and Neelakantan (1981) at Point Calimer, Vedaranyam and Kurup (1991) at Malabar coast are commendable.

No systematic studies have been done in south and central Kerala which has extensive areas of wetland aquatic habitats.

Paddy fields as a modified wetland habitat (managed wetland) have been a source of interest to many ornithologists. Hafner et al., 1986 observed that high density of invertebrates in paddy fields provides optimum foraging and high breeding success for birds. It has been pointed out that rice fields provide ample scope for niche overlapping and mixed foraging especially among herons and egrets (Fasola 1986). Thus birds segregate less in agricultural habitats than in non-agricultural habitats, as there is a temporary super abundance of prey/food (Lack 1971, Waite 1984, Fasola 1986). All the paddy fields in an area have more or less similar conditions with a single variable—the stage of development of the rice plants (Gaston-unpublished).

The effects of seasonal changes and man-made alterations on the wetland habitats and on the bird population are shown in many studies. Kushlan (1986) observes that extreme hydrological variability (increasing depth and receding water level) can exceed the accommodative limit of the birds resulting in decrease of populations. Changes in the water level and

subsequent change in salinity in many salt pans cause alterations in the size and quality of prey populations and this results in the change of population size of the waders (Velasquez 1992).

Habitat destruction and degradation have profound effects on the decrease of wetland bird population. In Bangladesh habitat destruction due to agricultural practices and fish farming, hunting and excessive withdrawal of water for irrigation has resulted in the extirpation of Black-necked Stork and Greater Adjutant Stork while all other stork species are under the threat of extirpation (Rezakhan 1987). Double crested Cormorants of the Canadian Lake Superior decreased by 80% by 1970; the decrease attributed to the hatching failures due to egg shell thinning and egg breakage—a consequence of DDE contamination (Postupalsky, 1978; Blockpoel et al., 1980). Hafner et al. (1986) reports that eventhough paddy fields are rich foraging sites, the use of insecticides have considerably reduced the breeding success.

Water management measures such as mechanical drainage and filling of wetlands, dredging of water ways, spraying mosquito control, construction of sewage pipe line etc. has serious consequences on the water bird populations (Cooch 1967; Lodge 1967; Erwin et al. 1986; Goss-Custard and Durrel 1990). Even when the land remains intact, the disturbances reduce the ability of the land to support wader populations (Senner and Howe 1984). Goss-Custard (1976) points out that as new habitats do not arise, habitat destruction leads to the

migration of birds to places already occupied by other birds. This leads to crowding, aggression, low food intake and decrease of habitat quality. Increase of density of population results in increase of mortality and decrease in rate of reproduction (Begon et al. 1986; Goss-Custard and Durrel 1990).

The adverse effects of habitat destruction and degradation of water bird population are also pointed out by Robertson and Kushlan 1974, Bock and Lepthien 1976, Custer et al. 1980. The population of marsh land birds has been used as a biological indicator of habitat quality (Burton 1956, Garden 1958, Custer and Osborn 1977, Custer et al. 1980, Hafner and Fasola 1992). Effects of environmental stress on bird population has also been studied by Keesvermeer 1990 and Lynne Dickson 1992.

Several studies have been made on the feeding strategy of water birds. The diet of marsh land birds, especially herons has been studied by direct observation in the field (Cook 1978, Reichner 1986) and by examination of the stomach contents of the dead adult bird (Florence 1914, 1912, Marquiss and Leitch 1990). Other relevant studies regarding food habits are provided by Hibbert-Ware 1940, Lowe 1954, Owen 1955, Kushlan 1976, Cramp and Simmons 1977, Giles 1981, Rohwer 1990 and Kushlan 1992.

Betts and Betts 1984 have studied the foraging tactics of herons and reported that these birds have a comparatively smaller hunting radius and they often wait longer time before getting a catch. They also observed that after a

successful attack the herons changed the hunting site. Further bits of information regarding the feeding strategy are provided by Mock 1980 and Rohwer 1990. Mock and Mock 1980 have reported on of the feeding behaviour of Goliath Heron. These large birds prefer to forage well away from the lake's edge among beds of floating macrophytes. They also catch comparatively larger preys with less capture rate.

Foraging success seems to be rather high in the morning as per several observers. Vessem and Draulans 1987 observed clumping of Grey Herons in the morning at the foraging site due to a high foraging rate. Food loading rate of Little Egrets in the first trip has been found to be thrice as high as any later trip (Junor 1972, Hafner et al. 1993). A comparative study of the distances covered by wetland birds and other birds for foraging has been done by Caraco et al., 1980.

Wanless et al., 1993 comment on the factors influencing the size of the food load. It has been shown that the load would be heavier when the Shags forage from farther sites. Brood size also influences the food load. Hiroyoshi Higuchi 1988 have reported about the bait fishing of Green-backed Heron—the bait such as flies, berries, etc. being dropped into the water to lure fishes. Mock and Mock 1980 have observed and reported on food piracy—fish eagle robbing the fish caught by a Goliath Heron. Kushlan 1979 observed that food piracy was more when the handling time of the prey was longer.

Mixed group foraging has been observed among egrets, gulls, terns, herons etc. Aggregation is maximum in the early morning when food items are more abundant (Master 1992). Mixed species foraging was found to be more in rice fields where prey items are super abundant (Lack 1971, Waite 1984, Fasola 1986). Kushlan 1979 and Master 1992 suggest a core species which is often a white bird such as White Ibis or Snowy Egret around which other species aggregate for mixed group foraging. Individual foraging territories for small groups of herons were noted by Higuchi (1988). Vessem and Draulance (1987) has observed the grouping and dispersion patterns of water birds especially Grey Herons.

Observing the breeding behaviour of water birds Custer et al. (1980) find out that most herons re-use the same breeding colony year after year. Hafner et al. (1993) conclude that high rate of breeding success and post-fledging survival of Little Egrets are related to abundance of food especially available for early morning intake. Similar observation on food abundance and breeding success in Jacanas has been made by Osborne and Bourne (1977).

Aebischer (1993) comments on the safer breeding site selection by experienced Shags leading to hatching and post-fledging success. Nest site quality and reproductive success have been reviewed by Jehl and Hassell (1966), Mac Nicholl (1979) and McNeil and Leger (1987), and also. Extensive studies on breeding behaviour of water birds have been made in North America (Baker 1935 and Holmes 1973, Nettleship 1973, Connors et al. 1979,

Senner 1979, Labutin et al. 1982 and Davis and Graham 1991). Different aspects of breeding behaviour, nest-site, site fidelity, parental care, nest-guarding, etc. are discussed by Meyerricks (1960), Collins (1970), Pratt (1970), Wolford and Boag (1971); Mac Roberts (1973), Hunter and Morris (1976), Bailey (1978), Gladston (1979), Fugioka and Yamagishi (1981), Oring and Lank (1984, 1982), Gratto et al. (1985), Oring (1988), Thompson and Hale (1989).

Diel activity and time budget of many marsh land birds have been reviewed. Mock and Mock (1980) have observed and reported the day-time budget of Goliath Heron. Brandman (1976) reported on the diel activity of Great Blue herons. Fasola and Canova (1993) have produced tabulated results of the observation of diel activity of 42 dominant species of water birds. The results show that majority are diurnal and very few are nocturnal.

In many developed countries there was concerted attempts to preserve wetland habitats and to co-ordinate agricultural use of wetlands and habitat development for wetland birds. An integrated wetland management comprising agriculture, pest control and bird protection has been discussed by Dolbeer (1990). In Canada the wetlands and prairie pot holes of Saskatoon, Manitoba, Alberta etc. have been subjected to extensive study. Saskatoon Wetland Seminar 1969 reviewed the significance of small wetlands for water fowl production, agricultural use of wetlands and hunting regulations (Jahn, 1969). Suggestions of this seminar include specification and limit for the acreage utilised for agricultural purpose in areas which are potential wild life habitats.

Camargue, delta of Rhone in S. France (Hafner et al. 1986), Minsmere Bird Reserve in England (Axell and Hosking 1977), Lower Inn river in S. Bavaria and Upper Austria (Reichholf 1994), wetlands along the Mediterranean coasts (Hafner and Fasola 1992) and a number of other marshland habitats in Western countries evoked interest since Ramsar convention, 1971. Fresh water bodies and marshes of Canada and their management and conservation of avifauna have been discussed in a number of papers published by Canadian Wild-life Service (Sugden 1973, Diskson 1992, Kees Vermer et al. 1992 and Woo et al. 1993).

In India, studies have been conducted on the avifauna and hydrobiology of keoladeo National Park, Bharatpur (Ali and Vijayan 1983 and 1986). An ecological survey of Vedaranyam swamp, an important water bird refuge in South India, was conducted by Ali and Neelakantan (1981). Tyabji 1994 has produced a check list of water birds of Bandhavgarh National Park in Madhya Pradesh.

Food habits of water birds in India have been studied by Mukherjee (1975, 1977), Kaul et al. (1980), Pandit (1982) and Mason et al. (1912). Other studies on water birds of India include breeding ecology of Bronz-winged Jacana and Pheasant-tailed Jacana in the Keoladeo National Park (Ali and Vijayan, 1986). Availability of food and South-West

monsoon were reported to be the limiting factors for breeding and clutch size of water birds in India.

Very few studies have been carried out on Water-birds of Kerala. A study on the ecology of birds of Malabar Coast and Lakshadweep has been carried out by Kurup (1991). Occurrence and habits of certain water birds are given by Ali (1969), Neelakantan and Sasikumar (1980), and Neelakantan (1996). Gaston (unpublished manuscript obtained from the author) has studied the shorebirds of Cheruthuruthy paddy fields near Shornur in Kerala during 1977-78 and observed that the major variable factor that influences the bird population in paddy fields is the stages of the paddy crop. Studies on the ecology of lapwings in Kerala have been produced by Vijayagopal (1991). Zacharias and Gaston (1993) have observed a decline in the number of Water birds in Wynad.

Authentic and exclusive studies or published work are lacking on Vembanad and Kuttanad avifauna other than Oommen (1992) who has conducted some studies on the ecological and breeding aspects of White breasted Kingfisher in Vembanad-Kuttanad area. A survey conducted in 1993 by the Kerala Forest Department listed 140 birds from Vembanad and adjoining regions including Kuttanad. This includes 30 wetland birds. However the survey was incomplete since the observation was extended only for a few days.

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## Chapter 2

### MATERIALS AND METHODS

As the study area is vast, the method of sample-plot survey was adopted. The sample plots were selected to represent the diverse physical and geographical features of Vembanad and Kuttanad.

Observations were carried out in four different locations of the Vembanad region:

- i) The Sanctuary: a marshy enclosure of about 5 hectares, by the side of the lake, well protected by barbed wire-fencing and thick hedges.
- ii) K.T.D.C. Complex and surrounding areas (excluding the sanctuary), about 40 hectares with artificial lakes, canals and with a variety of trees and shrubs.
- iii) The Vembanad lake south of Thanneermukkam barrage.
- iv) Pathiramanal—a small natural island of about 25 hectares.

Four sample plots were selected for the study of Kuttanad region.

- i) Stretches of paddy fields on either side of Kottayam-Kumarakom road, from Chengalam to Kumarakom—4 km length and 1 km width at both sides.
- ii) Rice fields reclaimed from the lake ('Kayal padoms')—Rani, Chithira, Marthandom and R-block (R-block is now not used for rice farming).

- iii) Stretches of paddy fields near the Rice Research Station (Kerala Agriculture University) Mankompu, by the side of Changanacherry-Alappuzha road—about 10 ha in area.
- iv) Paddy fields at Vazhappally, near Changanacherry—about 15 ha. in area.

Plot Nos. i and iv are closer to the uplands and may be identified as part of the upper Kuttanad while plot No.III may be said to belong lower Kuttanad, placed away from the uplands. Plot No.II is part of the lake-land (Kayal padoms).

The period of study was extended from August, 1992 to March, 1996. Regular observations and recording of data began on 27.08.92 and continued up to December, 1995.

Fortnightly trips were made to each of the study area—alternate trips to the plots associated with the lake and plots associated with the paddy fields of Kuttanad. Country boats and motor boats were employed for visiting the study plots in the lake and the islands. The other plots were surveyed by walking.

Direct counting was possible for the birds at the sanctuary and K.T.D.C. Complex. As Little Cormorants, Large Cormorants, Shags, Darters and Night Herons have more or less permanent roosting and resting place on the trees in the marsh, the birds on each tree could be counted with remarkable precision and the total number of birds in each species could be obtained. The birds lurking in the reeds and bushes were flushed out and approximate counting

was made. For the birds of the paddy fields, line-transect and point-transect methods (Gaston 1975) were employed to obtain approximate number of birds.

Bird/nest ratio was calculated for birds such as Little Cormorants, Large Cormorants, Darters and Night Herons. Nesting colonies of Pond Herons and Little Egrets in the study area were observed and actual count of the nests were made.

Feeding habits of different water birds were noted by direct observation. Interactions and mixed group foraging among water birds were also noted. In the case of water birds which frequent the paddy fields, the size of the population in relation to the stages of the crop and the influence of land utilisation on the avian fauna of the area were assessed.

The study period encompassed 4 winters and 3 south-west and north-east monsoons. The seasonal variation in populations, feeding habits and nesting habits round the year could be noted.

The data regarding pH, Salinity, Temperature, Humidity and Rain fall have been kindly provided by the Regional Research Station (R.R.S.) of Kerala Agriculture University (K.A.U.), at Kumarakom.

Fishes and other possible prey items in the lake and surrounding water bodies were regularly collected from the catches of local fishermen and identified.

The density of birds per hectare or per km<sup>2</sup>, the ratio of nests to total number of birds, ratio of young birds to adults, monthly variations in the size of populations round the year and comparative density of birds in different localities in the study area were calculated. The diversity of species in different regions of the study area was also assessed.

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Chapter 3

STUDY AREA—GEOGRAPHICAL, PHYSICAL AND BIOLOGICAL FEATURES

3.1. Geographical Features

The study area comprises the eastern banks of Vembanad Lake and adjoining marshes of the Kuttanad area which spreads over the eastern and southern regions of Vembanad Lake.

3.1.1. Vembanad Region

Vembanad Lake is the largest backwater body in Kerala, situated between latitude 9°28' and 10°10' north and longitude 76°13' and 76°31' east (Kurup et al, 1990), with overlapping estuarine brackish water and fresh water habitats. Beginning at Cochin where it merges with Arabian sea, the Vembanad lake extends southwards, parallel to the coastal line, as far as Alappuzha and stretches over the revenue districts of Ernakulam, Kottayam and Alappuzha. Its total area is 21050 hectares (210 km²). The lake is divided by a man-made 1402 m long barrage, the Thanneermukkam Bund extending across the lake. The waterflow through the bund is regulated by shutters. The northern upstream directly connected to sea at Cochin is estuarine in character while the southern downstream is either brackish or fresh water in character

with many fresh water rivers joining the lake. The major rivers that originate from Western Ghats and run into the lake are Moovattupuzha, Meenachil, Pampa and Manimala. Achenkovil and Periyar are indirectly linked to Vembanad. These rivers annually bring a large quantity of fresh water, nutrients and detritus to the lagoon.

A small uninhabited natural island called Pathiramanal is situated in the southern region of the lake. A considerable area of Vembanad lake has been reclaimed from time to time for agricultural purpose. R-block is such a reclaimed island with surrounding granite retention walls. The reclaimed land lies below the MSL. Rani, Chithira and Marthandom are reclaimed paddy fields.

On the whole the Vembanad lake, the surrounding marshes, meadows associated with the lake and the natural and man made islands form an ideal habitat for wet land birds. The rivers flowing into the lake often branch and unite at several places forming a sort of deltaic region in the vicinity of the lake.

On the eastern bank of the Vembanad lake at Kavanattinkara, bordered by Kavanar (a branch of Meenachil river) and Kumarakom-Vechoor road is the Baker estate. Once owned by an Englishman, this hundred-acre secluded place is now owned by the Kerala Tourism Development Corporation (KTDC) and kept as a heronry and tourist spot. Two tourist hotels flank this area. Baker estate in its natural condition with

marshes, magrove thickets and other trees is an ideal feeding, roosting and breeding ground for many species of herons, cormorants and darters. The state government proposes to convert the Vembanad lake with its small islands and Baker estate (KTDC complex) into a bird sanctuary.

3.1.2. Kuttanad Region

This vast area of paddy fields extends from 9°17' N to 9°40' N and 76°19E to 76°33' E and is separated from the Arabian sea by a narrow strip of land. Kuttanad may be said to be a deltaic formation of four river systems namely Meenachil, Pamba, Achenkovil and Manimala. It also includes the low-lying areas (marshes) of Vembanad lake. Kuttanad spreads over three districts, Alappuzha, Kottayam and Pathanamthitta. Its total area is 1157 km² with 66048 hectares of wetlands, 31086 Ha. of garden dry-lands and 18623 Ha. of water wastes, lakes and backwater. Among the wetlands, 53639 Ha. are identified as 'puncha' rice fields most of which are at or below sea-level. (KAU bulletin-1990). Large blocks of paddy fields ('Pada Sekhara') are separated by canals, bunds and water logged land masses.

In the geological past Vembanad and Kuttanad were part of the coastal area of Arabian sea and hence the subsoil of these places contains sediments of marine origin and molluscan shells (Aravindakshan and Joseph, 1990).

3.2. Social and Economic Importance of the Area

Vembanad lake and its premises play an important role in the socio-economic condition of the central Kerala. Vembanad lake is an important fishery resource. It also serves as a nursery ground for commercially important crustaceans. People around find a living in the rich aquatic resources of the lake. Small and large scale fishing and marketing support a number of families and a still larger sector of people is benefitted as consumers. Vast deposits of shell form the raw materials for the Vembanad Cement Factory located on the eastern side of the lake. Hundreds of lime factories are also thriving on the shell deposits of Vembanad. The lake area is always throbbing with activities of people indulged in fishing and shell collection. This lake is extensively used for navigational purpose and recreational activities such as boating, canoeing etc. All these activities often disturb the tranquility of the area.

Kuttanad is the granary of Kerala. Since rice is the chief food of people of Kerala, Kuttanad as the main rice producing area plays an important role in the economic development of the state. Two major rice research stations (Kumarakom and Monkompuzha) of the Kerala Agriculture University and several small research stations run by the state Agriculture Department conduct research and extension programmes for the improvement of rice cultivation. A large number of people find occupation as farmers, farm labourers and

fishermen in this area. Some traditional and a few modern rice mills also function in the same area. Coconut trees are grown along the bunds and reclaimed land masses as a major cultivation. Duck farming is a soaring business of the region. Farmers of Kuttanad find fish farming also as an alternate utilisation of paddy fields. Several roads and canals provide ample transportation facilities and now every corner of Kuttanad is accessible either by automobiles or by boats.

3.3. Physical Features

3.3.1. Salinity and pH

Salinity is one of the limiting factors of aquatic fauna and water dependant marsh land birds (Nair and Pillai, 1990). Salinity varies at different regions of the lake and also at different times of the year. In the downstream north of Thanneermukkam barrage, especially in the estuarine mouth near Kochi, salinity is at its maximum. It gradually decreases towards the southern regions. There is a sharp fall in salinity in the upstream south of Thanneermukkam barrage and the lowest is recorded in the southernmost end of the lake (Kuttanad Water Balance Study Project Report, 1987, 1990). Highest salinity values (18–32 ppt) in the downstream were recorded during pre-monsoon months (Feb–May) (Table 2). During monsoon and post-monsoon periods the salinity falls down to 5–18 ppt. In the upstream of the barrage, the salinity is never more than 10 ppt. at anytime, often less than 5

ppt. and as low as 0.5 ppt in the southernmost border (Table-1). This is because of the closure of the shutters of the barrage during the summer when the incursion of the saline water into the south Vembanad is prevented (Kurup et al. 1990). Recorded values of salinity at two stations in 1974 prior to the commissioning of shutters and in 1980 after the commissioning of shutters, for the same months were respectively 24.13–24.38 and 1.35–0.7 ppt.; an almost 94–97% reduction (Nair and Pillai 1990).

Table 1
Seasonal Variation in Salinity
 [A comparison between pre (1974) and post (1980) operation periods
 of the barrage and between north (I) and South (II) of the barrage]

Month	Section I			Section II		
	1974	1980	% reduction	1974	1980	% reduction
March	26.48	15.26	42.37	24.38	1.63	93.31
April	28.18	9.69	65.61	25.35	1.42	94.39
May	0.96	0.09	90.62	2.50	0.05	98.0
June	1.76	0	100	1.76	0	100
July	1.27	0	100	0.51	0	100
August	0.34	0	100	0.25	0	100
September	0.68	0.59	13.23	0.10	0	100
October	0.60	0	100	0.16	0	100
November	6.0	0	100	1.25	0	100
December	9.24	3.05	66.99	1.00	0	100

(Kerala Agriculture University Journal-1990)

Table 2
Salinity and pH—Mean Values at S. Vembanad and Adjoining Paddy Fields

Month		Salinity	pH
April	1989	2.56	8.0
May	"	2.37	7.0
June	"	3.27	6.5
July	"	0.75	6.5
August	"	0.75	6.75
September	"	0.57	6.65
October	"	0.61	7.0
November	"	0.96	7.5
December	"	1.11	9.0
January	1990	2.19	7.5
February	"	N.A.	8.3
March	"	1.90	7.91

(Kerala Agriculture University Journal-1990)

pH variations are at random and a recorded data for one year (1989 April-'90 March) shows a fluctuation between 6.5-9.00 (Padmakumar et al. 1990) (Table - 2)

3.3.2. Temperature, Humidity and Rain-fall

Vembanad and Kuttanad are warm humid regions. Humidity is reported to be very high throughout the year. (Table – 3) Temperature is fluctuating from 21°C to 36°C (Aravindakshan and Joseph, 1990). Minimum temperature is noted in July–September (Monsoon). From November onwards temperature goes higher with the maximum in April–May (Table-4).

Annual average rainfall is 300 cm. most of which is received in the South–West Monsoon during July–August and North–East Monsoon during October–November. January and February are the months with practically no rain while occasional rains occur in months, March–May (Table – 5).

Table 3
Percentage of Humidity at Kumarakom – 1991 to 1995

Month	91	92	93	94	95
January	N.A.	N.A.	N.A.	71	72
February	72	65	67	69	76
March	72	71	69	77	79
April	67	72	72	72	78
May	74	77	74	75	74
June	89	80	87	79	85
July	88	86	96	86	91
August	87	86	95	87	87
September	75	83	96	84	84
October	81	81	95	80	83
November	74	82	89	75	79
December	65	66	79	69	70

(RRS, KAU, Kumarakom)

Table 4
Maximum and Minimum Temperature Recorded at Kumarakom-1991-
1995 (Degree Celcius)

Months	1991		1992		1993		1994		1995	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
Jan.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	32.4	21.6	33.45	NA*
Feb.	33.9	21.9	32.2	19.2	32.3	21.06	32.8	20.7	34.23	NA*
Mar.	34.8	24.78	33.18	22.0	33.4	21.05	32.9	21.7	35.13	NA*
Apr.	34.8	24.8	34.6	22.9	34.5	24.2	31.1	21.08	34.4	NA*
May	34.8	25.3	35.2	24.2	34.3	24.7	32.9	20.6	33.1	NA*
Jun	29.5	23.5	33.19	23.9	33.4	24.8	33.1	18.5	31.4	NA*
Jul.	29.2	24.5	30.56	23.01	30.8	23.5	28.3	23.9	30.5	NA*
Aug.	29.4	23.7	29.8	21.8	30.0	23.5	26.4	24.4	30.9	NA*
Sep.	32.16	23.9	30.7	26.15	30.8	22.5	31.1	23.6	31.2	NA*
Oct.	31.2	22.9	30.6	26.2	31.6	21.9	31.77	NA	32.4	NA*
Nov.	32.2	22.6	31.75	27.1	31.1	21.8	32.7	NA	32.12	NA*
Dec.	32.5	20.8	32.5	25.8	29.8	21.8	33.44	NA	31.11	NA*

(RRS, KAU, Kumarakom)

NA* - Not available

Table 5
Annual Rainfall at Kumarakom from 1991-1995 (in mm.)

Months	1991	1992	1993	1994	1995
Jan.	—	—	—	21.2	0.6
Feb.	3.2	—	15.8	55.2	—
Mar.	68.2	—	7.2	25.4	134.4
Apr.	56.4	36.8	72.2	176.2	188.8
May	227.7	308.2	312.2	205.4	525.4
June	1211.2	772.2	998.2	604.6	526.8
July	626.4	731.4	770.6	554.8	457.6
Aug.	448.4	434.6	157.2	453.2	518.6
Sept.	30	215	199	216.8	494
Oct.	188.5	327.8	576.8	421.8	213.8
Nov.	61.6	278.7	198.8	188	83.6
Dec.	—	41.6	75	33.2	—

(-Regional Research Station, KAU, Kumarakom)

3.4. Biological Features

The flora and fauna of the study area is typical of the aquatic and semi aquatic habitats. However the biological features of Kuttanad is much transformed due to human intervention through agricultural planning.

3.4.1. Flora

The lake as such does not have any aquatic or semiaquatic plants of its own except the floating weeds such as *Eichornia crassipes* and *Salvinia mollesta*. These weeds are continually pushed to the lake from the rivers and inland waterbodies. The water edges have thickets of mangrove on the eastern side. Once flourished well, the mangrove vegetation is now on the decline. The mangrove bushes of Vembanad include about a dozen species belonging to the genera *Avicinnia*, *Bruguiera*, *Barringtonia*, *Rhizophora*, *Kandelia*, *Cerebera*, *Clerodendrum*, etc. (Table-6)

Table 6
Species of Mangrove Found at the Study Area (Kumarakom)

No.	Name	Occurrence
1	<i>Avicennia officinalis</i> *	Abundant
2	<i>Bruguiera gymnorrhiza</i> *	"
3	<i>Barringtonia racemosa</i>	"
4	<i>Kandelia candel</i>	"
5	<i>Rhizophora apiculata</i>	Moderately abundant
6	<i>Sonneratia caseolaris</i>	"
7	<i>Avicennia marina</i>	Sparse
8	<i>Acrostichum aureum</i>	"
9	<i>Thespesia populnea</i>	"
10	<i>Kandelia rheedii</i>	"
11	<i>Cerebera manghas</i>	"
12	<i>Clerodendrum inerme</i>	"

*Found only at Kumarakom

Two species of mangroves namely *Avicinnia officinalis* and *Bruguiera gymnorhiza* and an associated shrub, *Hibiscus tiliaceus* are found only at Kumarakom (Ramachandran et al. 1985 and Antony 1989)

Apart from mangroves the neighbourhood of the lake has trees like *Anona glabra*, *Callophyllum inophyllum*, *Polyalthia longifolia*, *Artocarpus integrifolia*, *Ardisia elliptica*, *A. littoralis*, *Heritiera littoralis* etc. Bamboos and reeds are also abundant. In the Baker estate there are plenty of rubber trees (*Hevea braziliensis*) on the dry lands surrounding the marshes. Though once planted, these trees along with coconut palms (*Cocos nucifera*) are now growing wild providing roosting and nesting places for many birds. Herbs and shrubs such as *Flagellaria indica*, *Acanthus ilicifolius*, *Fimbristylis miliacea*, *Monochoria vaginalis* and *Ludwigia perennis* are lushly growing in the marshes. The water bodies enclosed in the marsh lands have aquatic weeds like *Eichornia*, *Salvinia*, *Nymphaea*, *Colocasia* etc. forming thick covering on the surface. The flora of the area may be grouped into grasses, sedges, broad leafers, ferns, reeds, climbers, shrubs and trees (Table -7)

Table 7
List of Plants Identified at the Baker Estate Area

Name of Plant	Category	Frequency
<i>Echinochloa staghmina</i>	Grass	Most abundant
<i>Oryza rufupogon</i>	"	"
<i>Echinochloa colona</i>	"	Abundant
<i>E. crus-galli</i>	"	"
<i>Saccolopsis interrupta</i> (wild)	"	Moderate
<i>Isachne miliacea</i>	"	Sparse
<i>Eichornia crassipes</i>	Sedges	Most abundant
<i>Fimbristylis miliacea</i>	"	"
<i>Acanthus ilicifolius</i>	"	"
<i>Cyperus difformis</i>	"	Abundant
<i>C. iria</i>	"	"
<i>C. pangorei</i>	"	Moderate
<i>Utricularia exoleta</i>	"	Sparse
<i>Eleocharis dulcis</i>	"	"
<i>Hydrilla verticellata</i>	"	"
<i>Ipomoea aquatica</i>	"	"
<i>Monochoria vaginalis</i>	Broad leafes	Most abundant
<i>Ludwigia perennis</i>	"	Abundant
<i>Nymphaea nouchali</i>	"	"
<i>Limnocharis flava</i>	"	Abundant
<i>Nylumbium speciosum</i>	"	Sparse
<i>Salvinia mollesta</i>	Ferns	Most abundant
<i>Marselia quadrefoliata</i>	"	"
<i>Ceratopteris thalictroides</i>	"	Sparse
<i>Azolla pinnata</i>	"	"
<i>Flagellaria indica</i>	Climber	Abundant
<i>Derris trifoliata</i>	"	Sparse
<i>Salacia chinensis</i>	"	"
<i>Mucuna pruriens</i>	"	"
<i>Anamirta cocculus</i>	"	"
<i>Acampe praemorsa</i>	Epiphytic orchid	Rare
<i>Dendrophthoe falcata</i>	Parasitic on mangroves	"
<i>Viscum spp.</i>	"	"
<i>Ardisia elliptica</i>	Shrub	Sparse
<i>Terminalia catappa</i>	"	"
<i>Heritiera littoralis</i>	"	"
<i>Excoecaria agallocha</i>	"	"
<i>Anona glabra</i>	Tree	Restricted distribution
<i>Lagerstroemia speciosa</i>	"	"
<i>Polyalthia longifolia</i>	"	"
<i>Cerebera odollam</i>	"	"
<i>Callophyllum inophyllum</i>	"	"
<i>Artocarpus integrifolia</i>	"	"

* Mangroves and cultivated trees not included

3.4.2. Fauna

The study area harbours a rich fauna comprising invertebrates like nematodes, annelids, arthropods and molluscs and vertebrates like fishes, amphibians, reptiles, birds and mammals. Lower invertebrates such as nematodes and earthworms are abundant in the muddy soil which is rich in organic debris. Insects are innumerable in the area, especially in the paddy fields where many of them form pests. Many insect larvae and crustaceans form the major source of food for birds as well as fishes. Large crustaceans like crabs, prawns and shrimps are found in Vembanad lake and inundated paddy fields. Among molluscs *Pila globosa*, *Limnea*, *Planorbis*, *Lamellidens* etc are plentiful in the inland water bodies and paddy fields. The lake has a considerable wealth of *Villorita cyprinoides* (black clam) and *Paphia malabaricus* (brown clam).

Salinity variation seems to play an important role in regulating the primary productivity and planktonic population of the Vembanad lake. The occurrence of zooplanktons at the lake recorded in early seventies were fairly high (Nair and Tranter, 1971; Haridas et al. 1973). But in '80s with the commissioning of Thanneermukkam barrage, there was a considerable decline in the planktonic population behind the barrage especially in the upper reaches of the lake (Nair and Pillai, 1990). However the southernmost regions of the lake adjoining to Kuttanad and its riverine delta have fairly rich nutrients and

hence the primary productivity is higher (Pillai et al 1975). The difference in the primary productivity reflects on the number and size of the population of different aquatic prey species. Jhingran (1982) points out that the weed, *Salvinia* has several associated animal populations. (Table 8)

Table 8
Fauna associated with *Salvinia* (Nos/m²)

Groups of organism	Thanneerkukkam zone	Kuttanad Freshwater zone
Nematodes	360	2436
Annelids	132	1628
Copepods	2432	5240
Amphipods	544	844
Ostracods	—	872
Decapods	8	4
Insect larva	—	348
Bivalves	4	348
Gastropods	—	176
Fishes	—	4

Jhingran, 1982

Observations on the local fish catches show that grey mullets (*Mugil* spp) dominate the fish species in the lake. They are abundant in the northern part of the lake, i.e., north of the barrage. *Scatophagus*, *Lates*, *Platycephalus*, *Ambassis*, *Caranx*, *Gerres*, *Sillago* and *Mystus* are also found in considerable numbers in the estuarine part of the lake. Pearl spot (*Etroplus suratensis*) dominates the southern part of the lake. The more fresh water area of the lake

at the southernmost reaches is frequented by cat fishes, carps, *Mastacembalus*, *Channa*, *Anabas* and smaller fishes like *Aplocheilus* and *Gambusia*. The Indian shad *Hilsa ilisha* is found in the estuary during October–November. Altogether 34 different species of fishes have been identified from the study area during 1992–95 (Table 9c).

Table 9
Common Crustaceans, Molluscs and Fishes of Vembanad–Kuttanad area

A. Crustaceans

(i) Prawns

No.	Species	Common name	Ecological Status
1	<i>Macrobrachium rosenbergii</i>	Giant prawn	Fresh water–Estuarine
2	<i>M. idella</i>	“	“
3	<i>M. rude</i>	“	“
4	<i>M. scabriculum</i>	“	“
5	<i>M. equidens</i>	“	“
6	<i>Metapenaeus dobsoni</i>	River prawn	Fresh water— Larvae migrate to estuary used as nursery ground
7	<i>Penaeus indicus</i>	Indian white prawn Tiger prawn	“
8	<i>P. monodon</i>	Yellow or Banana prawn	“
9	<i>P. semisulcatus</i>	Flower tail	“
10	<i>Parapenaeopsis stylifera</i>		“
11	<i>Acetus indicus</i>	—	Estuarine

ii) Crabs

No.	Species	Common name	Ecological Status
1.	<i>Scylla serrata</i>	Mud crab	Estuarine-juveniles migrating to lower salinity
2.	<i>Uca uca</i>	Fiddler crab	"
3.	<i>Uca anulepis</i>	"	"
4.	<i>Sesarma spp.</i>	Hardy crab	Estuarine
5.	<i>Cardiosoma spp.</i>	Estuarine crab	Estuarine

B. Mollusca

No.	Species	Common name	Ecological Status
1.	<i>Villorita cyprinoids</i>	Black clam	Brackish water
2.	<i>Paphia malabaricus</i>	Brown clam	"
3.	<i>Modiolus modiolus</i>	Duck feed mussel	"
4.	<i>Lamellidens marginalis</i>	Fresh water mussel	Paddy fields, shallow waters
5.	<i>Pila globosa</i>	Apple snail	Fresh water, paddy fields
6.	<i>Limnaea spp.</i>	—	"
7.	<i>Planorbis spp</i>	—	"

C. Fishes

No.	Species	Common name	Ecological Status
1.	<i>Mugil parsia</i> (<i>Liza parsia</i>)	Grey mullet	Estuarine
2.	<i>M. cephalus</i>	Mullet	"
3.	<i>Liza tade</i>	"	"
4.	<i>Lates calcarifer</i>	Sea bass	Estuarine/brachish water
5.	<i>Scatophagus argus</i>	Mullet	"
6.	<i>Hilsa ilisha</i>	Indian shad	Migrating from sea to the lake in October and November
7.	<i>Platycephalus malabaricus</i>	"	Estuarine/brachish water
8.	<i>Ambassis dayi</i>	"	"
9.	<i>A. thomassi</i>	"	"
10.	<i>Caranx carangus</i>	Carangid	"
11.	<i>C. malabaricus</i>	"	"
12.	<i>Gerres filamentosus</i>	Silvery fish	Estuarine/brachish water
13.	<i>G. lucidus</i>	"	"
14.	<i>Sillago siliama</i>	Lady's fish	"
15.	<i>Mystus gulio</i>	Cat fish	Brachish water
16.	<i>M. oar</i>	"	"
17.	<i>Parluciosoma daniconius</i>	—	"
18.	<i>Etoplus suretensis</i>	Pearl spot	"
19.	<i>E. maculatus</i>	—	Fresh water
20.	<i>Polynemus heptadactylus</i>	Thread fin	Brachish water/ Fresh water
21.	<i>Channa striatus</i>	Snake head	Fresh water
22.	<i>C. marauius</i>	"	"
23.	<i>Periophthalmus spp.</i>	Mud skipper	"
24.	<i>Labeo bata</i>	Minor carp	"
25.	<i>L. rohita</i>	Rohu/major carp	Cultured fish, Now spread in the lake
26.	<i>Wallago attu</i>	River shark	Fresh water
27.	<i>Heteropneustes fossilis</i>	Cat fish	"
28.	<i>Clarias batrachus</i>	"	"
29.	<i>Anabas testudineus</i>	Climbing perch	"
30.	<i>Aplocheilus lineatus</i>	Top minnow	"
31.	<i>Gambusia affinis</i>	minnow	"
32.	<i>Barbus curmuca</i>	—	"
33.	<i>Mastacembalus armatus</i>	Spinny eel	"
34.	<i>Anguillus bengalensis</i>	Eel	"

Amphibians and reptiles are also flourishing well. Commonly found amphibians are frogs such as *Rana hexadactyla*, *R. tigrina* and *R. cyanophlyctis* and the toad *Bufo melanosticus*. Reptiles are represented by a variety of lizards and snakes and a few tortoises. Lizards like *Hemidactylus leschenaulty*, *H. frenatus*, *Calotes versicolor* and *Mabuya carinata*, tortoises like *Melanochelys trijuga* and *Geochelone travencorica* and snakes like *Ptyas mucosus* (Rat snake), *Lycodon travancoricus* (non poisonous snake mimicking krait), *Vipera russelli* (Russel's viper), *Bangarus coeruleus* (Krait) and *Naja naja* (Indian cobra) are abundant in the marshes and the vicinities. The non poisonous water snake *Natrix* is very common in the water bodies.

Not many mammals are thriving in the area except rats and moles. Rats are dwelling everywhere in the muddy and dry soil, under cover. Otters (*Lutra vulgaris*) are occasionally caught from the lake and also from the rivers connected to the lake.

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Chapter 4

OBSERVATION

4.1. Bird Sanctuary at Baker Estate

4.1.1. Marshy enclosure Protected as a heronry

The small marshy enclosure in the Baker estate is often dense with many water birds. But the place is dominated by cormorants and Night Herons. The trees such as *Bruguera gymnorhiza*, *Avicennia officinalis*, *Barringtonia racemosa* and *Kandelia candel* growing wild in the marsh and cultivated trees such as *Cocas nucifera* (Coconut palm) and *Hevea braziliensis* (rubber tree) provide resting, roosting and nesting sites for cormorants, Darters and herons. Herons and egrets often seek shelter in the lower branches of trees or among the reeds which are abundant in the marsh.

Three species of cormorants namely *Phalacrocorax niger* (Little Cormorant), *Ph. carbo* (Large Cormorant) and *Ph. fuscicollis* (Indian Shag) are found in the area. Little Cormorant outnumbers all other bird species. Little Cormorants when occupy a tree, virtually colonise it spreading themselves on almost all branches from top to bottom. However they often avoid lower branches. Larger trees usually harbour 30–40 Little Cormorants. Smaller

colonies consisting of 10–20 birds are also found. The size of the colony depends on the size of the tree. The colony does not seem to be still or inactive as the birds are constantly moving in and out. The birds which are flying out are subsequently be replaced by those which are moving in and the size of the colony is more or less maintained. The cormorant colony thus appears to be lively and vibrant by this frequent departures and arrivals.

The Large Cormorants were not apparently present when the study commenced in August 1992. Their first appearance was noted in October, 1992 and the number increased considerably by July, 1993 (Table–11). Large cormorants were also found in colonies of their own, on separate trees. The number of colonies and the size of population in each colony were less when compared to Little Cormorants (Table 10, 11, 17, 18 and 24, 25). The average number of these birds per tree was 15–25.

The Indian Shag *Phalacrocorax fuscicollis* is still less in number—rarely exceeding a hundred at any time (Table–12, 19). They often perch on separate trees. Mixed colonies of different cormorants have not been observed during the study. But Little Cormorants were observed sharing a tree with Darters and Night Herons.

Indian Darters (Snake Birds) *Anhinga rufa* also have their own colonies. They occupy taller trees, usually on the upper branches, sometimes leaving the

lower branches to Little Cormorants. The number of Darters is comparatively less (Table-13, 20, 27).

Night Herons *Nycticorax nycticorax* are found in large numbers. Their actual number could be far above the estimated number, as many of them are hiding in the shelter of dense reeds in the marshes. To flush out all of them together would be unsuccessful. However a plethora of their coarse crocking sound reveals their abundance among bushes. Night Herons are often seen sitting on the coconut leaves, either solitary or in small groups upto 10.

Three species of egrets which frequent the marsh are Little Egret *Egretta garzetta*, Median Egret *Egretta intermedia* and Cattle Egret *Bubulcus ibis*. They are casual visitors and their annual occurrence does not conform to their abundance in the neighbouring paddy fields. Of the three species of egrets *Egretta intermedia* is the least abundant. Egrets often keep a distance from cormorants and remain on branches of shrubs and short trees and among the reeds.

Pond Heron (Paddy Bird) *Ardeola grayii*, the most abundant in the paddy fields of the locality is very rarely appearing in the marsh (Table 16, 23, 30). The other water birds rarely found here are Chestnut Bittern *Ixobrychus cinnamoneus*, Yellow Bittern *Ixobrychus sinensis*, Black Bittern *Ixobrychus flavicollis*, Large Egret *Egretta alba*, White-breasted water hen *Amauornis phoenicurus*, Grey Heron *Ardea cinerea* and Purple Heron *Ardea purpurea*.

Grey Heron and Purple Heron each were found only once during the 24 months study. Three species of king fishers, though not in large numbers, visit this area. They are the Little Blue King fisher *Alcedo atthis*, White-breasted King fisher *Halcyon smyrnensis* and Pied King fisher *Ceryle rudis*.

In the marshy enclosure the water level is more or less constant and there is no direct inlet and outlet for the water. The recycling of materials follow a more or less closed system pattern. The decayed vegetation, wastes of food, excreta of birds and other animals and other organic and inorganic materials derived from the plants and animals of the marsh remain in the aquatic enclosure and in turn support the marshy fauna and flora. The fluctuations in the density of population of cormorants, Darters and Night Herons which are the permanent dwellers of the area influence the plant life. The trees occupied by the cormorants are constantly defoliated and dried up leaving only their stumps. The effect is acute when hundreds of Little Cormorants perch on a tree. The considerable amount of excreta of these birds soon leaves the tree in ruins. The cormorants subsequently desert the place. This occurred in January-February period of 1993, '94 and '95. Following the cormorants, Darters also left the place or moved to the rubber trees and coconut palms surrounding the marsh. The Night Herons were not affected by the destruction of trees as they were not much dependant on trees for their shelter, they mainly remained among shrubs and reeds. Birds such as Pond Herons and egrets also increased in the area during this period.

With the departure of cormorants and Darters, predatory birds and egg/nestling pirates became more frequent in the marsh. Crows (*Corvus splendens* and *C. macrorhynchos*), kites (*Milvus migrans* and *Haliastur indus*), Tree Pie (*Dendrocitta vagabunda*) and Crow Pheasant (*Centropus sinensis*) were observed during this period (Table-31). These birds were not to be found when the marsh was packed with cormorants. As the new sprouts develop on the tree stumps the cormorants return to occupy the place again.

Though Little Cormorants do not share a colony with Large Cormorants and Shags, they sometimes form mixed colonies with Darters and Night Herons. There are instances when a tall tree is shared by Darters which occupy the higher branches and Little Cormorants occupying the lower branches. Rarely Night Herons also are seen to occupy the lowest branches of trees, the upper parts of which are occupied by cormorants or Darters.

The cormorants and other regular inhabitants usually do not use the marsh as a foraging ground. However the Little Cormorants could be seen catching preys from the marshy pond on six occasions during the study period. Once a Darter could be seen slipping through the branches of the tree on which it perched, in order to collect certain prey from the marsh. The Night Herons, known to be foraging at night were observed feeding on preys from the pond in day light on a few occasions.

Nests of all the three cormorant species are found in colonies. When the study commenced in August 1992 there were 32 nests of Little Cormorants spread over three trees. At the peak time of nesting i.e., in April–May 1993 there were over 300 nests (Table–10) with an average of 20–25 nests per tree. Eventhough there were 20–30 colonies of Little Cormorants during this period, the nests were built on 9–13 trees only—others were non–breeding colonies. The nests with breeding birds or with nestlings were found from April and continued until September–October. The Large Cormorants and Shags had a more restricted nesting period as observed in the study. Both species started nesting activities in April and continued to June. The Shags and Large Cormorants had nesting colonies on two trees each in the marsh with total nests 36 and 19 respectively. There was an increase in the number of both birds and nests in 1994 in the case of Large Cormorants (Table–18) but in the case of Shags there was a decline during the same period (Table – 19).

Darters build their nests on the upper branches of relatively tall trees. During the study period in 1992–96 which covered five nesting seasons of Darters, in the first four seasons the birds were found to build nests on a specific tree (*Anona glabra*). In the fifth season there were no nests of Darter in the area. Night Herons had their peak period of nesting from April to June. Nests were also found in February and March (Table–14, 21, 28). Night Herons usually nested at the lower branches of trees and in the shrubs.

Table 10
Annual Variations in the Occurrence of Little Cormorant *Phalacrocorax niger* and their Nests in the Marshy Enclosure (Bird Sanctuary) - 1992-'93

Month	1992					1993						
	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.
Adult	680	800	1150	1260	1600	24	-	738	1200	1560	1380	1460
Immature	72	126	53	34	-	-	-	-	-	210	188	182
Nest	32	22	11	9	-	-	-	-	83	375	316	108
Density/* Hectare	136	160	230	252	320	4.8	0	147.5	240	312	276	292
Immature/ adult ratio	0.105	0.156	0.046	0.027	-	-	-	-	-	0.13	0.136	0.125
Nest/bird ratio	0.047	0.028	0.01	0.007	-	-	-	-	0.07	0.24	0.23	0.074

* Total area of the Marsh: 5 hectares. Density = $\frac{\text{Nos. of birds}}{5} / \text{Ha}$

Table 11
Annual Occurrence of Large Cormorants *Phalacrocorax carbo* and their Nests in the Marshy Enclosure 1992-93

Month	1992					1993						
	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.
Adult	-	-	23	47	70	-	-	28	96	95	226	235
Immature	-	-	-	-	-	-	-	-	5	17	28	23
Nest	-	-	-	-	-	-	-	7	19	13	5	-
Density/* Hectare	0	0	4.6	9.4	14	0	0	3.6	19.2	19	45.2	47
Immature/ adult ratio	-	-	-	-	-	-	-	-	0.05	0.18	0.12	0.098
Nest/bird ratio	-	-	-	-	-	-	-	0.25	0.198	0.137	0.022	-

Table 12
Annual Fluctuations in the Occurrence of Shag *Phalacrocorax fuscicollis* and their Nests - 1992-93

Months	1992					1993						
	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
Adult	18	26	59	51	22	-	-	19	84	117	93	49
Immature	-	-	-	-	-	-	-	-	14	23	22	14
Nest	-	-	-	-	-	-	-	-	22	36	18	-
Density/* Hectare	3.6	5.2	11.8	10.2	4.4	0	0	3.8	16.8	23.4	18.6	9.8
Immature/ adult ratio	-	-	-	-	-	-	-	-	0.167	0.197	0.237	0.286
Nest/bird ratio	-	-	-	-	-	-	-	-	0.26	0.308	0.194	-

Table 13
Annual Fluctuations in the Occurrence of Darter *Anhinga rufa* and their Nests – 1992-93

Months	1992					1993						
	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
Adult	26	37	46	14	27	-	20	7	19	36	37	22
Immature	11	8	18	8	9	-	4	3	-	7	18	9
Nest	7	9	11	7	6	-	-	-	10	13	9	-
Density/* Hectare	5.2	7.4	9.2	2.8	5.4	0	4	1.4	3.8	7.2	7.4	4.4
Immature/ adult ratio	0.42	0.22	0.39	0.57	0.33	-	0.2	0.43	-	0.19	0.49	0.41
Nest/bird ratio	0.27	0.24	0.24	0.5	0.22	-	-	-	0.53	0.36	0.24	-

Table 14
Annual Fluctuations in the Occurrence of Night Heron *Nycticorax nycticorax* in the Marshy Enclosure
(Baker estate) - 1992-93

Months	1992					1993						
	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
Adult	33	38	49	85	23	12	35	82	15	43	59	34
Immature	17	19	23	16	12	2	6	32	7	11	23	17
Nest	-	-	-	-	-	-	-	2	4	7	4	1
Density/* Hectare	6.6	7.6	9.8	17	4.6	2.4	7	16.4	3	8.6	11.8	6.8
Immature/ adult ratio	0.52	0.5	0.46	0.19	0.52	0.17	0.17	0.39	0.47	0.26	0.39	0.5
Nest/bird ratio	-	-	-	-	-	-	-	0.024	0.27	0.16	0.07	-

Table 15
Annual Fluctuations in the Occurrence of Egrets in the Marshy Enclosure
(Baker estate)-1992-93

Months Birds	1992					1993						
	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
<i>Egretta garzetta</i>												
Actual No.	11	16	21	7	-	9	-	51	18	6	17	26
Density/Ha	2.2	3.2	4.2	1.4	0	1.8	0	10.2	3.6	1.2	3.4	5.2
<i>E. intermedia</i>												
Actual No.	8	7	4	11	2	2	-	-	-	-	2	2
Density/Ha	1.6	1.4	0.8	2.2	0.4	0.4	0	0	0	0	0.4	0.4
<i>Bubulcus ibis</i>												
Actual No.	4	2	-	7	-	2	6	9	13*	11*	-	-
Density/ha	0.8	0.4	0	1.4	0	0.4	1.2	1.8	2.6	2.2	0	0

*Males assumed nuptial plumage

Table 16
Birds which Infrequently Appeared in the Marshy Enclosure during August 1992–July 1993

Months \ Birds	1992					1993						
	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
<i>Ardea purpurea</i> (Purple Heron)	-	-	-	-	-	-	2	-	-	-	-	-
<i>A. cinerea</i> (Grey Heron)	-	-	-	-	-	-	-	-	2	-	-	-
<i>Ardeola grayii</i> (Pond Heron)	4	3	-	-	-	5	2	3	2	-	12	16
<i>Ixobrychus cinnamomeus</i> (Ch. Bittern)	-	-	-	2	-	-	-	-	-	-	-	2
<i>I. flavicollis</i> (Black Bittern)	-	-	-	-	1	-	-	-	-	-	2	-
<i>Egretta alba</i> (Large Egret)	-	-	-	-	-	1	-	-	-	-	-	-
<i>Amaurornis phoenicurus</i> (W.B. Water hen)	1	-	1	-	1	1	-	1	1	2	-	-
<i>Ceryle rudis</i> (Pied King fisher)	4	2	2	-	2	2	-	4	4	2	-	-
<i>Alcedo atthis</i> Blue K. F.	4	2	4	-	4	3	-	1	1	2	-	4
<i>Halcyon smyrnensis</i> (W. B. King Fisher)	2	2	-	-	2	1	1	2	4	2	-	2

Table 17
Annual Fluctuations in the Occurrence of *Phalacrocorax niger* and their Nests in the Marsh – 1993–94

Months	1993					1994						
	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
Adult	1680	1360	1800	1400	1180	-	-	486	2260	2400	1780	1560
Immature	216	124	74	66	-	-	-	-	220	240	312	228
Nest	80	42	14	-	-	-	-	-	98	228	186	160
Density/* Hectare	336	272	360	280	236	0	0	97.2	452	480	356	312
Immature/ adult ratio	0.32	0.09	0.04	0.047	-	-	-	-	0.097	0.1	0.18	0.15
Nest/bird ratio	0.05	0.03	0.008	-	-	-	-	-	0.04	0.095	0.1	0.1

Table 18
Annual Fluctuations in the Occurrence of *Phalacrocorax carbo* and their Nests in the Marsh - 1993-94

Months	1993					1994						
	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
Adult	138	232	400	348	272	-	12	92	284	266	174	218
Immature	16	24	36	29	33	-	-	16	62	46	58	33
Nest	-	-	-	-	-	-	-	-	37	41	23	14
Density/* Hectare	27.6	46.4	80	69.6	54.4	0	2.4	18.4	56.8	53.2	34.8	43.6
Immature/ adult ratio	0.12	0.1	0.09	0.08	0.12	-	-	0.17	0.22	0.17	0.33	0.15
Nest/bird ratio	-	-	-	-	-	-	-	-	0.13	0.15	0.13	0.06

Table 19
Annual Fluctuations in the Occurrence of Shag *Phalacrocorax fuscicollis* and their Nests in the Marshy Enclosure
-1993-94

Months	1993					1994						
	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
Adult	11	24	18	14	8	-	-	16	96	86	48	-
Immature	3	9	-	2	-	-	-	7	14	16	6	-
Nest	-	-	-	-	-	-	-	-	12	14	7	-
Density/* Hectare	2.2	4.8	3.6	2.8	1.6	0	0	3.2	19.2	17.2	9.6	0
Immature/ adult ratio	0.27	0.38	-	0.14	-	-	-	0.44	0.15	0.19	0.13	-
Nest/bird ratio	-	-	-	-	-	-	-	-	0.13	0.16	0.15	-

Table 20
Annual Fluctuations in the Occurrence of Darter *Anhinga rufa* and their Nests in the Marshy Enclosure - 1993-94

Months	1993					1994						
	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
Adult	17	38	12	8	14	-	-	22	27	37	38	22
Immature	9	21	7	2	3	-	-	-	12	7	14	9
Nest	6	14	-	1	-	-	-	4	8	12	14	8
Density/* Hectare	3.4	7.6	2.4	1.6	2.8	0	0	4.4	5.4	7.4	7.6	4.4
Immature/ adult ratio	0.53	0.55	0.58	0.25	0.21	-	-	-	0.44	0.19	0.37	0.4
Nest/bird ratio	0.35	0.37	-	0.125	-	-	-	0.18	0.3	0.32	0.37	0.36

Table 21
Annual Fluctuations in the Occurrence of Night Heron *Nycticorax nycticorax* in the Marshy Enclosure
(Baker Estate) - 1993-94

Months	1993					1994						
	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
Adult	62	71	67	18	47	88	157	245	460	380	220	216
Immature	24	18	31	7	23	16	25	42	68	36	28	19
Nest	-	-	-	-	-	-	4	9	28	16	12	-
Density/* Hectare	12.4	14.2	13.4	3.6	9.4	17.6	31.4	50.8	92	76	44	43.2
Immature/ adult ratio	0.39	0.25	0.46	0.39	0.49	0.18	0.16	0.17	0.15	0.09	0.13	0.09
Nest/bird ratio	-	-	-	-	-	-	0.025	0.04	0.06	0.04	0.05	-

Table 22
Annual Fluctuations in the Occurrence of Egrets in the Marshy Enclosure
(Baker Estate)-1993-94

Birds \ Months	1992					1993						
	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
<i>Egretta garzetta</i>												
Actual No.	4	-	13	7	28	14	18	-	-	8	11	4
Density/Ha	0.8	0	2.6	1.4	5.6	2.8	3.6	0	0	1.6	2.2	0.8
<i>E. intermedia</i>												
Actual No.	-	-	-	4	-	5	7	-	4	-	2	-
Density/Ha	0	0	0	0.8	0	1	1.4	0	0.8	0	0.4	0
<i>Bubulens ibis</i>												
Actual No.	7	7	4	3	6	9	6	5	3*	4*	-	-
Density/ha	1.4	1.4	0.8	0.6	1.2	1.8	1.2	1	0.6	0.8	0	0

*Males assumed nuptial plumage

Table 23

Birds which Infrequently Appeared in the Marshy Enclosure during August 1993–July 1994 and August 1994–July 1995

A. 1993–94

Months	1993					1994						
	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June	July
Birds												
<i>Ardeola grayii</i>	–	2	–	7	4	11	9	–	–	3	–	–
<i>Ixobrychus cinnamoneus</i>	–	–	–	–	–	–	–	–	–	2	–	2
<i>Ixobrychus flavicollis</i>	–	–	–	–	2	–	–	–	–	–	4	–
<i>Amaurornis phoenicurus</i>	1	1	–	2	2	1	1	–	1	1	–	2
<i>Ceryle rudis</i>	–	2	–	2	–	–	–	–	2	–	2	2
<i>Alcedo atthis</i>	4	2	2	–	2	2	4	2	–	–	2	4
<i>Halcyon smyrnensis</i>	1	2	1	–	1	1	2	2	1	1	2	2

B. 1994–1995

Months	1994					1995						
	Aug	Sept	Oct	Nove.	Dec.	Jan.	Feb	Mar.	April	May	June	July
<i>Ardeola grayii</i>	3	–	–	11	2	7	6	–	–	3	2	12
<i>Amaurornis phoenicurus</i>	–	–	1	–	–	–	–	–	1	–	–	–
<i>Ceryle rudis</i>	2	–	–	–	2	–	2	2	–	2	–	2
<i>Alcedo atthis</i>	4	8	2	3	2	4	–	6	–	–	3	2
<i>Halcyon smyrnensis</i>	–	2	2	–	–	4	–	1	–	1	2	2

Table 24
Annual Variations in the Occurrence of Little Cormorants *Phalacrocorax niger* and their Nests in the Marshy Enclosure (Baker Estate) - 1994-95

Month	1994					1995						
	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.
Adult	1020	412	326	286	-	-	-	-	238*	166*	242*	268
Immature	18	22	-	-	-	-	-	-	-	-	-	-
Nest	24	14	-	-	-	-	-	-	16	18	18	-
Density/ Hectare	204	82.4	65.2	57.2	0	0	0	0	47.6	33.2	48.2	53.6
Immature/ adult ratio	0.018	0.053	-	-	-	-	-	-	-	-	-	-
Nest/bird ratio	0.024	0.034	-	-	-	-	-	-	0.067	0.108	0.074	-

*Cormorants on the rubber trees at the edge of the marsh

Table 25
Annual Variations in the Occurrence of Large Cormorants *Phalacrocorax carbo* and their Nests in the Marshy Enclosure (Baker Estate) - 1994-95

Month	1994					1995						
	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.
Adult	206	112	60	-	-	-	-	-	-	-	-	-
Immature	28	14	-	-	-	-	-	-	-	-	-	-
Nest	-	-	-	-	-	-	-	-	-	-	-	-
Density/* Hectare	41.2	22.4	12	0	0	0	0	0	0	0	0	0
Immature/ adult ratio	0.14	0.125	-	-	-	-	-	-	-	-	-	-
Nest/bird ratio	-	-	-	-	-	-	-	-	-	-	-	-

Table 26
Annual Variations in the Occurrence of Shags *Phacrocorax fuscicollis* and their Nests in the Marshy Enclosure (Baker Estate) - 1994-95

Month	1994					1995						
	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.
Adult	6	4				9	5	-	-	-	4	2
Immature	2	1				4	1	-	-	-	1	1
Nest	-	-				-	-	-	-	-	-	-
Density/* Hectare	1.2	0.8				1.8	1	-	-	-	0.8	0.4
Immature/ adult ratio	0.33	0.25	No sighting			0.44	0.2	-	-	-	0.25	0.5
Nest/bird ratio	-	-				-	-	-	-	-	-	-

Table 27
Annual Fluctuations in the Occurrence of Darters *Anhinga rufa* and Nests in the Marshy Enclosure
(Baker Estate) – 1994–95

Month	1994					1995						
	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.
Adult	23	16	12	14	22	-	-	-	21*	22*	18*	12*
Immature	7	9	4	-	-	-	-	-	-	-	4	-
Nest	6	-	-	-	-	-	-	-	-	12	6	-
Density/ Hectare	4.6	3.2	2.4	2.8	4.4	0	0	0	4.2	4.4	3.6	2.4
Immature/ adult ratio	0.3	0.56	0.33	-	-	-	-	-	-	-	0.22	-
Nest/bird ratio	0.26	-	-	-	-	-	-	-	-	0.55	0.33	-

* Birds on the rubber trees at the bank of the marsh

Table 28
Annual Fluctuations in the Occurrence of Night heron *Nycticorax nycticorax* and their Nests in the Marshy Enclosure (Baker Estate) – 1994–95

Month	1994					1995						
	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.
Adult	326	312	364	224	388	362	186	198	120	216	330	368
Immature	66	32	38	32	44	-	-	-	14	34	62	66
Nest	-	-	-	-	-	-	-	4	12	22	-	-
Density/ Hectare	65.2	62.4	72.8	44.8	77.6	72.4	37.2	39.6	24	43.2	66	73.6
Immature/ adult ratio	0.2	0.1	0.1	0.14	0.11	-	-	-	0.12	0.16	0.19	0.18
Nest/bird ratio	-	-	-	-	-	-	-	0.02	0.1	0.1	-	-

Table 29
Annual Fluctuations in the Occurrence of Egrets in the Marshy Enclosure (Baker Estate) – 1994–95

Birds	Months	94					95						
		Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July
<i>Egretta garzetta</i>													
Actual No		28	14	32	23	36	42	34	16	11	9	12	16
Density/Ha		5.6	2.8	4.6	6.4	7.2	8.4	6.8	3.2	2.2	1.8	2.4	3.2
<i>E. intermedia</i>													
Actual No.		6	–	2	3	4	2	3	–	–	–	1	2
Density/Ha		1.2	0	0.4	0.6	0.8	0.4	0.6	0	0	0	0.2	0.4
<i>Bubulcus ibis</i>													
Actual No.		12	18	9	17	25	14	21	7	4	2	7	4
Density/Ha		2.4	3.6	1.8	3.4	5	2.8	4.2	1.4	0.8	0.4	1.4	0.8

Table 30
Nests of Birds in the Sanctuary

1992-93

Birds	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July
Little Corm.	32	22	11	9	-	-	-	-	83	375	316	108
Large Corm.	-	-	-	-	-	-	-	7	19	13	5	-
Shag	-	-	-	-	-	-	-	-	22	36	18	-
Darter	7	9	11	7	6	-	-	-	10	13	9	-
N. Heron	-	-	-	-	-	-	-	2	4	7	4	-

1993-94

Little Corm.	80	42	14	-	-	-	-	-	98	228	186	160
Large Corm.	-	-	-	-	-	-	-	-	37	41	23	14
Shag	-	-	-	-	-	-	-	-	12	14	7	-
Darter	6	14	-	1	-	-	-	4	8	12	14	8
N. Heron	-	-	-	-	-	-	4	9	28	16	12	-

1994-95

Little Corm.	24	14	-	-	-	-	-	-	16	18	18	-
Large Corm.	-	-	-	-	-	-	-	-	-	-	-	-
Shag	-	-	-	-	-	-	-	-	-	-	-	-
Darter	6	-	-	-	-	-	-	-	-	12	6	-
N. Heron	-	-	-	-	-	-	-	4	12	22	-	-

Table 31
Birds of Prey and Nestling/egg Pirates which Visited the Marshy Enclosure during 93-95 (Baker Estate)

Bird	1993		1994		1995		Sightings
	Jan	Feb	Jan	Feb	Jan	Feb	Total sightings
<i>Milvus migrans</i>	2	2	-	-	1	2	7
<i>Haliaeetus indus</i>	-	-	2	2	1	-	5
<i>Dendrocitta vagabunda</i>	4	2	2	2	4	2	16
<i>Centropus sinensis</i>	1	2	-	-	2	2	7
<i>Corvus splendens</i>	6	5	3	8	4	5	31
<i>C. macrorhynchos</i>	1	1	-	-	-	2	4
<i>Circus aeruginosus</i>	-	-	-	-	-	1	1
Total birds	14	12	7	12	12	14	71

Table 32
Birds Observed in the Baker Estate (KTDC Complex) Excluding the Marshy Enclosure-1992-93

Months	1992					1993						
	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July
Birds												
<i>Phalacrocorax niger</i>	98	92	30	48	65	89	108	83	92*	126*	116	107
<i>Ph. carbo</i>	-	-	-	-	-	-	-	-	18	35*	32*	26
<i>Anhinga rufa</i>	14*	17*	12	16	13	8	10	-	18*	11*	14*	12
<i>Nycticorax nycticorax</i> ⁺	39	42	24	68	72	44	36	48	66*	70*	42*	44
<i>Egretta garzetta</i>	68	28	48	44	56	8	16	18	28	88*	96*	74
<i>E. intermedia</i>	-	-	-	4	8	7	11	4	-	-	-	2
<i>Bubulcus ibis</i>	26	22	42	58	64	32	24	32	98*	63*	7	-
<i>Ardeola grayii</i>	48	76	80	72	94	24	25	46	78	128*	96*	24
<i>Ardea purpurea</i> ⁺	-	-	2	2	-	-	-	-	-	2	-	-
<i>Amaurormis phoenicurus</i>	6	2	-	-	4	4	2	-	1	4	1	2
<i>Ceryle rudis</i>	6	2	4	2	-	2	4	6	6	8	2	2
<i>Alcedo atthis</i>	18	6	12	10	-	8	7	2	8	12	4	8
<i>Halcyon Smyrnensis</i>	2	4	4	6	7	4	12	8	12	9	6	3
<i>Ixobrychus cinnamoneus</i>	-	-	2	-	-	-	1	-	-	-	-	1
<i>Ixobrychus flavicollis</i>	1	-	-	2	-	-	-	-	-	-	-	-
<i>Ixobrychus sinensis</i>	-	-	-	-	1	-	-	-	-	-	-	-
No. of species in each month	11	10	11	12	10	11	12	9	11	12	11	13

*Nesting colonies ⁺Night Herons and Purple Herons only in the magrove thickets adjoining the eastern banks of Vembanadu lake.

Table 33
Birds Observed in the Baker Estate (KTDC Complex) Excluding the Marshy Enclosure - 1993-94

Months \ Birds	1993					1994						
	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July
Phalacrocorax niger	88	80	102	64	72	16	22	34	62*	86*	74	42
Ph. carbo	24	22	24	30	22	-	-	-	-	-	-	-
Anhinga rufa	21*	26	20	14	16	14	-	12	12*	12*	14	19
Nycticorax nycticorax ⁺	38	42	36	48	42	34	28	32	48	56*	60*	44
Egretta garzetta	16	21	28	7	-	4	16	22	42	68*	58*	20
E. intermedia	-	-	-	-	8	2	2	2	4	-	-	5
Bubulcus ibis	2	8	14	18	22	4	8	2	16	28	-	-
Ardeola grayii	8	20	11	14	22	7	13	21	16	88*	60*	18
Ardea purpurea ⁺	-	2	-	-	2	2	-	-	-	-	-	-
Amauornis phoenicurus	2	1	1	-	-	1	1	3	2	1	4	1
Ceryle rudis	2	2	2	2	-	-	2	2	-	-	2	-
Alcedo atthis	6	8	4	4	-	2	4	4	2	-	6	4
Halcyon Smyrnensis	2	-	-	-	2	-	6	2	2	2	4	2
Ixobrychus cinnamoneus	-	-	-	-	2	-	-	-	-	-	-	-
Ixobrychus flavicollis	-	-	-	2	-	-	-	-	-	-	-	-
Ixobrychus sinensis	-	-	-	-	-	1	-	-	-	-	-	-
No. of species in each month	11	11	10	10	10	11	10	11	9	7	10	10

*Nesting colonies ⁺ Only in the mangrove thickets.

Table 34
Birds Observed in the Baker Estate (KTDC Complex) Excluding the Marshy Enclosure - 1994-95

Months \ Birds	1994					1995						
	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July
Phalacrocorax niger	40	44	62	64	38	22	28	46*	58*	67*	48	26
Anhinga rufa	14	20	22	18	16	16	-	-	26*	24*	18	-
Nycticorax nycticorax	64	58	44	40	34	28	30	32	48*	62*	60*	43
Egretta garzetta	19	18	20	12	10	14	12	16	28	36*	48*	16
E. intermedia	-	-	-	-	2	-	-	4	-	2	-	3
Bubulcus ibis	7	5	16	9	4	-	18	8	-	4	-	-
Ardeola grayii	16	22	12	18	11	16	29	36	46*	66*	42*	9
Ardea purpurea	-	-	-	6	-	4	3	-	-	-	-	-
Amaurormis phoenicurus	1	2	-	1	1	3	2	-	1	-	2	2
Ceryle rudis	-	2	-	2	1	4	2	2	-	-	-	-
Alcedo atthis	6	3	11	4	-	7	2	2	6	2	2	4
Halcyon smyrnensis	-	-	-	2	2	1	-	-	4	-	2	2
Ixobrychus cinnamoneus	-	-	-	1	-	-	-	1	-	-	-	1
Ixobrychus flavicollis	-	-	-	2	1	2	-	-	-	-	-	-
No. of species in each month	8	9	7	13	11	11	9	9	8	8	9	10

*Nesting colonies

Table 35

Total Number of Species of Water Birds Appeared in each Month in the Bird Sanctuary during 1992-95 Period

A. Marshy Enclosure

Months/Period	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July
92-93	12	11	10	9	10	11	6	12	13	11	9	11
93-94	10	11	9	11	12	8	9	8	10	11	11	11
94-95	10	8	10	8	8	7	6	6	8	9	9	10

B. Baker Estate Excluding the Marshy Enclosure

Months/Period	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July
92-93	11	10	11	12	10	11	12	9	11	12	11	13
93-94	11	11	10	10	10	11	10	11	9	7	10	10
94-95	8	9	7	13	11	11	9	9	8	8	9	10

Table 36
Birds Observed at Vembanad Lake (Kavanar-Pathiramanal Stretch) 1994: January-December

No.	Birds	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec
1	<i>Phalacrocorax niger</i>	38	56	131	123	128	42	33	26	79	68	82	73
2	<i>Phalacrocorax carbo</i>	-	14	23	26	17	12	18	29	40	42	36	32
3	<i>Phalacrocorax fuscicollis</i>	-	-	4	7	-	2	-	-	9	13	11	6
4	<i>Anhinga rufa</i>	-	2	-	-	3	-	-	7	4	6	7	4
5	<i>Nycticorax nycticorax</i>	8	11	16	17	4	2	4	11	14	11	11	12
6	<i>Ardeola grayii</i>	16	8	22	11	4	6	24	12	20	18	6	18
7	<i>Dendrocygna javanica</i>	140	140	80	70	4	-	-	12	32	80	140	130
8	<i>Nettapus coramandelianus</i>	2	6	-	4	-	7	-	4	8	8	8	10
9	<i>Anas acuta</i>	600	480	520	28	-	-	-	-	420	800	740	840
10	<i>Anas crecca</i>	680	860	420	260	-	-	-	-	340	530	600	800
11	<i>Anas querquedula</i>	920	1000	1200	700	-	-	-	-	400	600	1000	1000
12	<i>Larus ridibundus</i>	16	12	12	8	-	-	-	-	2	8	11	18
13	<i>Larus brunnicephalus</i>	41	36	37	18	-	-	-	-	8	24	44	59
14	<i>Larus fuscus</i>	14	14	7	-	-	-	-	-	-	14	13	17
15	<i>Chlidonias hybridus</i>	28	31	19	-	-	-	-	18	36	40	42	39
16	<i>Sterna albifrons</i>	4	-	-	-	-	-	-	3	-	-	5	9
17	<i>Hydroprogne caspia</i>	-	-	-	-	-	-	-	-	-	-	2	-

Table 37
Birds Observed at Vembanad Lake (Kavanar-Pathiramanal Stretch) 1995: January-December

No.	Birds	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec
1	<i>Phalacrocorax niger</i>	66	82	38	48	112	108	36	62	120	148	160	128
2	<i>Phalacrocorax carbo</i>	12	6	22	16	14	32	18	14	21	26	34	30
3	<i>Phalacrocorax fuscicollis</i>	-	-	-	-	9	-	-	4	8	-	11	5
4	<i>Anhinga rufa</i>	6	4	4	-	9	-	-	7	4	-	5	4
5	<i>Nycticorax nycticorax</i>	8	12	14	18	4	6	3	9	11	10	2	8
6	<i>Ardeola grayii</i>	13	7	4	12	2	-	-	4	14	18	20	27
7	<i>Dendrocygna javanica</i>	60	48	20	36	-	-	-	8	18	32	30	64
8	<i>Nettapus coramandelianus</i>	8	8	8	4	4	-	-	6	6	12	12	8
9	<i>Anas acuta</i>	960	860	700	-	-	-	-	-	600	800	880	1200
10	<i>Anas crecca</i>	320	240	200	280	-	-	-	-	460	480	640	720
11	<i>Anas querquedula</i>	1200	1000	700	400	-	-	-	-	380	480	600	900
12	<i>Larus ridibundus</i>	18	14	10	4	-	-	-	-	12	23	18	21
13	<i>Larus brunnicephalus</i>	37	33	18	-	-	-	-	-	4	26	33	38
14	<i>Larus fuscus</i>	14	11	4	-	-	-	-	-	6	14	17	18
15	<i>Chlidonias hybridus</i>	32	25	14	17	-	-	-	4	8	36	44	46
16	<i>Sterna albifrons</i>	7	-	2	-	-	-	-	-	-	9	6	8
17	<i>Hydroprogne caspia</i>	2	-	-	-	-	-	-	-	-	-	-	-

Table 38
Birds Observed at Pathiramanal Island 1994: January–December

No.	Birds	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec
1	<i>Phalacrocorax niger</i>	44	82	264	414	265	352	680	560	590	620	640	400
2	<i>Phalacrocorax carbo</i>	28	24	66	68	96	160	156	82	110	125	90	68
3	<i>Phalacrocorax fuscicollis</i>	12	19	44	42	58	52	46	34	30	-	-	22
4	<i>Anhinga rufa</i>	-	8	6	-	-	-	-	-	-	-	-	-
5	<i>Nycticorax nycticorax</i>	68	56	79	120	112	216	188	160	124	86	92	78
6	<i>Ardeola grayii</i>	16	22	18	11	4	-	-	18	13	7	11	17
7	<i>Egretta garzetta</i>	18	13	14	16	11	7	4	9	14	19	17	14
8	<i>Egretta intermedia</i>	4	1	2	-	-	-	2	2	3	1	1	3
9	<i>Egretta alba</i>	2	-	-	-	-	-	-	-	2	1	2	2
10	<i>Bubulcus ibis</i>	2	6	3	-	-	-	-	8	6	3	3	2
11	<i>Ixobrychus cinnamomeus</i>	-	-	-	2	-	-	-	-	-	-	-	1
12	<i>Ixobrychus flavicollis</i>	4	-	-	-	-	-	-	-	2	-	-	-
13	<i>Ixobrychus sinensis</i>	-	-	1	-	-	-	-	-	-	-	-	-
14	<i>Amaurornis phoenicurus</i>	1	-	-	-	1	-	-	-	-	1	1	-
15	<i>Vanellus indicus</i>	4	4	2	6	-	2	4	8	6	4	4	6
16	<i>Vanellus malabaricus</i>	-	2	-	-	-	-	2	-	-	-	2	2
17	<i>Tringa ochropus</i>	2	4	-	-	-	-	-	-	2	-	4	4
18	<i>Tringa hypoleucos</i>	6	8	2	-	-	-	-	-	4	6	8	6
19	<i>Tringa glareola</i>	18	22	16	-	-	-	-	-	6	14	20	24
20	<i>Larus ridibundus</i>	21	16	18	-	-	-	-	-	-	12	22	25
21	<i>Larus brunnicephalus</i>	64	46	48	-	-	-	-	-	-	22	54	68
22	<i>Larus fuscus</i>	7	4	-	-	-	-	-	-	-	2	6	9
23	<i>Chlidonias hybridus</i>	12	4	-	-	-	-	-	-	-	4	-	6
24	<i>Sterna albifrons</i>	2	-	-	-	-	-	-	-	-	-	4	2
25	<i>Alcedo atthis</i>	8	2	4	2	-	-	-	4	2	-	-	2
26	<i>Halcyon smyrnensis</i>	2	-	-	-	2	-	-	-	-	1	-	1

Table 39
Birds Observed at Pathiramanal Island 1995: January-December

No.	Birds	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec
1	<i>Phalacrocorax niger</i>	268	240	450	610	560	680	840	720	620	660	600	580
2	<i>Phalacrocorax carbo</i>	42	34	45	40	158	166	192	140	102	106	124	65
3	<i>Phalacrocorax fuscicollis</i>	26	24	34	38	58	62	70	43	18	20	22	24
4	<i>Anhinga rufa</i>	-	-	-	-	-	-	-	-	-	-	12	14
5	<i>Nycticorax nycticorax</i>	84	66	92	148	166	192	156	124	88	82	84	74
6	<i>Ardeola grayii</i>	21	28	19	16	-	-	-	9	14	12	18	16
7	<i>Egretta garzetta</i>	11	7	12	-	-	-	7	13	17	14	16	14
8	<i>Egretta intermedia</i>	3	2	1	-	-	-	-	-	1	3	4	2
9	<i>Egretta alba</i>	2	2	-	-	-	-	-	-	-	3	2	2
10	<i>Bubulcus ibis</i>	4	4	8	-	-	-	-	4	3	7	6	4
11	<i>Ixobrychus cinnamomeus</i>	2	-	-	-	-	-	-	-	-	-	-	-
12	<i>Ixobrychus flavicollis</i>	-	-	2	-	-	-	-	-	2	-	-	-
13	<i>Ixobrychus sinensis</i>	-	2	-	-	-	-	-	-	-	-	-	-
14	<i>Amauornis phoenicurus</i>	-	2	-	-	1	-	-	-	2	-	-	1
15	<i>Vanellus indicus</i>	6	2	2	8	2	-	4	4	6	6	4	4
16	<i>Vanellus malabaricus</i>	2	-	-	1	-	-	-	-	1	-	2	2
17	<i>Tringa ochropus</i>	4	2	-	-	-	-	-	-	-	2	2	2
18	<i>Tringa hypoleucos</i>	4	4	2	-	-	-	-	-	-	2	6	6
19	<i>Tringa glareola</i>	20	16	18	-	-	-	-	-	4	8	14	18
20	<i>Larus ridibundus</i>	22	24	16	-	-	-	-	-	-	14	22	26
21	<i>Larus brunnicephalus</i>	62	58	42	-	-	-	-	-	-	26	58	56
22	<i>Larus fuscus</i>	11	13	8	-	-	-	-	-	-	4	12	13
23	<i>Chlidonias hybridus</i>	8	4	-	-	-	-	-	-	-	16	14	8
24	<i>Sterna albifrons</i>	6	2	-	-	-	-	-	-	-	-	-	-
25	<i>Alcedo atthis</i>	3	1	-	2	-	2	-	4	2	2	5	1
26	<i>Halcyon smymensis</i>	2	-	-	-	2	1	-	-	-	1	-	-
27	<i>Ceryle rudis</i>	-	-	2	-	-	-	-	-	-	-	-	-

Table 40
Birds Observed at the Reclaimed Paddy Fields (Rani, Chithira, Marthandom and R-block) and Southern Stretches of Vembanad - 1994 January-December

No.	Birds	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec
1	Phalacrocorax niger	86	120	136	224	180	68	-	64	188	212	170	136
2	Phalacrocorax carbo	6	4	-	-	-	-	-	14	12	-	7	3
3	Phalacrocorax fuscicollis	-	-	-	-	2	-	-	-	-	-	6	-
4	Anhinga rufa	-	2	-	-	-	-	-	-	-	-	4	-
5	Nycticorax nycticorax	18	12	23	14	17	13	-	12	20	17	12	22
6	Ardeola purpurea	-	-	2	4	2	4	4	7	-	1	-	-
7	Ardea cinerea	-	2	-	-	2	-	-	-	-	2	-	-
8	Ardeola grayii	28	34	62	12	-	2	4	6	66	47	88	26
9	Butorides striatus	1	-	-	1	1	-	-	2	2	-	1	1
10	Egretta garzetta	32	40	48	14	16	12	-	12	66	64	48	44
11	Egretta intermedia	8	5	-	-	-	-	-	-	4	2	2	-
12	Egretta alba	-	1	1	-	-	-	-	-	-	-	-	-
13	Bubulcus ibis	12	39	34	-	-	-	-	12	14	27	26	18
14	Ixobrychus cinnamoneus	-	-	1	-	-	-	-	-	-	2	-	1
15	Ixobrychus flavicollis	2	-	-	2	-	-	-	-	1	-	-	2
16	Ixobrychus sinensis	-	1	-	-	-	-	-	-	-	1	-	-
17	Podiceps ruficollis	-	14	14	16	14	-	-	-	13	16	14	7
18	Nettapus coramandelianus	6	6	4	4	2	-	-	2	-	8	8	8
19	Dendrocygna javanica	160	90	70	50	-	-	-	-	7	110	160	130
20	Anas acuta, A. querquedula and A. crecca	2000	3000	2100	-	-	-	-	-	-	-	800	2400
21	Porzana fusca	-	-	2	-	-	-	-	-	3	2	3	2
22	Rallina eurizonoides	4	6	1	-	-	-	-	-	-	2	5	3
23	Rallus striatus	1	-	1	-	2	-	-	-	-	1	2	1
24	Amaurornis phoenicurus	3	1	-	1	4	-	-	-	-	2	1	1
25	Gallicrex cinerea	4	1	6	1	-	-	3	-	2	1	1	2
26	Gallinula chloropus	1	2	2	4	2	-	-	4	-	2	4	6
27	Porphyrio porphyrio	16	18	28	12	17	4	-	-	-	-	9	14
28	Metopidius indicus	2	3	4	7	2	1	-	-	-	2	6	5
29	Hydrophasianus chirurgus	-	6	4	12	-	-	-	3	9	5	-	7
30	Vanellus indicus	8	6	6	4	-	-	-	-	-	4	4	4

Table 40 conti.....

No.	Birds	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec
31	<i>Vanellus malabaricus</i>	2	2	-	-	-	-	-	-	-	-	1	2
32	<i>Charadrius dubius</i>	133	130	138	82	-	-	-	-	-	-	84	88
33	<i>Charadrius alexandrinus</i>	22	28	24	-	-	-	-	-	-	-	12	20
34	<i>Tringa totanus</i>	7	2	4	4	-	-	-	-	-	-	6	11
35	<i>Tringa nebularia</i>	1	-	1	-	-	-	-	-	-	-	2	-
36	<i>Tringa ochropus</i>	2	2	4	2	-	-	-	-	-	-	4	4
37	<i>Tringa hypoleucos</i>	22	16	18	8	-	-	-	-	-	8	12	15
38	<i>Tringa glareola</i>	1	2	-	-	-	-	-	-	-	-	-	-
39	<i>Chlidonia hybridus</i>	168	126	132	18	-	-	-	-	8	22	114	140
40	<i>Sterna albifrons</i>	6	14	9	4	-	-	-	-	2	-	-	2
41	<i>Hydroprogne caspia</i>	-	-	-	-	-	-	-	-	-	-	4	-
42	<i>Alcedo atthis</i>	8	14	-	2	4	4	-	2	8	5	3	6
43	<i>Halcyon Smyrnensis</i>	4	12	-	-	-	2	-	6	4	14	7	9
44	<i>Ceryle rudis</i>	-	2	2	2	-	-	-	4	2	2	4	-
45	<i>Pelargopsis capensis</i>	3	2	2	4	1	2	-	-	1	2	2	3
46	<i>Phoenicopterus roseus*</i>											2	

* Seen on 8.11.1994 (2 nos) and 10.11.94 (2 nos)—could be the same.

Table 41
Birds Observed at the Reclaimed Paddy Fields and Southern Stretches of Vembanad- 1995 January-December

No.	Birds	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec
1	<i>Phalacrocorax niger</i>	112	82	146	210	136	82	108	74	136	220	210	168
2	<i>Phalacrocorax carbo</i>	8	-	-	2	11	4	-	4	6	3	5	9
3	<i>Phalacrocorax fuscicollis</i>	-	7	-	-	-	-	-	-	3	9	-	-
4	<i>Anhinga rufa</i>	-	2	-	-	-	-	-	-	1	-	2	4
5	<i>Nycticorax nycticorax</i>	24	21	36	24	14	12	14	18	21	22	29	24
6	<i>Ardeola purpurea</i>	-	-	-	2	2	6	3	4	2	4	2	-
7	<i>Ardea cinerea</i>	-	1	-	3	-	-	2	-	1	-	2	-
8	<i>Ardeola grayii</i>	42	40	98	16	8	6	14	19	17	48	123	82
9	<i>Butorides striatus</i>	2	1	-	-	-	-	-	-	1	-	-	-
10	<i>Egretta garzetta</i>	32	38	22	14	14	18	-	29	58	69	48	46
11	<i>Egretta intermedia</i>	-	-	3	-	-	-	-	-	-	7	2	3
12	<i>Egretta alba</i>	-	-	1	-	-	-	-	-	1	-	-	-
13	<i>Bubulcus ibis</i>	16	12	8	6	-	-	-	-	17	24	27	20
14	<i>Ixobrychus cinnamomeus</i>	2	1	-	-	-	-	-	-	-	1	1	-
15	<i>Ixobrychus flavicollis</i>	1	-	-	1	-	-	-	-	-	2	-	3
16	<i>Ixobrychus sinensis</i>	-	1	-	-	-	-	-	-	-	-	2	-
17	<i>Podiceps ruficollis</i>	17	15	14	11	-	-	-	-	14	14	16	10
18	<i>Nettapus coramandelianus</i>	8	4	-	6	-	-	-	4	6	6	4	8
19	<i>Dendrocygna javanica</i>	100	120	70	-	-	-	-	7	80	130	110	140
20	<i>Anas acuta, A. querquedula and A. crecca</i>	3000	1900	2100	-	-	-	-	-	-	600	1700	3200
21	<i>Porzana fusca</i>	4	4	1	-	-	-	-	1	-	2	3	3
22	<i>Rallina eurizonoides</i>	3	4	2	2	-	1	-	-	3	2	5	2
23	<i>Rallus striatus</i>	-	-	1	1	2	-	-	1	-	1	-	-
24	<i>Amaurornis phoenicurus</i>	1	-	2	2	2	-	1	-	1	-	2	2
25	<i>Gallixrex cinerea</i>	-	-	1	1	-	-	1	-	-	-	1	-
26	<i>Gallinula chloropus</i>	4	1	2	5	1	-	1	-	2	2	3	1
27	<i>Porphyrio porphyrio</i>	22	19	11	16	-	-	-	-	-	4	8	14
28	<i>Metopidius indicus</i>	3	3	2	6	2	-	1	-	1	1	2	2
29	<i>Hydrophasianus chirurgus</i>	4	-	7	11	4	-	4	-	6	2	-	4
30	<i>Vanellus indicus</i>	2	4	4	2	-	2	-	-	2	4	4	8

Table 41 contd.....

No.	Birds	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec
31	<i>Vanellus malabaricus</i>	2	2	-	-	-	-	1	-	-	2	2	1
32	<i>Charadrius dubius</i>	148	82	74	44	-	-	-	-	-	63	128	142
33	<i>Charadrius alexandrinus</i>	20	22	24	-	-	-	-	-	-	12	14	18
34	<i>Tringa totanus</i>	14	10	12	-	-	-	-	-	-	8	14	11
35	<i>Tringa nebularia</i>	-	-	2	-	-	-	-	-	-	-	1	1
36	<i>Tringa ochropus</i>	4	6	2	-	-	-	-	-	-	2	4	4
37	<i>Tringa hypoleucos</i>	14	16	4	-	-	-	-	-	-	12	18	14
38	<i>Tringa glareola</i>	2	2	-	-	-	-	-	-	-	2	2	4
39	<i>Rostratula benghalensis</i>	-	1	1	-	1	-	-	-	-	1	1	1
40	<i>Chlidonia hybridus</i>	240	180	220	40	-	-	-	-	14	36	86	124
41	<i>Sterna albifrons</i>	4	8	2	-	-	-	-	-	-	-	4	12
42	<i>Alcedo atthis</i>	4	7	-	-	-	4	-	12	8	7	11	6
43	<i>Halcyon Smyrnensis</i>	7	5	3	-	-	-	-	2	8	3	9	8
44	<i>Ceryle rudis</i>	-	2	4	4	2	-	2	4	4	2	-	-
45	<i>Pelargopsis capensis</i>	2	3	4	1	1	-	2	4	2	1	3	4

Table 42
Birds Observed at Kuttanad — Kumarakom - Chengalam Region-1994 (January-December)

No.	Birds	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec
1	<i>Phalacrocorax niger</i>	12	3	8	22	13	18	-	31	17	23	19	8
2	<i>Anhinga rufa</i>	-	-	2	1	-	-	-	1	-	1	-	-
3	<i>Ardeola grayii</i>	14	22	84	112	48	22	-	17	88	264	120	36
4	<i>Butorides striatus</i>	2	1	-	-	-	-	-	1	-	1	-	1
5	<i>Egretta garzetta</i>	46	33	46	32	30	22	-	152	218	420	164	68
6	<i>Egretta intermedia</i>	7	2	-	4	-	-	-	1	3	-	5	1
7	<i>Bubulcus ibis</i>	18	21	34	26	12	-	-	14	38	88	64	11
8	<i>Ixobrychus cinnamoneus</i>	1	2	-	2	-	-	-	-	1	-	2	1
9	<i>Ixobrychus flavicollis</i>	-	2	-	-	-	-	1	-	-	2	-	-
10	<i>Ixobrychus sinensis</i>	1	-	-	-	1	-	-	-	-	1	-	-
11	<i>Podiceps ruficollis</i>	-	-	16	17	18	14	-	-	7	12	13	15
12	<i>Nettapus coramandelianus</i>	8	8	12	18	5	6	-	2	-	2	4	12
13	<i>Dendrocygna javanica</i>	14	12	6	8	8	8	-	-	-	-	12	13
14	<i>Gallinula chloropus</i>	2	-	-	-	-	-	1	-	-	-	2	-
15	<i>Porphyrio porphyrio</i>	2	1	1	7	3	-	-	4	-	-	3	-
16	<i>Amauornis phoenicurus</i>	2	1	-	-	2	-	2	-	4	1	2	-
17	<i>Vanellus indicus</i>	2	-	2	-	-	-	-	-	2	-	2	-
18	<i>Charadrius dubius</i>	14	11	8	-	-	-	-	-	-	-	18	14
19	<i>Charadrius alexandrinus</i>	23	19	16	-	-	-	-	-	-	12	13	18
20	<i>Himantopus himantopus</i>	4	4	2	-	-	-	-	-	-	4	4	4
21	<i>Tringa hypoleucos</i>	28	22	25	-	-	-	-	-	-	12	22	24
22	<i>Tringa ochropus</i>	6	4	3	-	-	-	-	-	-	-	2	4
23	<i>Tringa glareola</i>	2	3	-	-	-	-	-	-	-	4	4	4
24	<i>Chlidonias hybridus</i>	186	220	240	-	-	-	-	-	40	200	250	250
25	<i>Sterna albifrons</i>	16	6	9	-	-	-	-	-	2	12	14	10
26	<i>Alcedo atthis</i>	16	6	9	4	7	-	-	2	8	14	10	5
27	<i>Halcyon smyrnensis</i>	2	6	2	1	1	1	-	4	3	5	2	4
28	<i>Ceryle rudis</i>	4	2	2	-	-	-	-	2	2	4	2	4
29	<i>Pelargopsis capensis</i>	2	1	1	1	-	-	1	2	2	4	1	2

Table 43
Birds Observed at Kuttanad — Kumarakom-Chengalam Region — 1995 (January-December)

No.	Birds	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec
1	<i>Phalacrocorax niger</i>	7	3	11	19	12	14	4	9	28	22	18	4
2	<i>Anhinga rufa</i>	1	-	-	-	1	-	-	-	2	1	-	1
3	<i>Ardeola grayii</i>	21	110	144	180	176	36	48	168	330	310	286	68
4	<i>Butorides striatus</i>	1	-	-	2	-	-	-	-	1	-	-	1
5	<i>Egretta garzetta</i>	78	112	96	184	26	14	18	74	95	192	290	85
6	<i>Egretta intermedia</i>	2	4	-	-	-	-	-	1	4	1	2	2
7	<i>Bubulcus ibis</i>	23	36	32	22	-	-	-	28	32	69	43	17
8	<i>Ixobrychus cinnamoneus</i>	2	-	-	1	-	-	-	1	-	-	1	-
9	<i>Ixobrychus flavicollis</i>	-	2	1	-	-	1	-	-	-	-	2	-
10	<i>Ixobrychus sinensis</i>	-	-	1	-	-	-	-	-	-	1	-	-
11	<i>Threskiornis aethiopica</i>	-	-	-	-	12	-	-	-	-	-	-	-
12	<i>Podiceps ruficollis</i>	14	-	-	-	8	13	-	12	16	11	13	12
13	<i>Nettapus coramandelianus</i>	8	10	12	4	3	-	-	2	-	14	11	7
14	<i>Dendrocygna javanica</i>	12	12	10	12	-	-	4	8	6	8	6	12
15	<i>Gallinula chloropus</i>	-	1	-	1	1	-	2	-	-	-	2	-
16	<i>Porphyrio porphyrio</i>	2	1	-	-	-	1	-	2	-	-	2	2
17	<i>Amauornis phoenicurus</i>	1	2	2	-	1	1	-	-	1	3	1	1
18	<i>Vanellus indicus</i>	4	-	2	-	-	-	-	-	2	4	4	2
19	<i>Charadrius dubius</i>	20	12	19	7	-	-	-	-	-	14	16	16
20	<i>Charadrius alexandrinus</i>	20	18	21	-	-	-	-	-	-	12	14	12
21	<i>Himantopus himantopus</i>	4	4	-	-	-	-	-	-	-	4	4	4
22	<i>Tringa hypoleucos</i>	23	24	20	8	-	-	-	-	-	2	16	20
23	<i>Tringa ochropus</i>	4	4	2	-	-	-	-	-	-	4	6	6
24	<i>Tringa glareola</i>	4	2	-	-	-	-	-	-	-	-	-	2
25	<i>Chlidonias hybridus</i>	240	240	140	44	-	-	-	-	16	80	360	380
26	<i>Sterna albifrons</i>	14	9	-	-	-	-	-	-	-	2	4	12
27	<i>Alcedo atthis</i>	9	4	11	-	3	4	10	7	8	11	9	7
28	<i>Halcyon smymensis</i>	2	1	4	2	2	1	4	3	7	1	6	4
29	<i>Ceryle rudis</i>	4	4	2	2	-	-	2	2	4	2	2	-
30	<i>Pelargopsis capensis</i>	1	-	-	-	1	-	-	2	-	3	2	1

Table 44
Birds Observed at Kuttanad — Monkompuzh Region - 1994 (January-December)

No.	Birds	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec
1	<i>Phalacrocorax niger</i>	9	12	17	9	-	-	-	8	14	16	9	11
2	<i>Anhinga rufa</i>	-	-	1	-	-	-	-	1	-	2	1	1
3	<i>Ardeola grayii</i>	32	12	7	43	36	4	8	28	33	77	66	42
4	<i>Butorides striatus</i>	1	-	-	1	-	-	-	-	1	1	-	-
5	<i>Egretta garzetta</i>	18	9	11	21	26	9	5	18	26	32	48	23
6	<i>Egretta intermedia</i>	-	-	-	3	-	-	-	-	-	2	-	1
7	<i>Egretta alba</i>	1	-	-	-	1	-	-	-	2	-	-	1
8	<i>Bubulcus ibis</i>	14	6	17	32	-	3	5	21	24	34	27	19
9	<i>Ixobrychus cinnamomeus</i>	-	2	-	1	-	-	-	-	-	-	1	-
10	<i>Ixobrychus flavicollis</i>	-	-	2	-	-	-	-	-	-	-	-	-
11	<i>Gallicrex cinerea</i>	-	-	1	-	-	1	-	-	2	-	1	1
12	<i>Gallinula chloropus</i>	1	1	-	-	-	-	1	-	1	-	-	2
13	<i>Porzana fusca</i>	2	-	-	1	-	-	-	-	-	-	2	2
14	<i>Rallina eurizonoides</i>	-	2	-	-	-	-	-	-	-	1	1	-
15	<i>Porphyrio porphyrio</i>	7	3	16	6	3	-	-	4	2	-	13	5
16	<i>Amauromis phoenicurus</i>	2	-	6	-	1	-	-	1	-	1	-	2
17	<i>Podiceps ruficollis</i>	17	16	16	18	-	4	-	8	-	15	19	18
18	<i>Charadrius dubius</i>	22	24	22	-	-	-	-	-	-	22	26	35
19	<i>Charadrius alexandrinus</i>	22	19	14	-	-	-	-	-	-	18	14	18
20	<i>Tringa totanus</i>	-	1	2	-	-	-	-	-	-	-	1	-
21	<i>Tringa hypoleucos</i>	26	17	11	4	-	-	-	-	-	3	18	23
22	<i>Tringa ochropus</i>	7	7	4	-	-	-	-	-	-	-	5	7
23	<i>Tringa glareola</i>	2	4	-	-	-	-	-	-	-	-	1	2
24	<i>Himantopus himantopus</i>	2	2	1	-	-	-	-	-	-	-	2	2
25	<i>Chlidonias hybridus</i>	22	18	19	14	-	-	-	-	4	13	24	28
26	<i>Sterna albifrons</i>	2	3	-	-	-	-	-	-	-	1	2	1
27	<i>Alcedo atthis</i>	8	14	6	7	4	2	-	6	2	5	2	2
28	<i>Halcyon smymensis</i>	2	2	4	-	-	-	2	2	3	-	1	1
29	<i>Ceryle rudis</i>	-	2	2	-	2	-	-	2	-	2	-	-
30	<i>Pelargopsis capensis</i>	-	2	-	1	-	-	1	-	-	1	-	2

Table 45
Birds Observed at Kuttanad — Monkompuzh Region - 1995 (January-December)

No.	Birds	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec
1	<i>Phalacrocorax niger</i>	12	9	15	11	7	-	-	6	13	22	18	21
2	<i>Anhinga rufa</i>	1	2	-	-	1	-	-	-	1	-	1	-
3	<i>Ardeola grayii</i>	28	19	11	26	21	6	5	19	38	86	74	38
4	<i>Butorides striatus</i>	-	-	-	1	-	-	-	-	1	-	-	2
5	<i>Egretta garzetta</i>	17	8	15	19	23	-	-	14	23	45	42	18
6	<i>Egretta intermedia</i>	1	-	2	2	-	-	-	-	-	2	1	-
7	<i>Egretta alba</i>	-	1	-	-	-	-	1	-	-	-	1	-
8	<i>Bubulcus ibis</i>	4	2	6	18	22	-	2	15	13	27	18	12
9	<i>Ixobrychus cinnamomeus</i>	-	1	-	-	-	-	-	-	-	1	-	-
10	<i>Ixobrychus flavicollis</i>	2	-	2	-	-	2	2	-	4	-	-	2
11	<i>Gallinula chloropus</i>	2	-	4	-	-	-	-	6	-	-	1	-
12	<i>Gallinula chloropus</i>	1	-	1	-	-	-	-	1	-	-	1	-
13	<i>Porzana fusca</i>	1	2	-	-	-	-	-	2	2	-	1	1
14	<i>Rallina eurizonoides</i>	1	1	-	-	-	-	-	1	-	-	2	1
15	<i>Porphyrio porphyrio</i>	2	4	6	-	-	2	-	-	-	12	6	6
16	<i>Amaurornis phoenicurus</i>	-	1	2	-	-	-	1	-	-	1	-	2
17	<i>Podiceps ruficollis</i>	16	22	20	-	7	-	-	16	16	18	11	19
18	<i>Charadrius dubius</i>	36	28	24	4	-	-	-	-	-	32	38	47
19	<i>Charadrius alexandrinus</i>	14	16	12	-	-	-	-	-	-	12	14	16
20	<i>Tringa totanus</i>	2	4	4	-	-	-	-	-	-	2	-	1
21	<i>Tringa hypoleucos</i>	17	16	6	-	-	-	-	-	-	14	19	21
22	<i>Tringa ochropus</i>	2	6	3	-	-	-	-	-	-	2	2	3
23	<i>Tringa glareola</i>	4	3	-	-	-	-	-	-	-	2	2	2
24	<i>Himantopus himantopus</i>	2	2	-	-	-	-	-	-	-	-	2	2
25	<i>Chlidonias hybridus</i>	17	21	16	4	-	-	-	-	2	8	13	35
26	<i>Sterna albifrons</i>	2	-	-	-	-	-	-	-	-	4	3	-
27	<i>Alcedo atthis</i>	3	9	4	6	11	1	2	4	8	12	7	4
28	<i>Halcyon smyrnensis</i>	2	1	-	4	-	1	2	3	5	2	3	6
29	<i>Ceryle rudis</i>	-	2	-	-	-	-	4	2	4	2	-	2
30	<i>Pelargopsis capensis</i>	1	-	-	2	-	4	-	-	-	1	2	-

Table 46
Birds Observed at Kuttanad — Vazhappally Region - 1994 (January-December)

No.	Birds	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec
1	<i>Phalacrocorax niger</i>	4	2	8	3	4	-	-	2	8	7	4	4
2	<i>Anhinga rufa</i>	-	-	1	-	-	-	-	-	2	-	-	-
3	<i>Ardeola grayii</i>	17	8	19	36	49	12	8	13	42	66	45	27
4	<i>Egretta garzetta</i>	14	6	16	29	21	3	2	15	36	34	38	19
5	<i>Egretta intermedia</i>	-	-	2	-	-	-	-	-	2	-	-	1
6	<i>Bubulcus ibis</i>	4	8	29	32	-	-	2	17	23	22	38	17
7	<i>Amauornis phoenicurus</i>	-	2	2	1	-	-	1	2	2	-	1	-
8	<i>Charadrius dubius</i>	24	14	-	-	-	-	-	-	12	12	18	20
9	<i>Tringa hypoleucos</i>	14	10	9	-	-	-	-	-	-	9	7	11
10	<i>Chlidonias hybridus</i>	22	17	8	-	-	-	-	-	4	13	26	22
11	<i>Alcedo atthis</i>	3	2	2	5	-	4	7	2	10	7	2	3
12	<i>Halcyon smyrnensis</i>	2	-	-	2	1	-	-	4	2	1	2	2
13	<i>Ceryle rudis</i>	-	4	-	-	2	-	-	2	2	-	4	2

Table 47
Birds Observed at Kuttanad — Vazhappally Region - 1995 (January-December)

No.	Birds	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec
1	<i>Phalacrocorax niger</i>	7	2	5	6	5	-	2	9	3	7	7	4
2	<i>Anhinga rufa</i>	-	2	-	1	-	-	-	-	1	-	-	-
3	<i>Ardeola grayii</i>	18	12	24	38	17	4	6	11	28	42	38	25
4	<i>Egretta garzetta</i>	6	9	21	24	21	7	-	12	32	34	36	28
5	<i>Egretta intermedia</i>	1	1	-	-	2	-	-	-	1	-	-	-
6	<i>Bubulcus ibis</i>	7	4	28	36	-	-	-	13	28	26	21	7
7	<i>Amaurornis phoenicurus</i>	1	4	-	-	1	-	1	-	-	2	-	1
8	<i>Charadrius dubius</i>	13	22	18	-	-	-	-	-	-	12	24	21
9	<i>Tringa hypoleucos</i>	14	10	11	-	-	-	-	-	-	7	12	11
10	<i>Chlidonias hybridus</i>	18	29	16	9	-	-	-	-	3	21	25	19
11	<i>Alcedo atthis</i>	4	7	2	2	1	4	8	11	7	2	5	5
12	<i>Halcyon smymensis</i>	2	1	2	3	-	3	1	2	5	1	4	4
13	<i>Ceryle rudis</i>	-	2	-	2	-	-	-	4	-	-	2	2

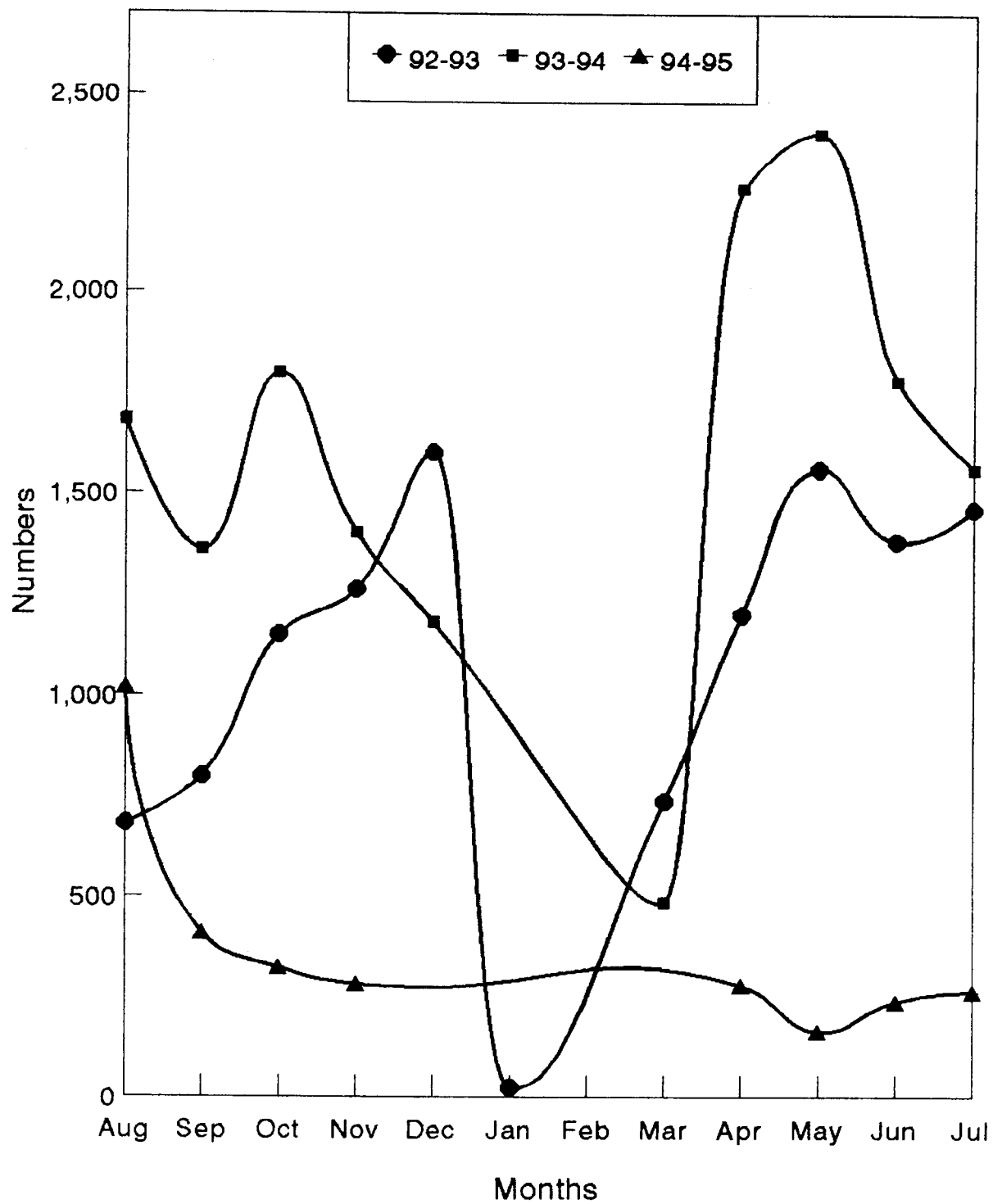


Figure 1 Population Trend of Little Cormorants in the Marshy Enclosure 1992-95

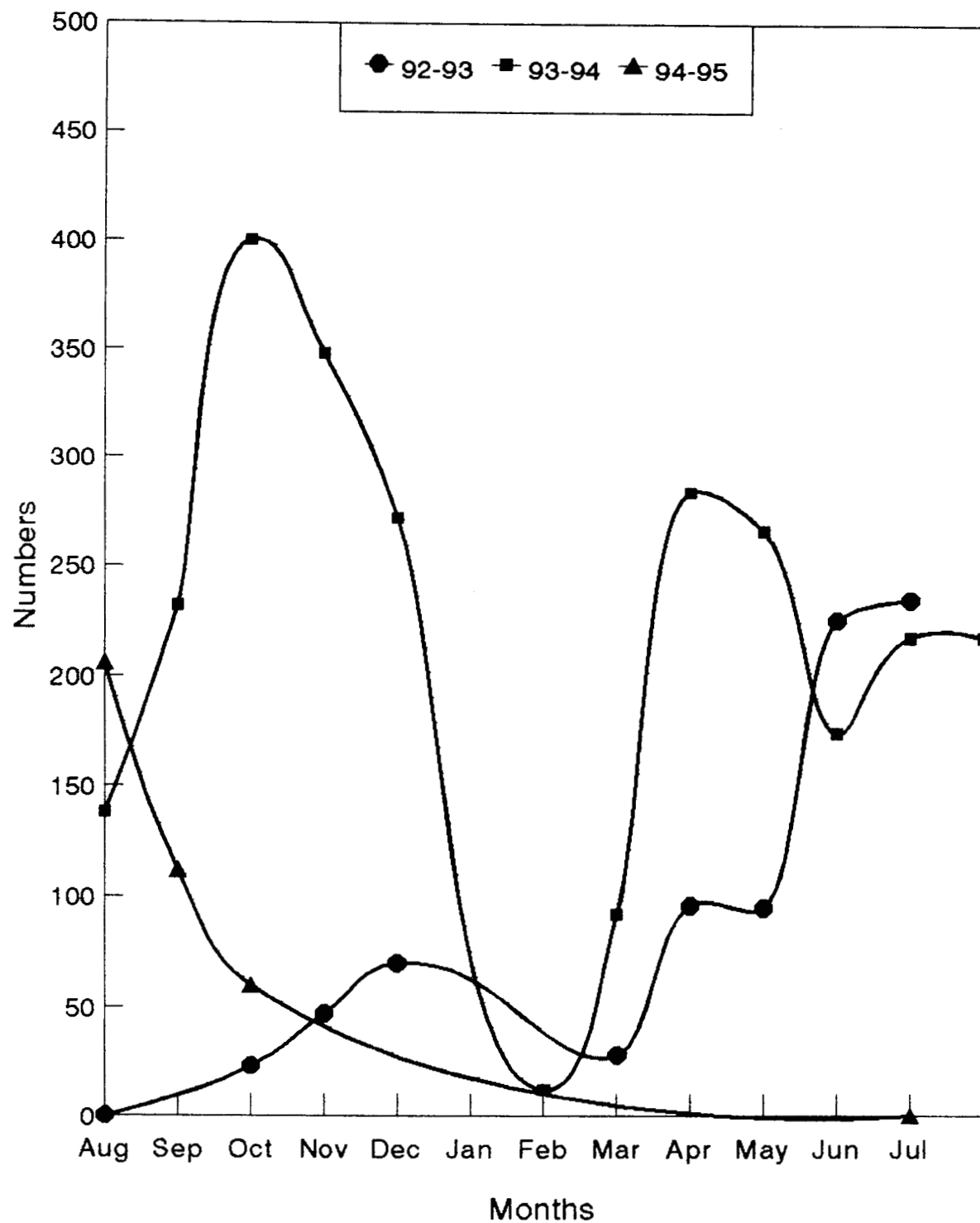


Figure 2 Population Trend of Large Cormorants in the Marshy Enclosure 1992-95

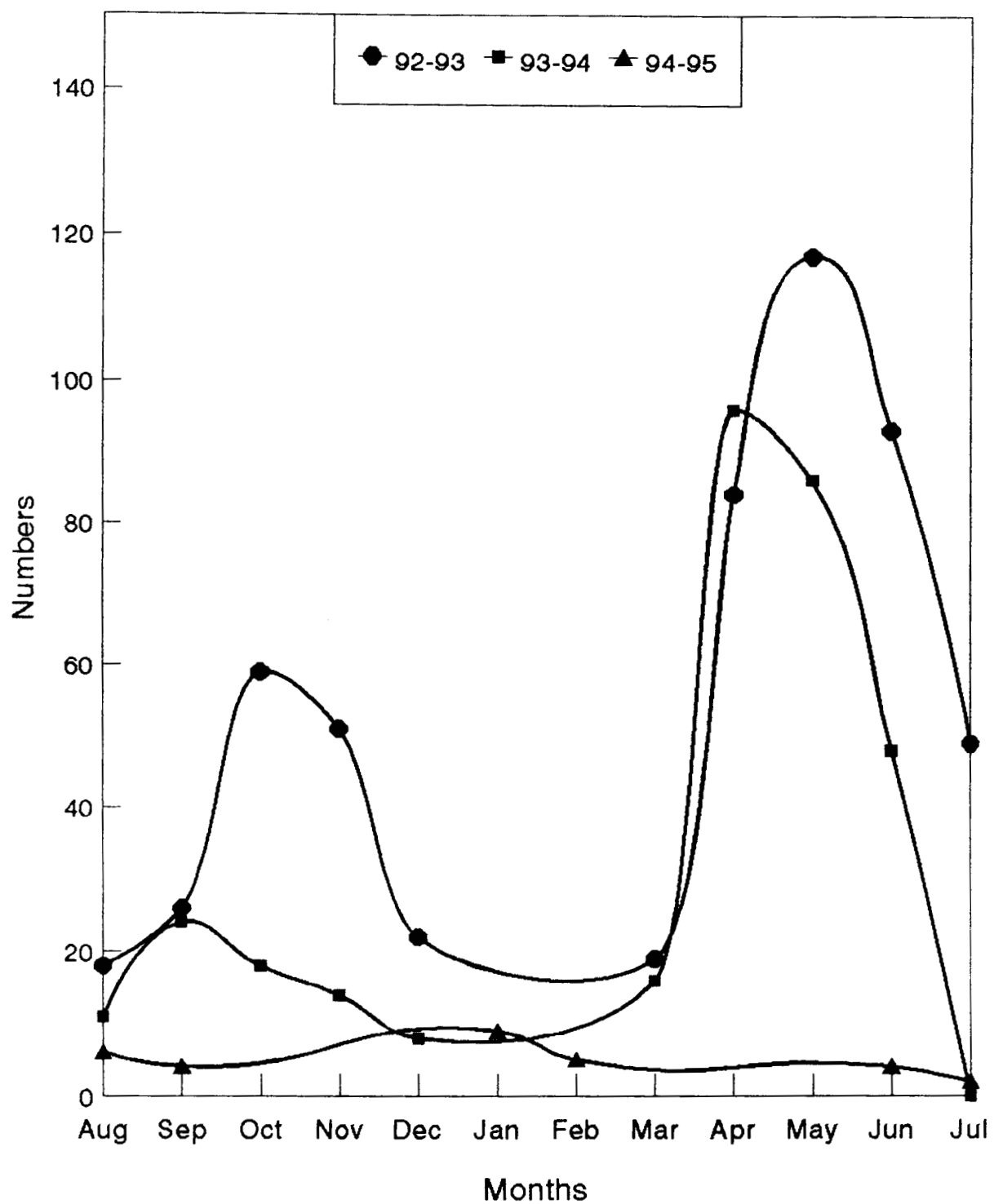


Figure 3 Population Trend of Shags in the Marshy Enclosure 1992-95

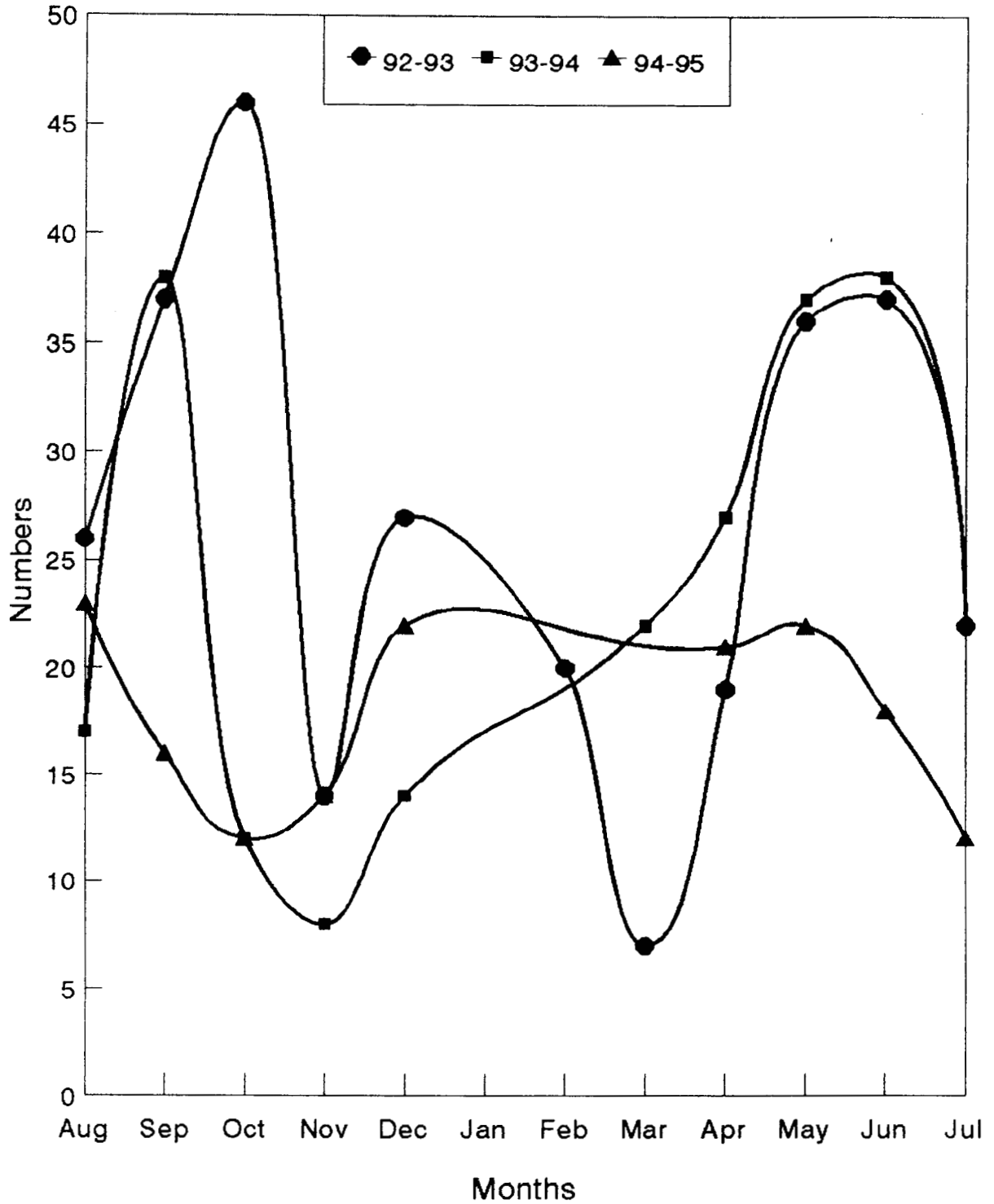


Figure 4 Population Trend of Darters in the Marshy Enclosure 1992-95

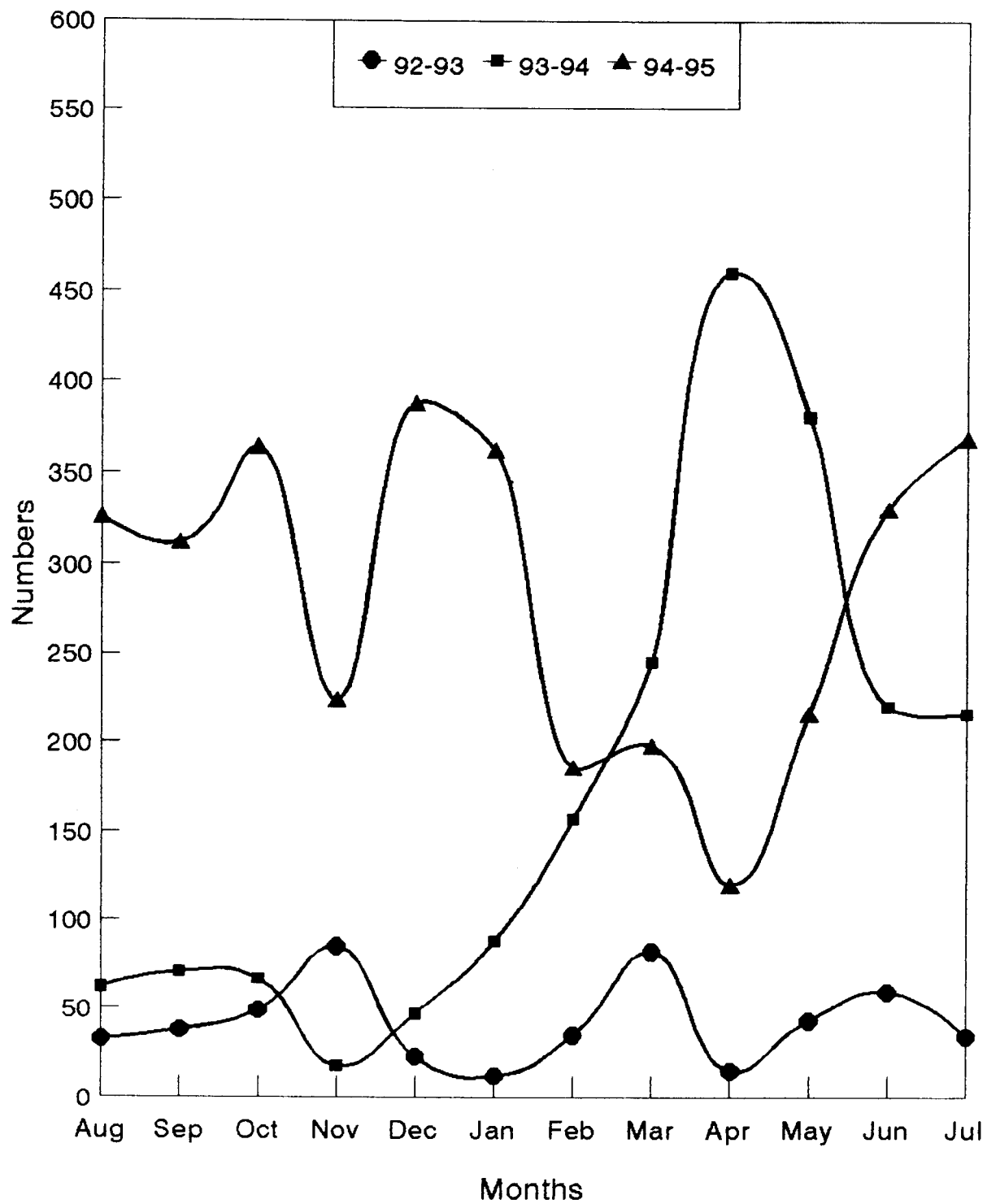


Figure 5 Population Trend of Night Herons in the Marshy Enclosure 1992-95

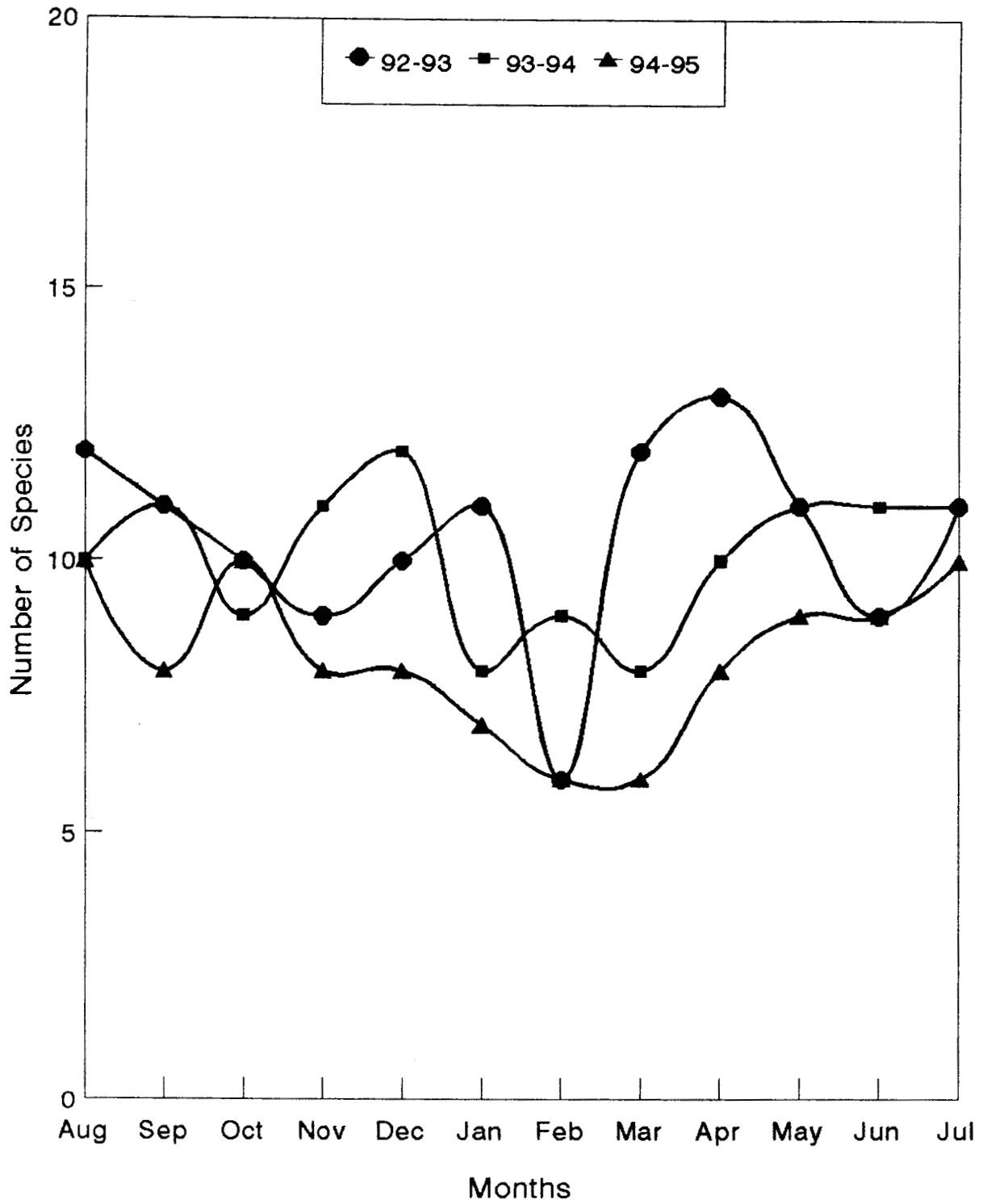


Figure 6 Bird Diversity in the Marshy Enclosure 1992-95

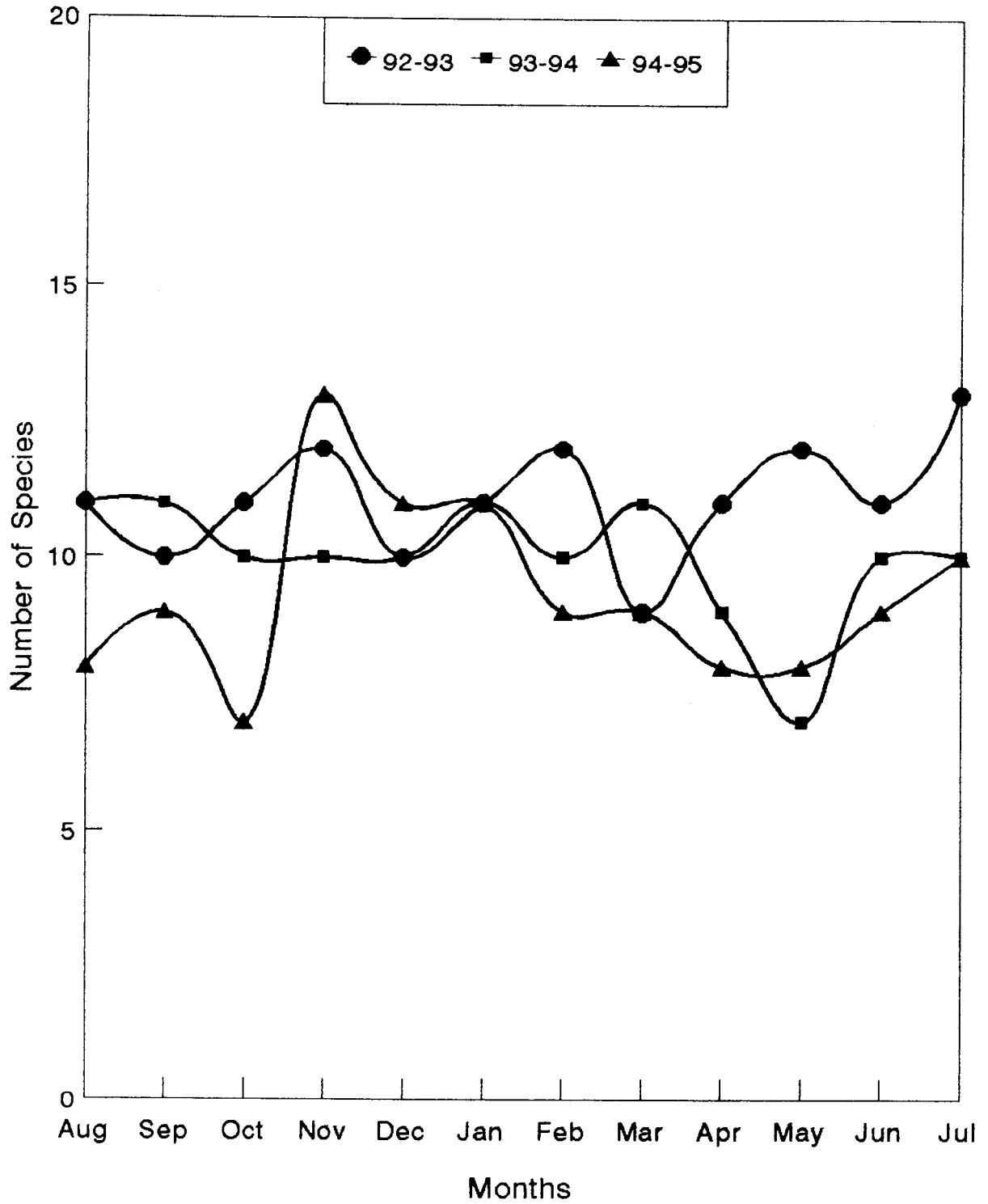


Figure 7 Bird Diversity in the Baker Estate 1992-95

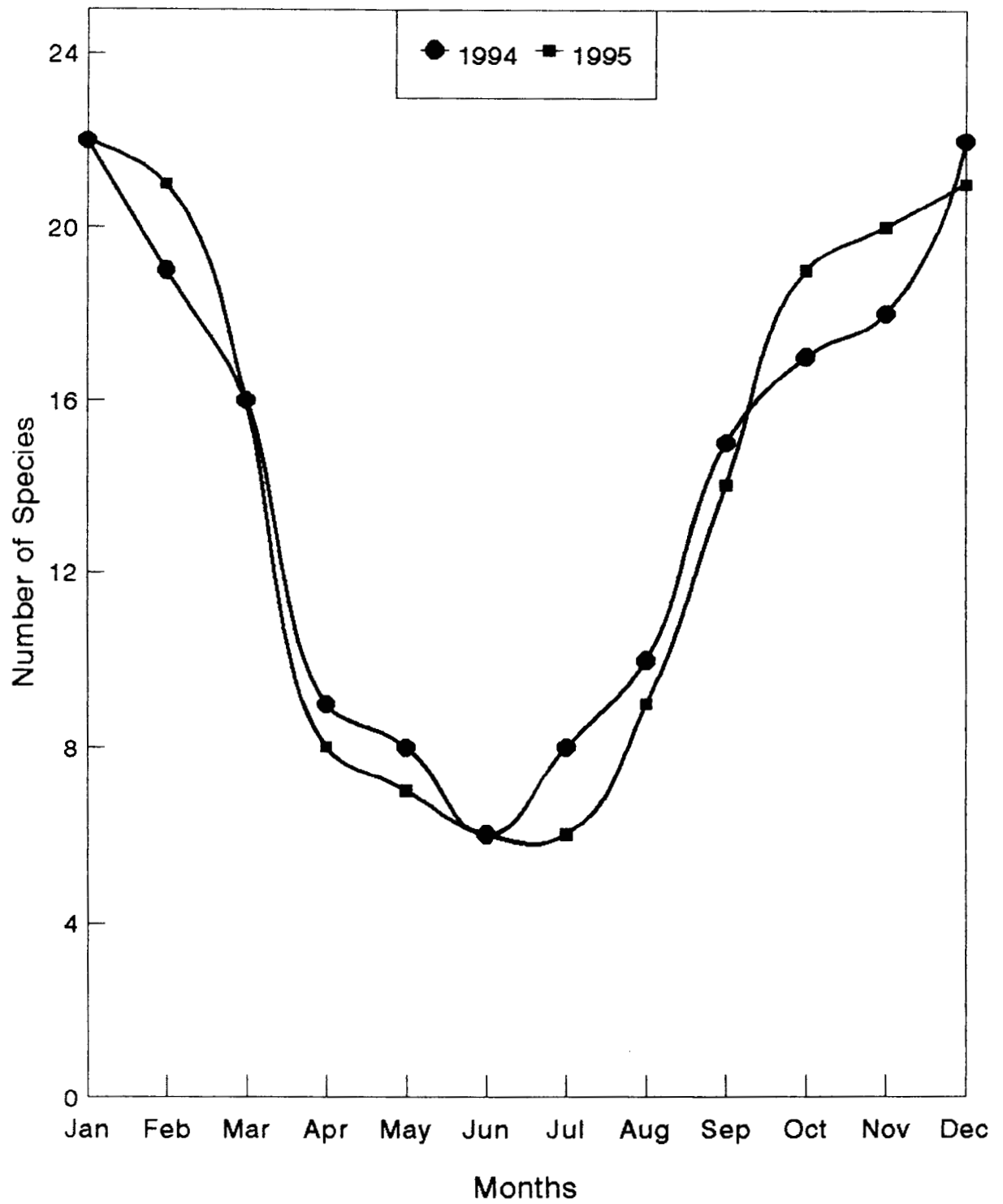


Figure 8 Bird Diversity in the Pathiramanal Island 1994 & 1995

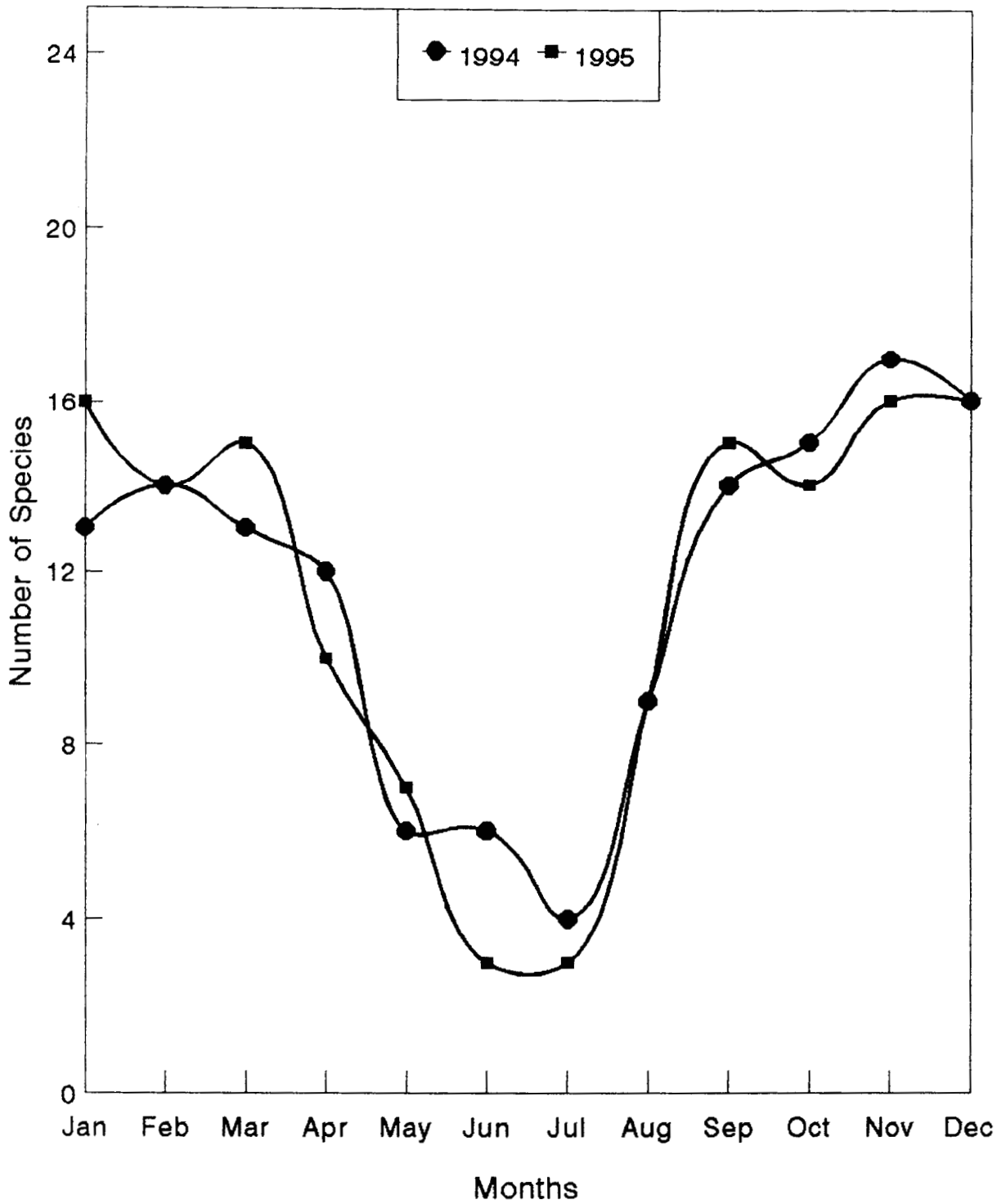


Figure 9 Number of Bird Species appeared at the Lake Region during 1994 and 1995

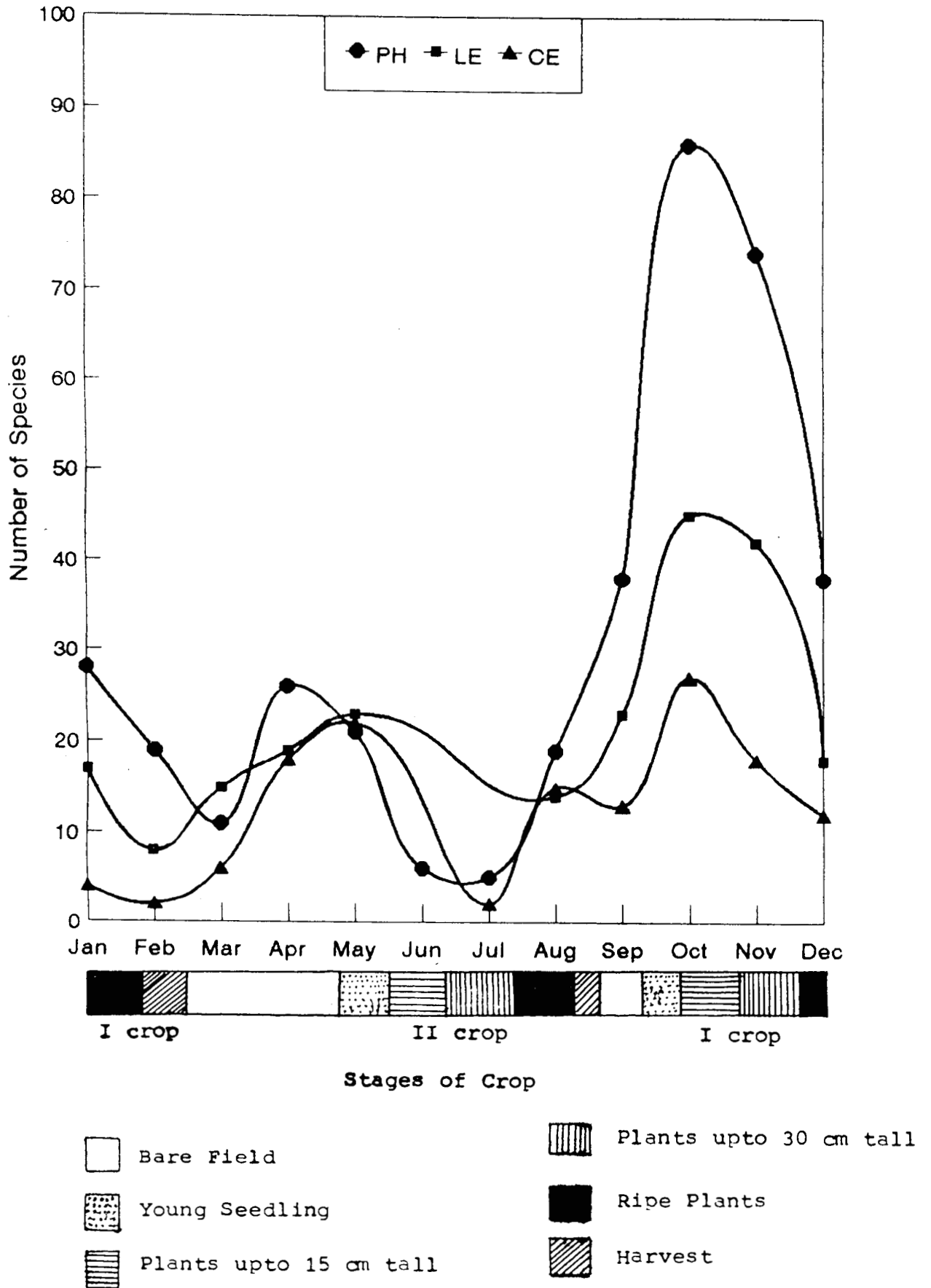


Figure 10 Pond Heron, Little Egret, Cattle Egret-their Population in the Paddy Field in Relation to the Stages of the Crop

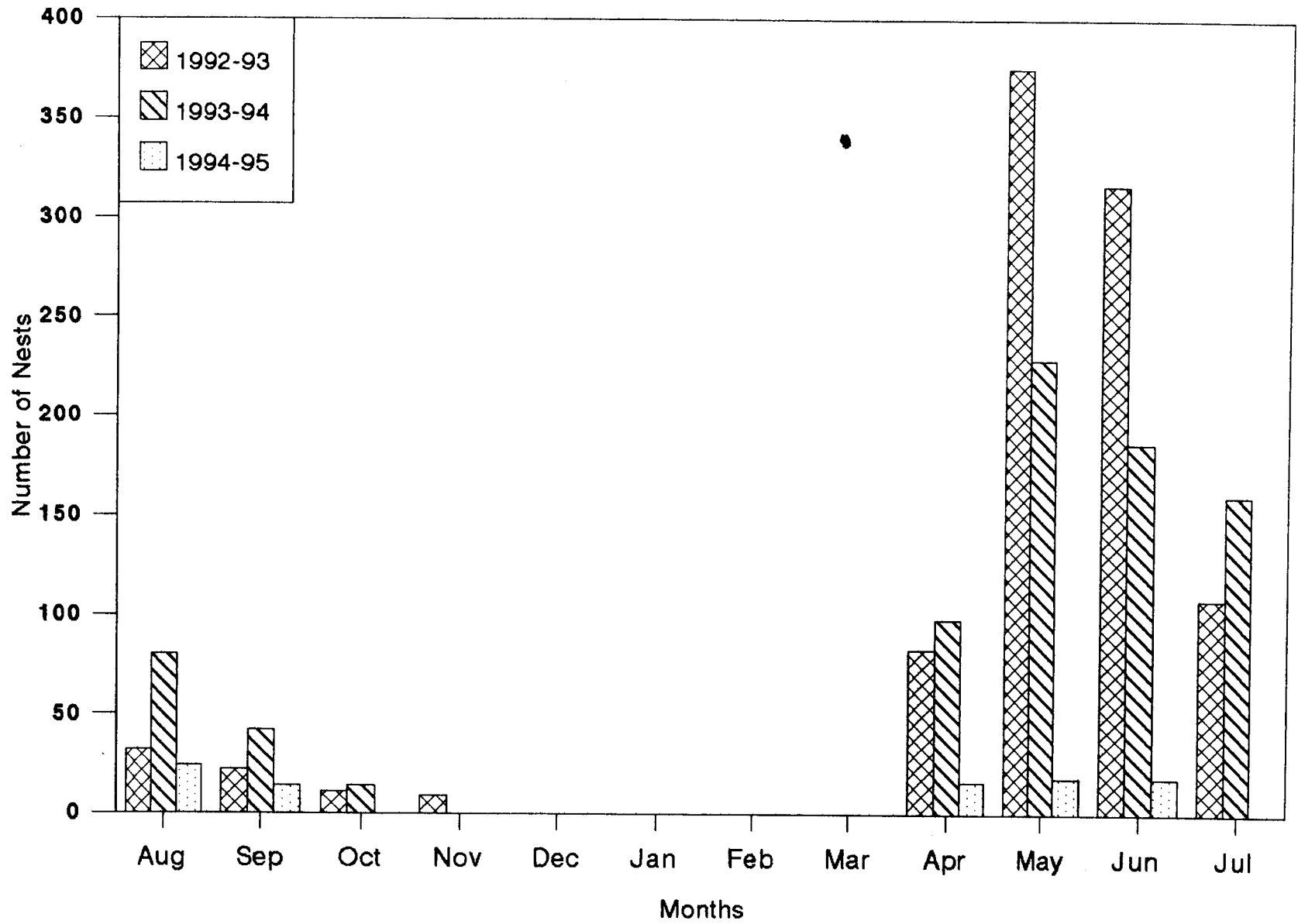


Figure 11 Nesting Trends of Little Cormorants in the Marshy Enclosure during 1992-95

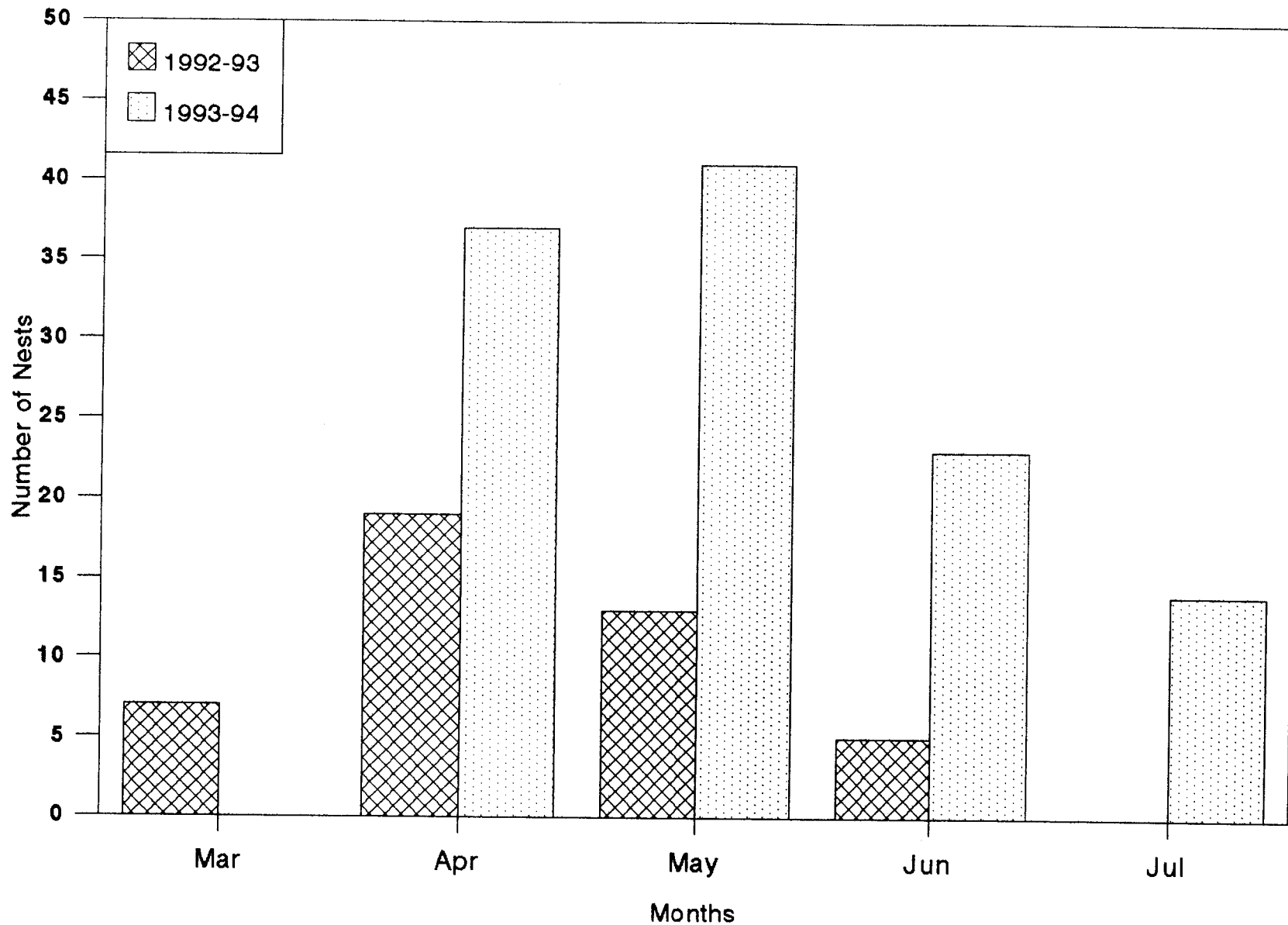


Figure 12 Nesting Trends of Large Cormorants in the Marshy Enclosure during 1992-95

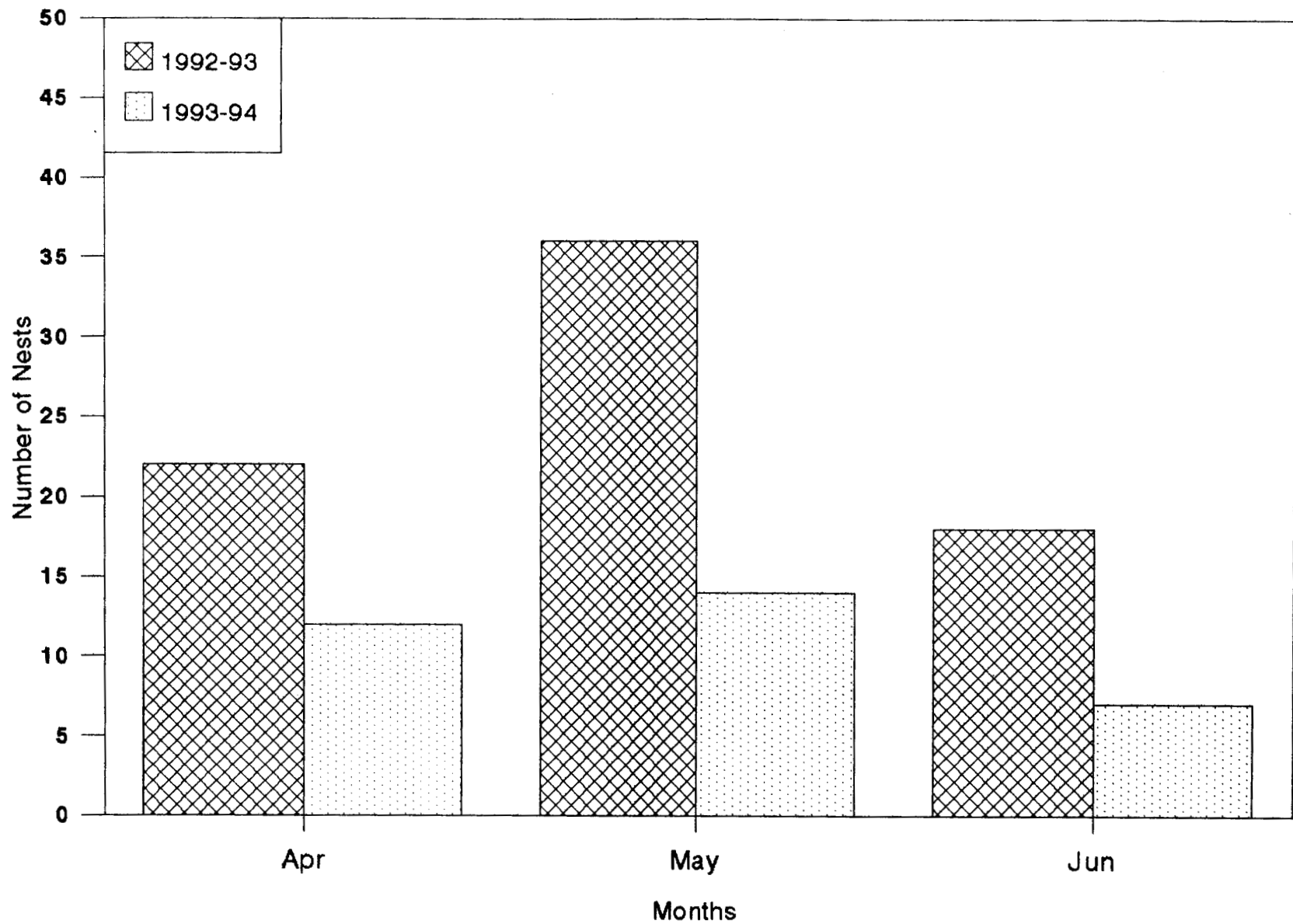


Figure 13 Nesting Trends of Shags in the Marshy Enclosure during 1992-95

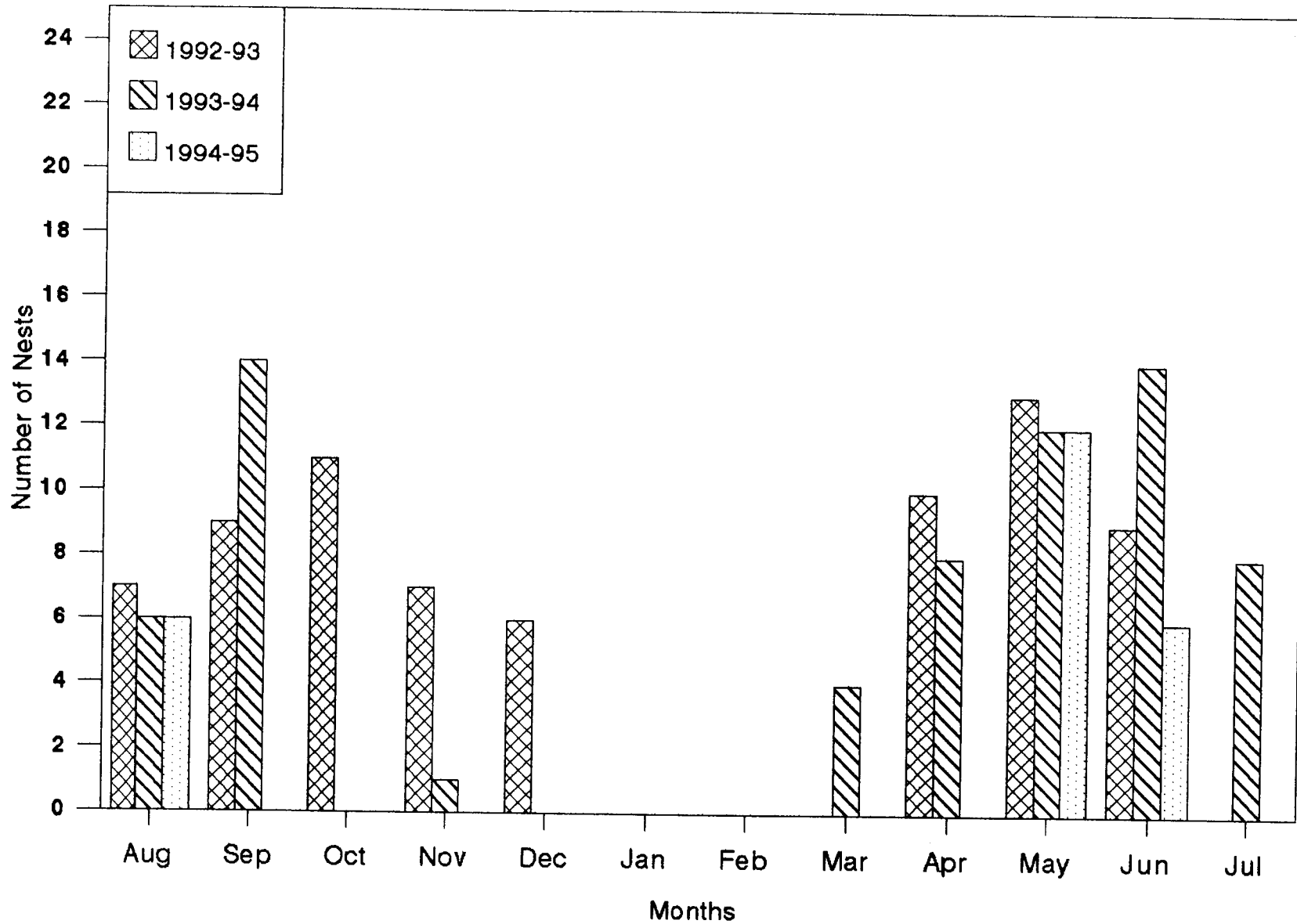


Figure 14 Nesting Trends of Darters in the Marshy Enclosure during 1992-95

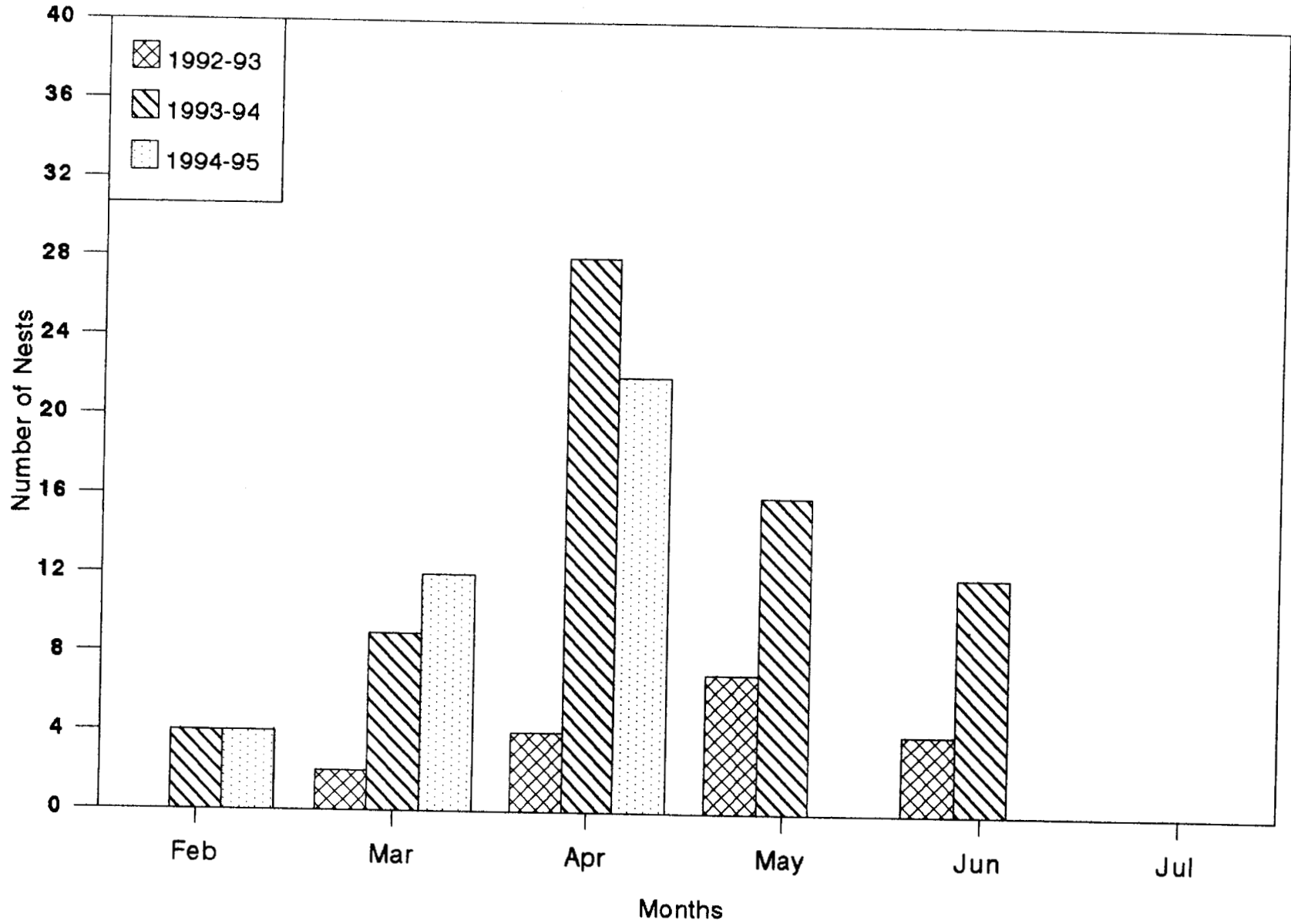


Figure 15 Nesting Trends of Night Herons in the Marshy Enclosure during 1992-95

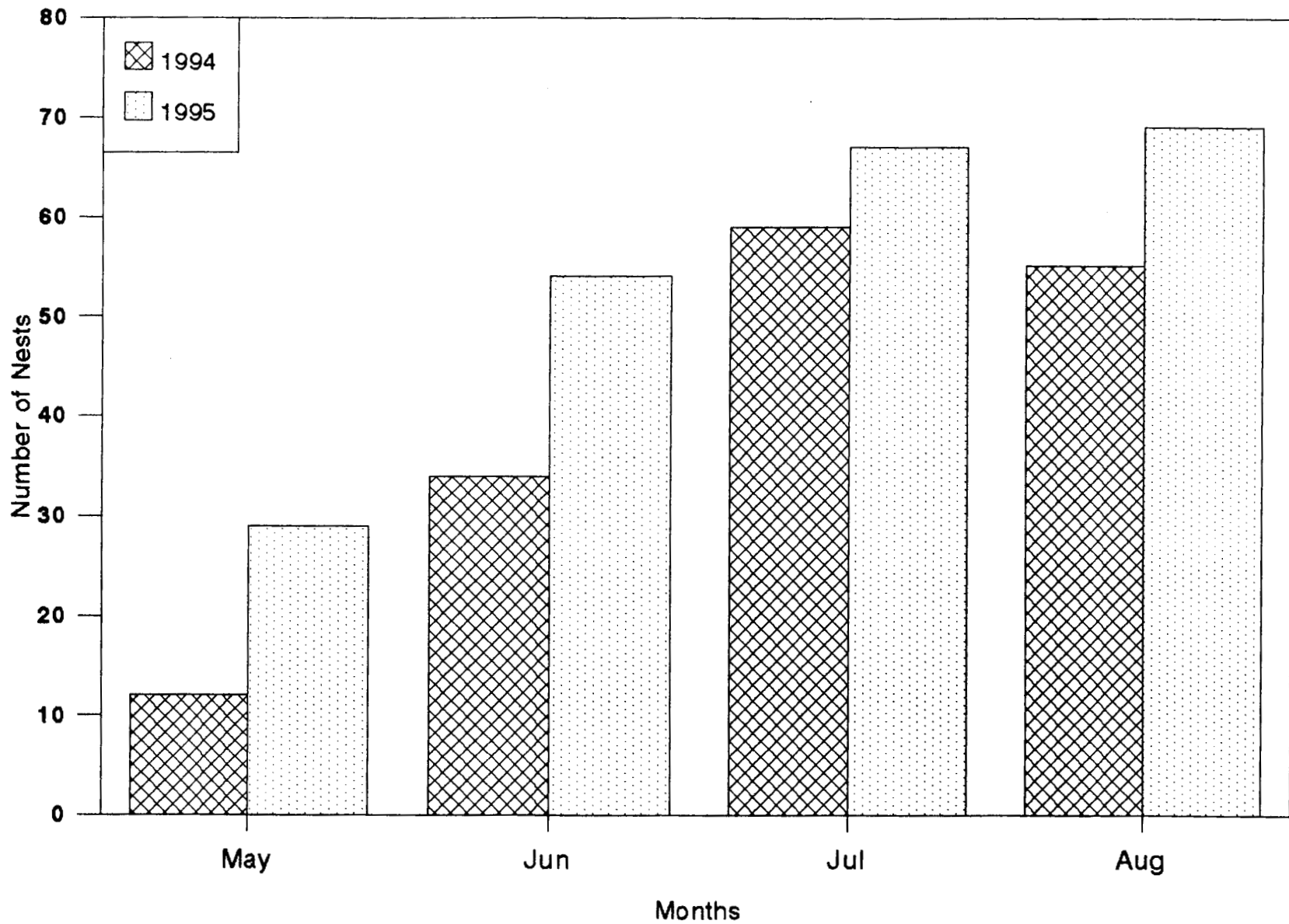


Figure 16 Nesting of Little Cormorants in Pathiramanal - 1994 and 1995

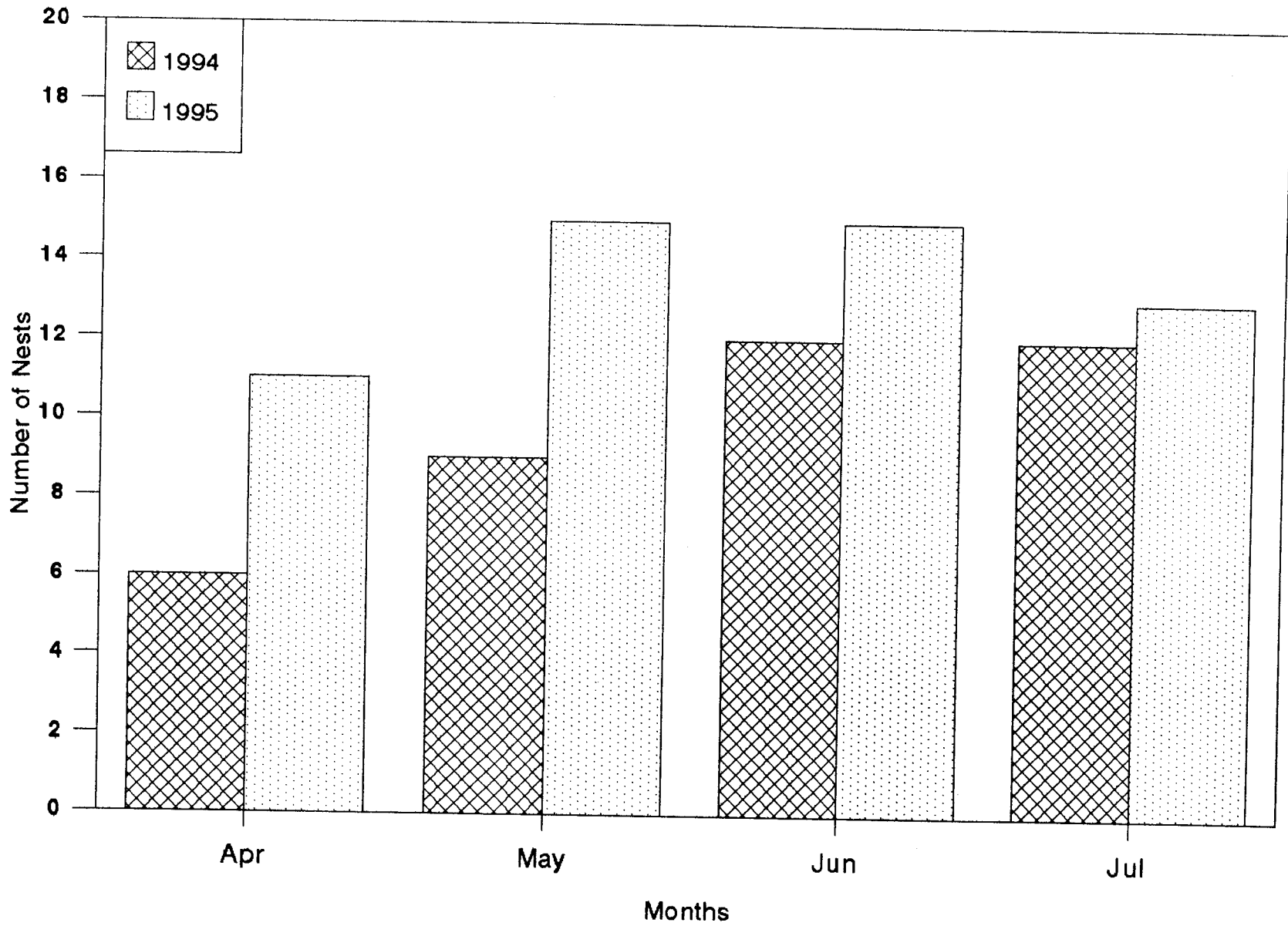


Figure 17 Nesting of Large Cormorants in Pathiramanal - 1994 and 1995

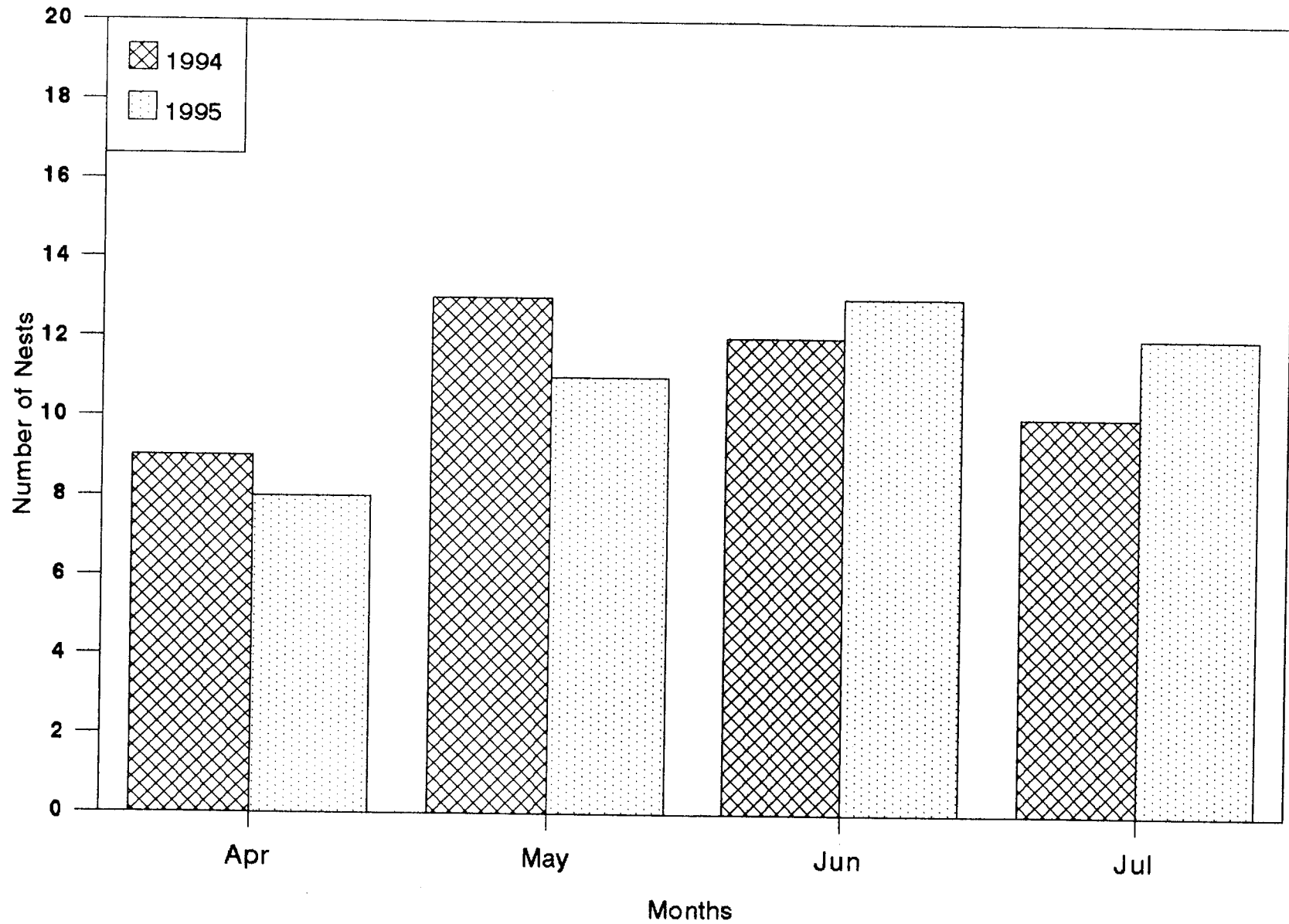


Figure 18 Nesting of Shags in Pathiramanal - 1994 and 1995

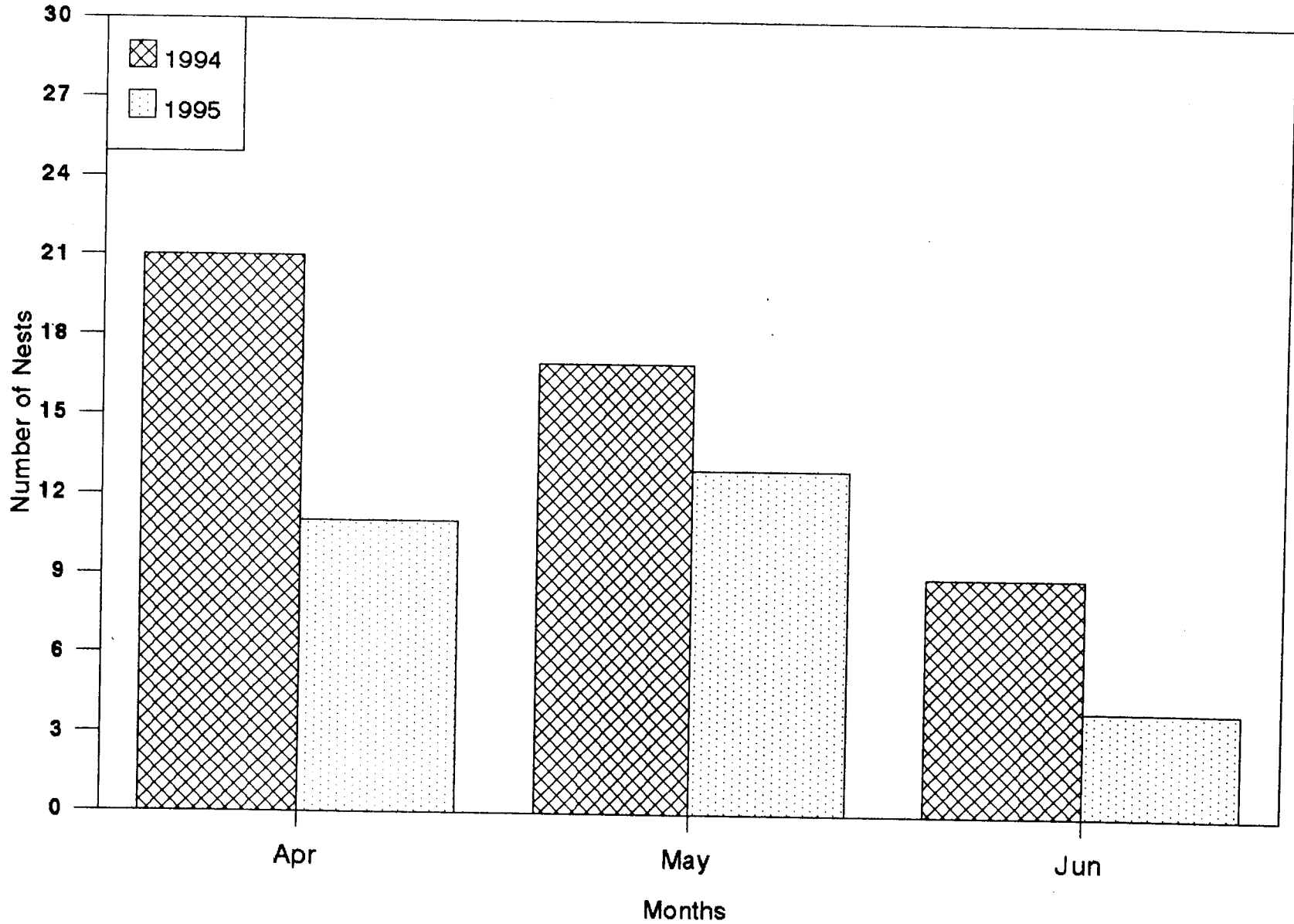


Figure 19 Nesting of Night Herons in Pathiramanal - 1994 and 1995

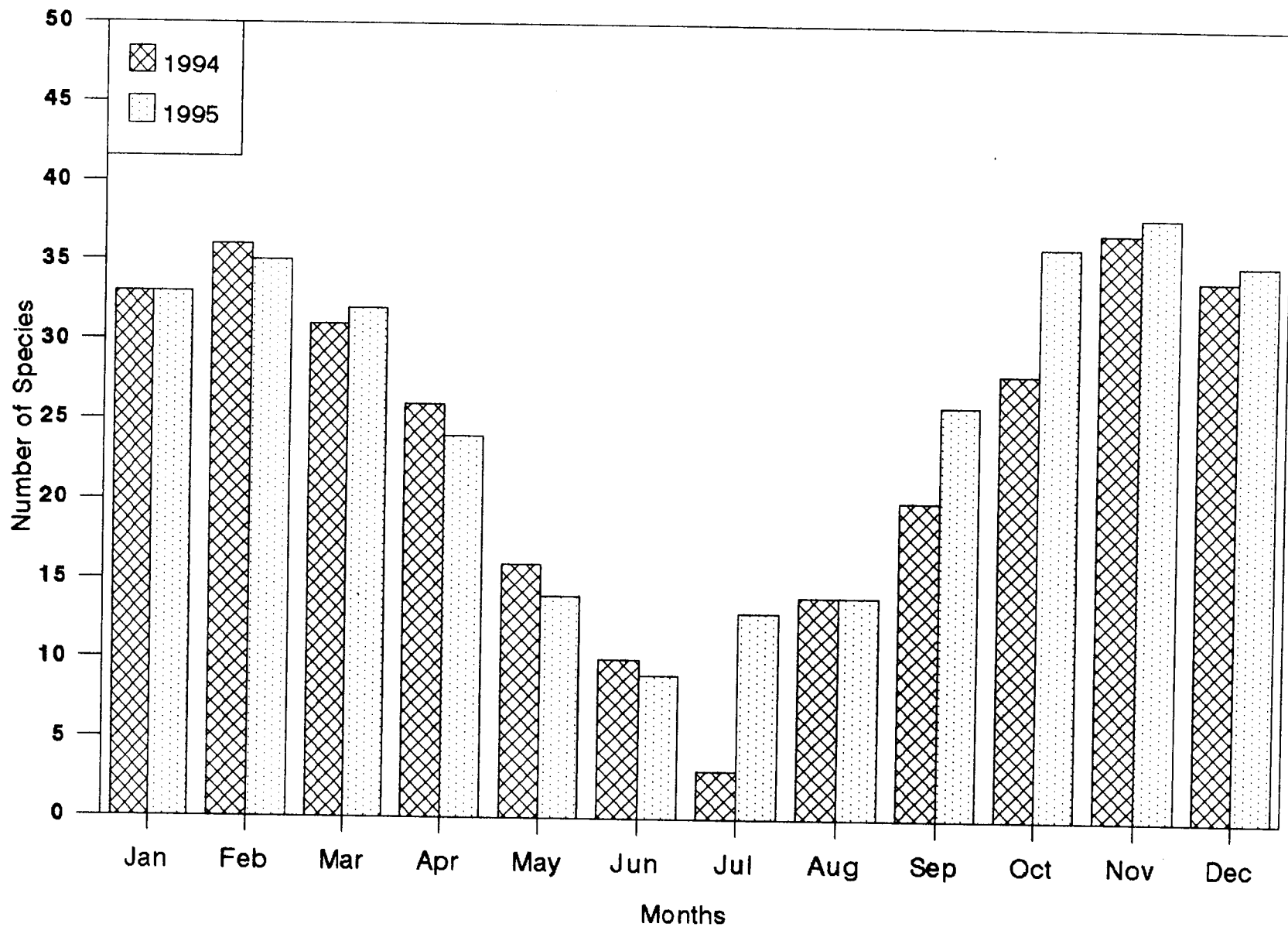


Figure 20 Bird Diversity in Reclaimed Paddy Fields - 1994 and 1995

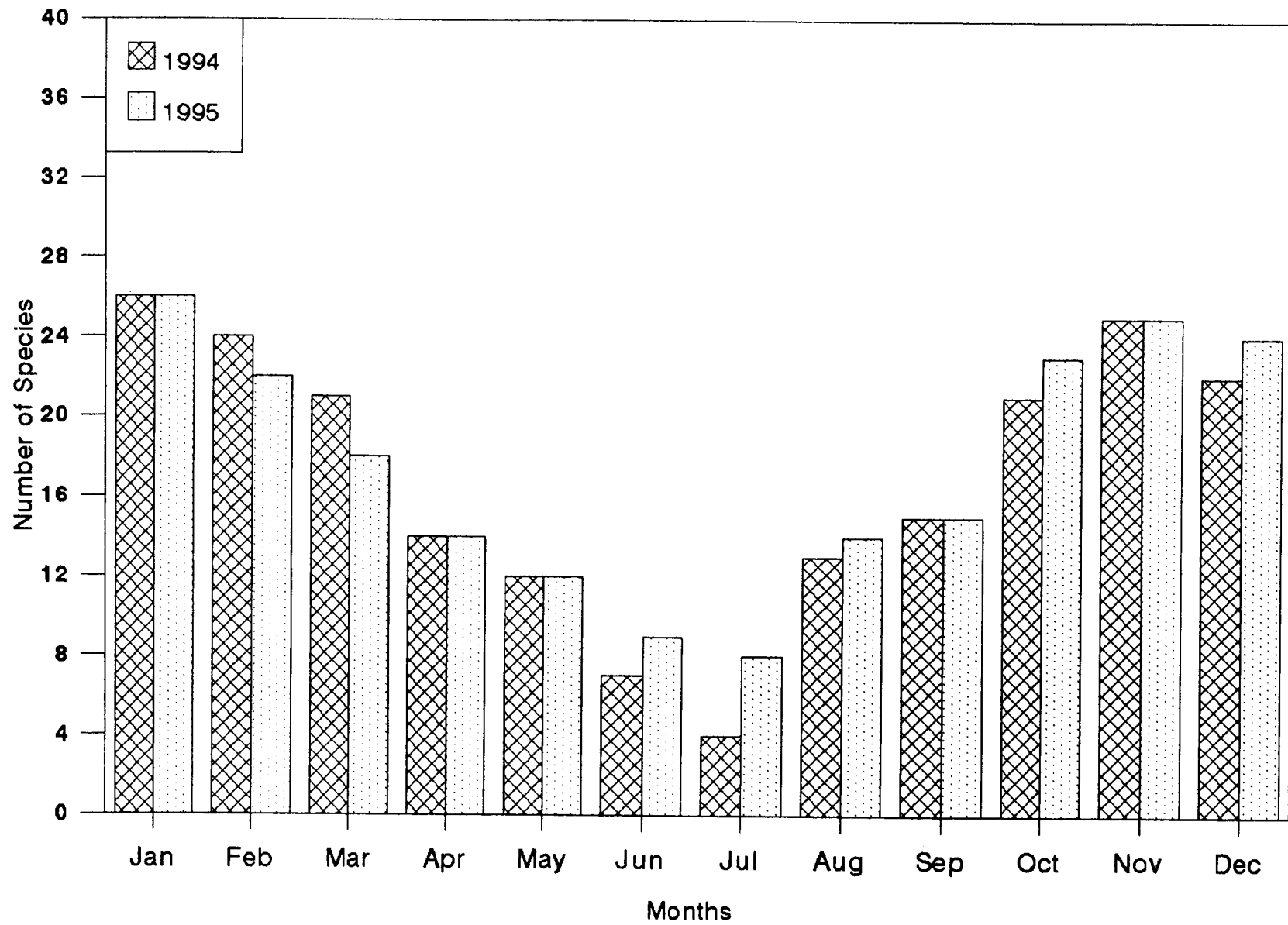


Figure 21 Bird Diversity in Kumarakom-Chengalam Region (Paddy Fields) - 1994 and 1995

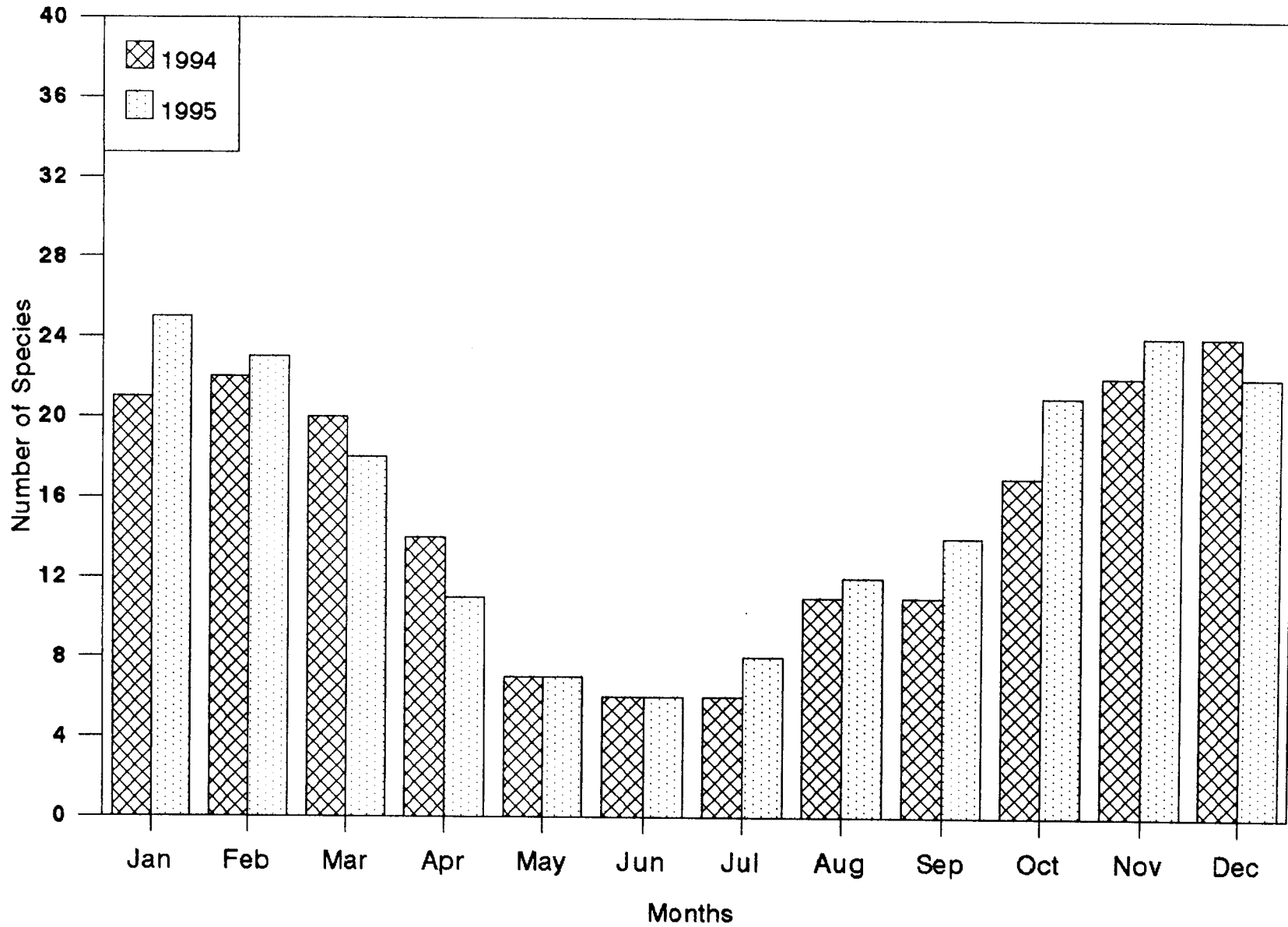


Figure 22 Bird Diversity in Monkompou Region (Paddy Fields) - 1994 and 1995

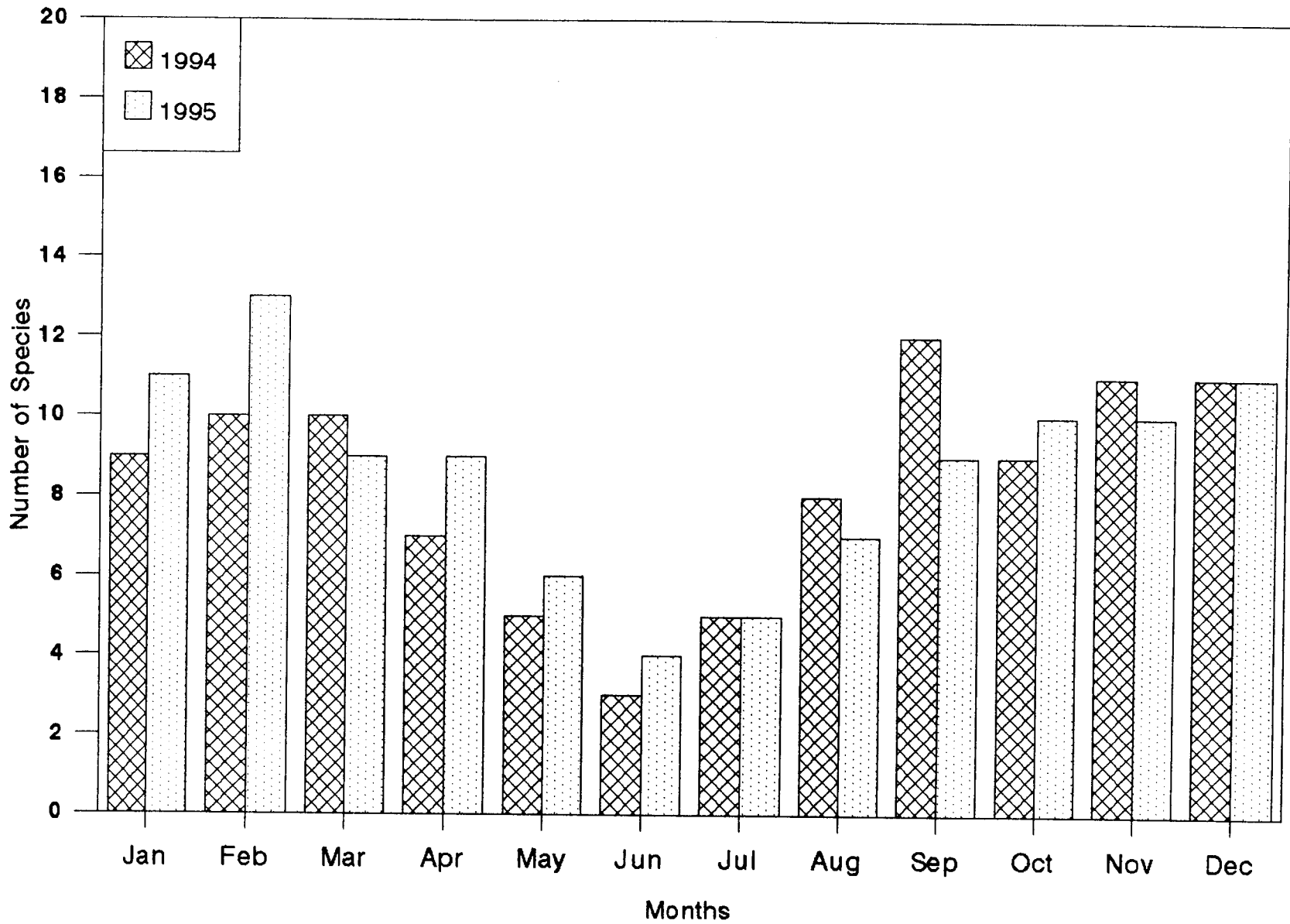


Figure 23 Bird Diversity in Vazhappally Region (Paddy Fields) - 1994 and 1995

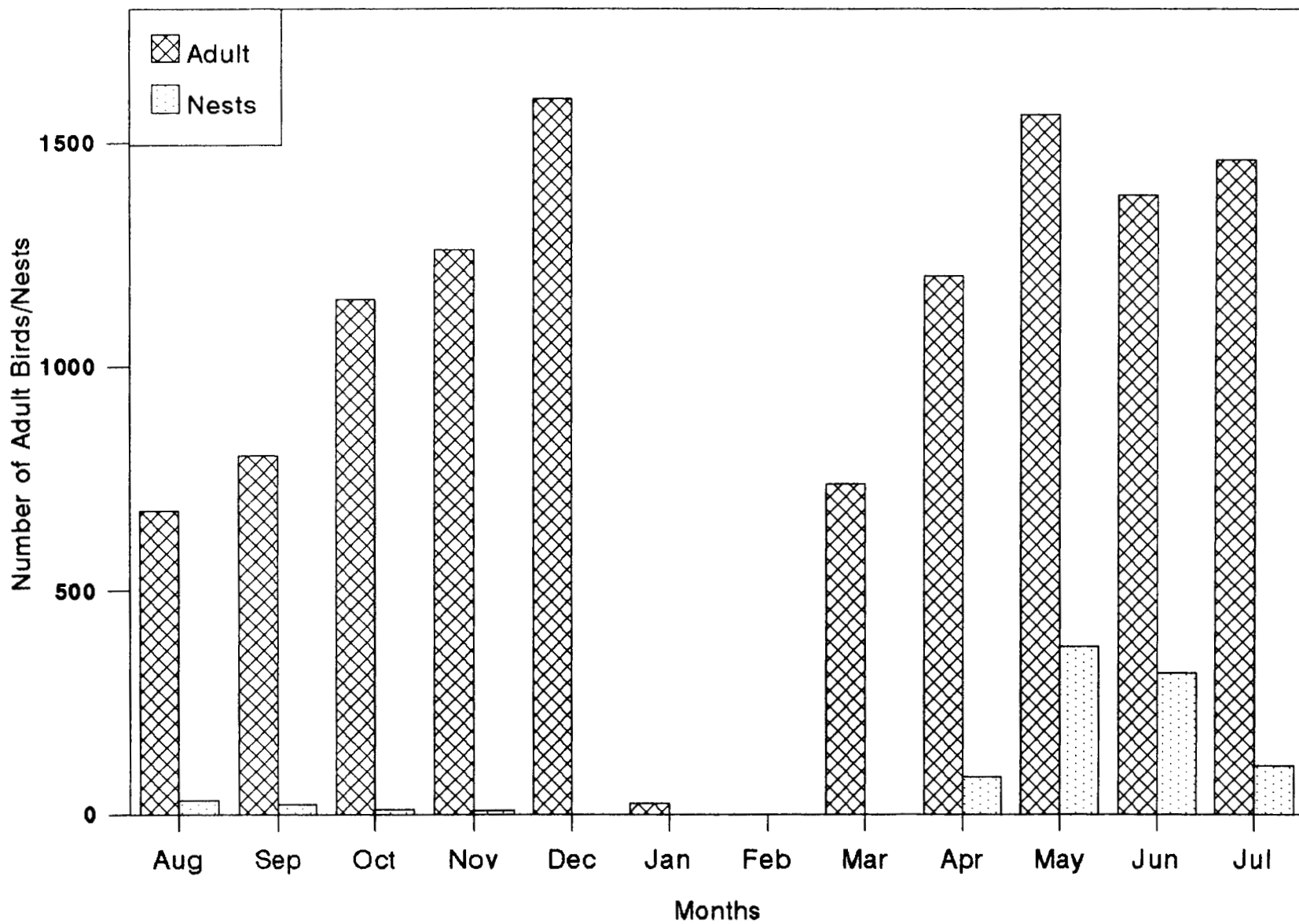


Figure 24 Adult-Nest Ratio of Little Cormorants in the Marshy Enclosure 1992-93

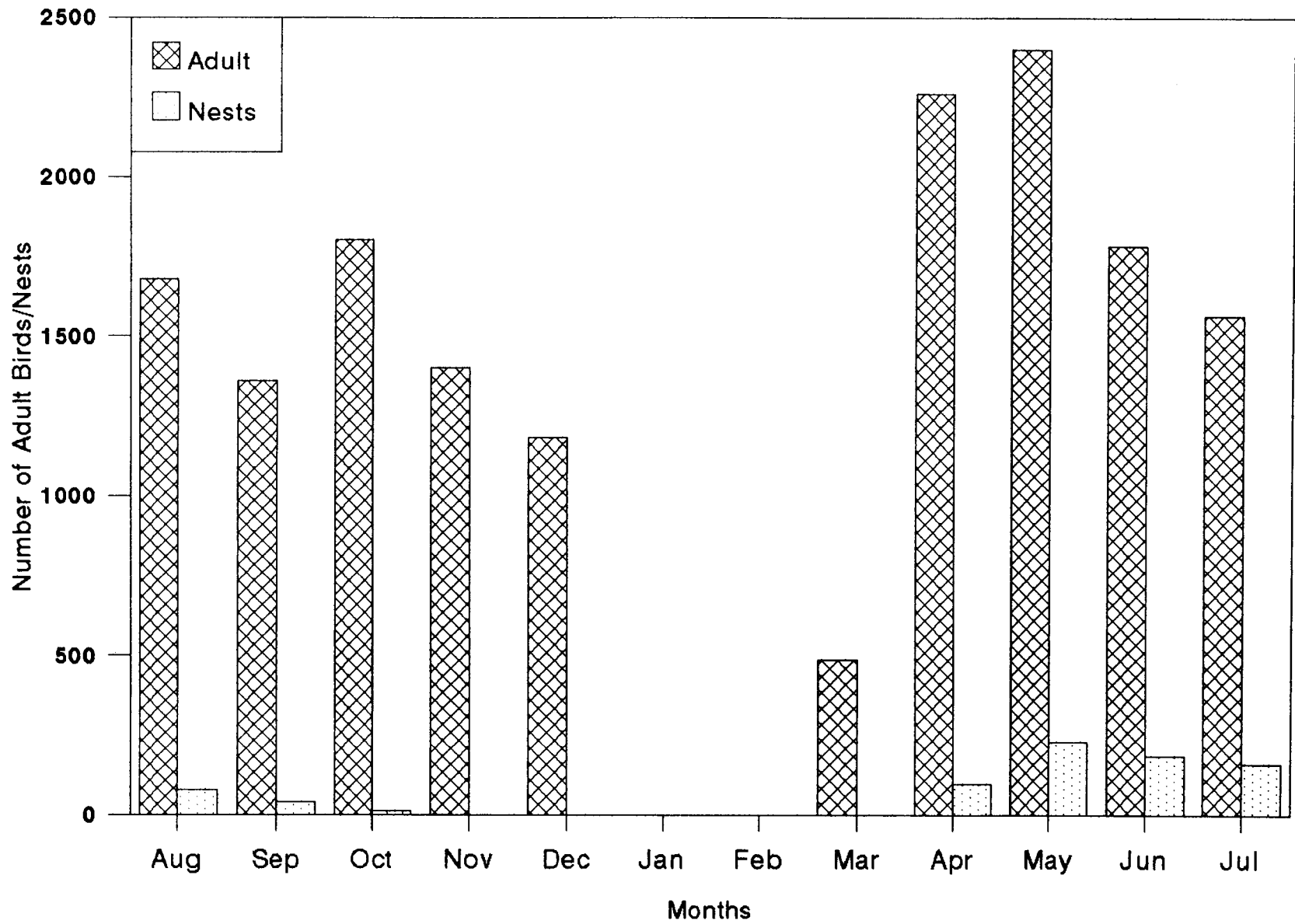


Figure 25 Adult-Nest Ratio of Little Cormorants in the Marshy Enclosure 1993-94

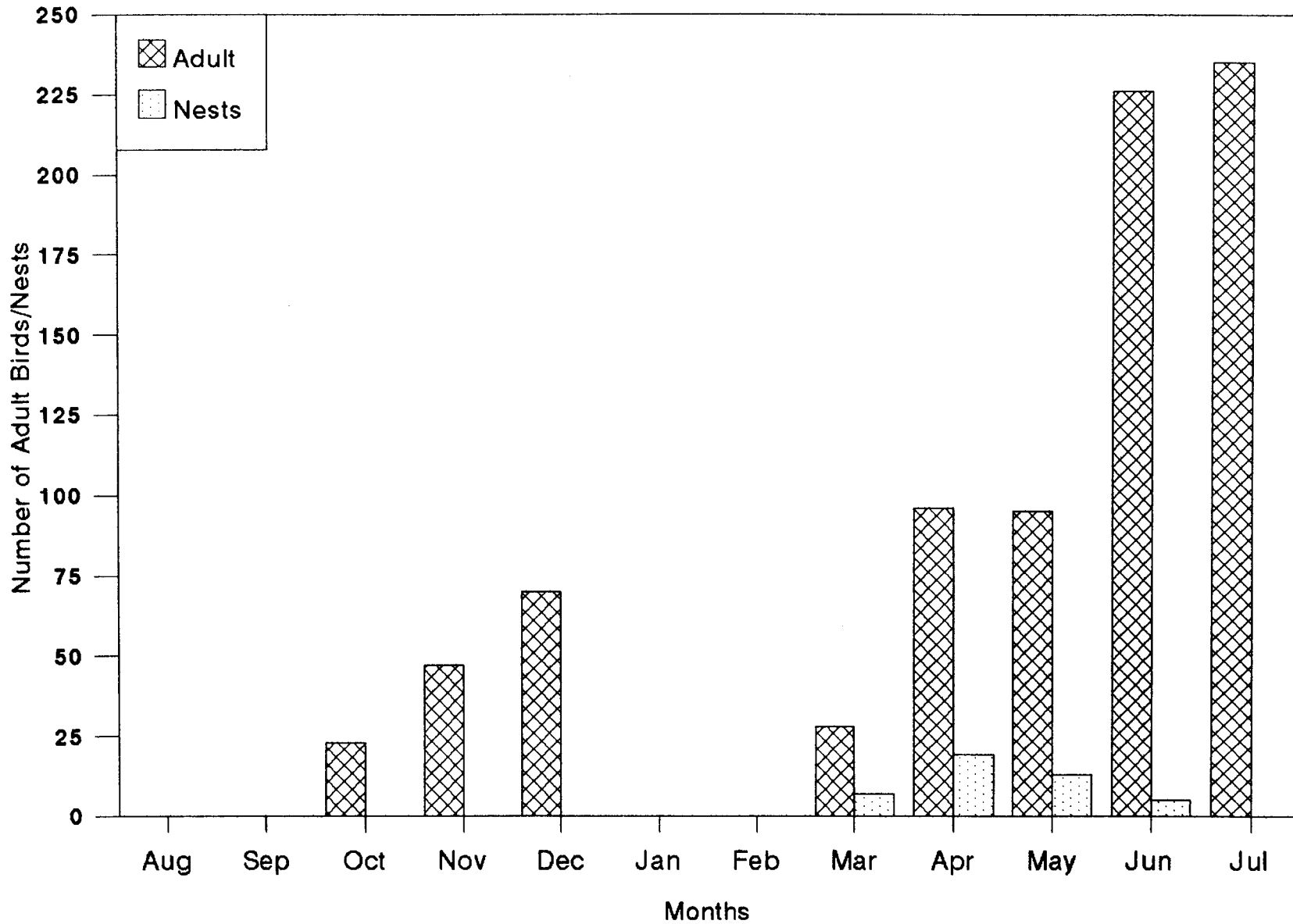


Figure 26 Adult-Nest Ratio of Large Cormorants in the Marshy Enclosure 1992-93

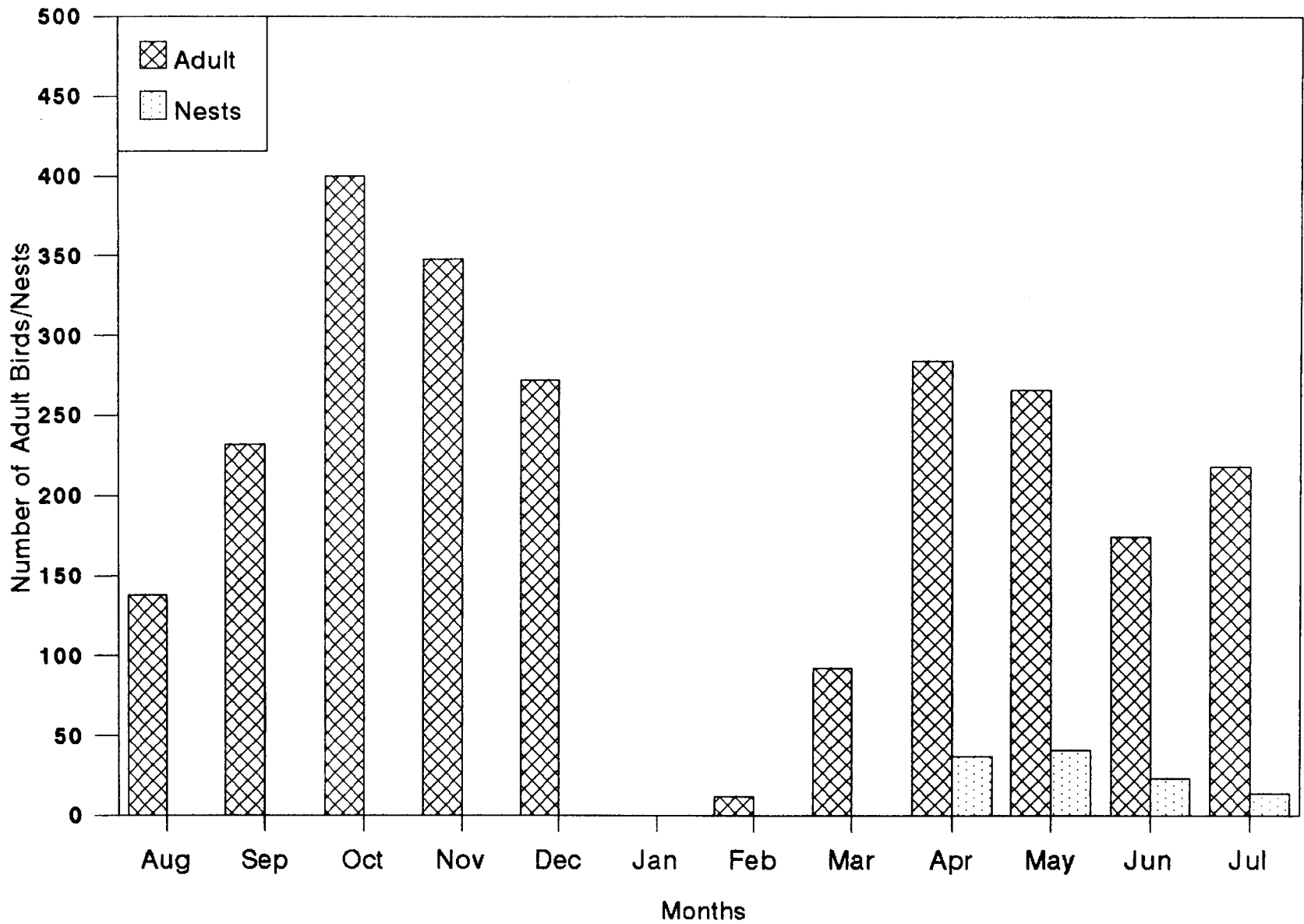


Figure 27 Adult-Nest Ratio of Large Cormorants in the Marshy Enclosure 1993-94

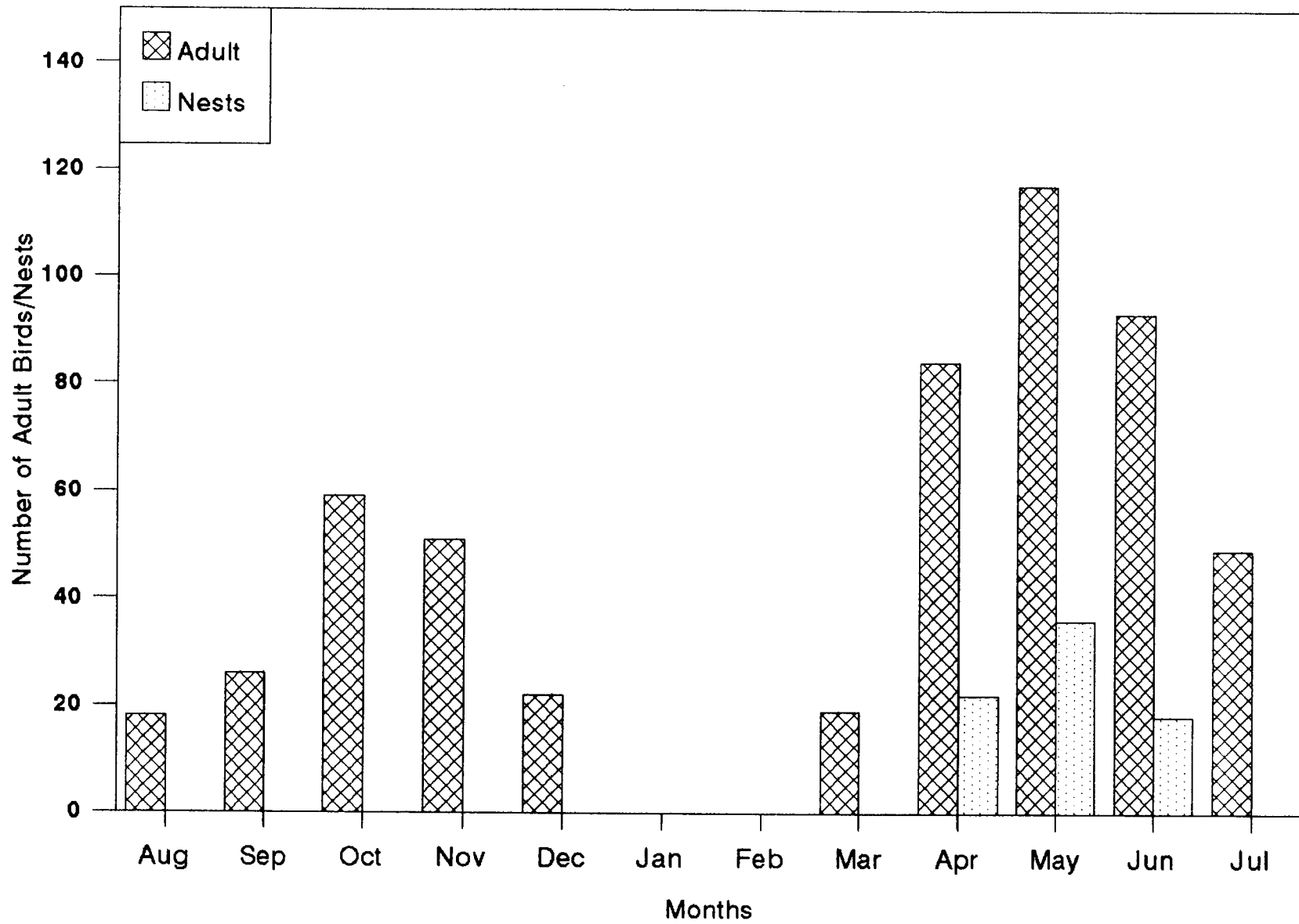


Figure 28 Adult-Nest Ratio of Shag and in the Marshy Enclosure 1992-93

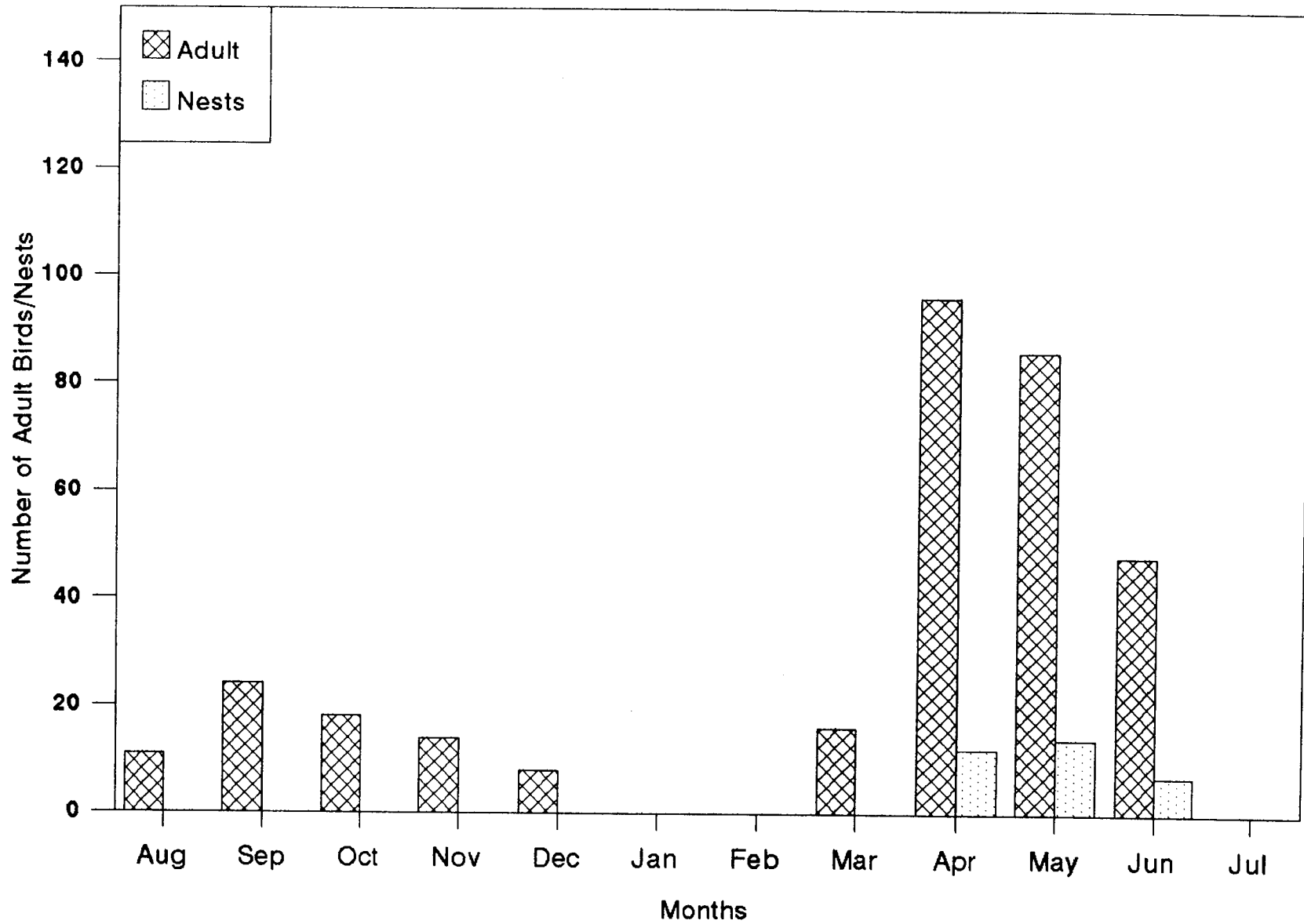


Figure 29 Adult-Nest Ratio of Shag in the Marshy Enclosure 1993-94

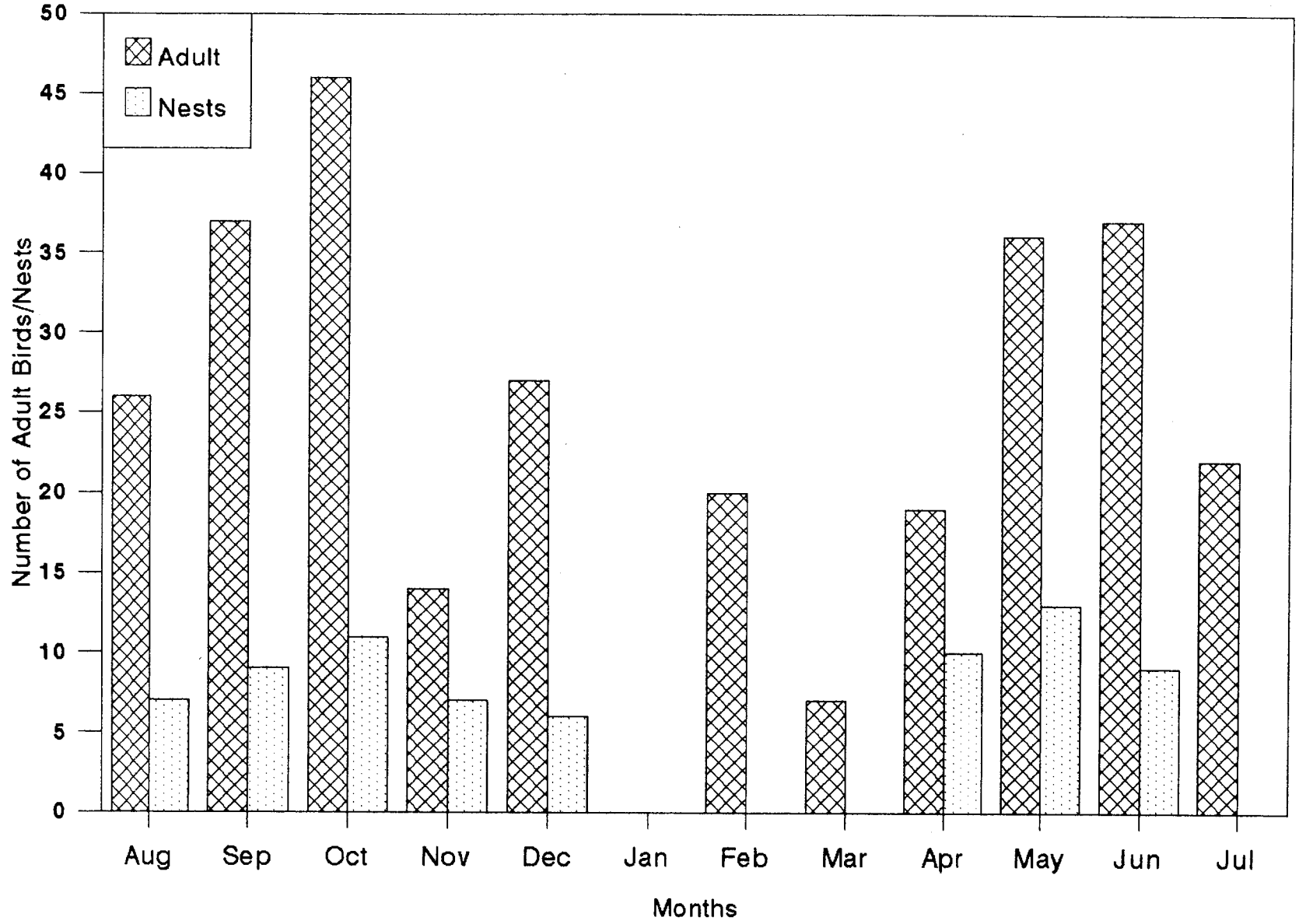


Figure 30 Adult-Nest Ratio of Darters in the Marshy Enclosure 1992-93

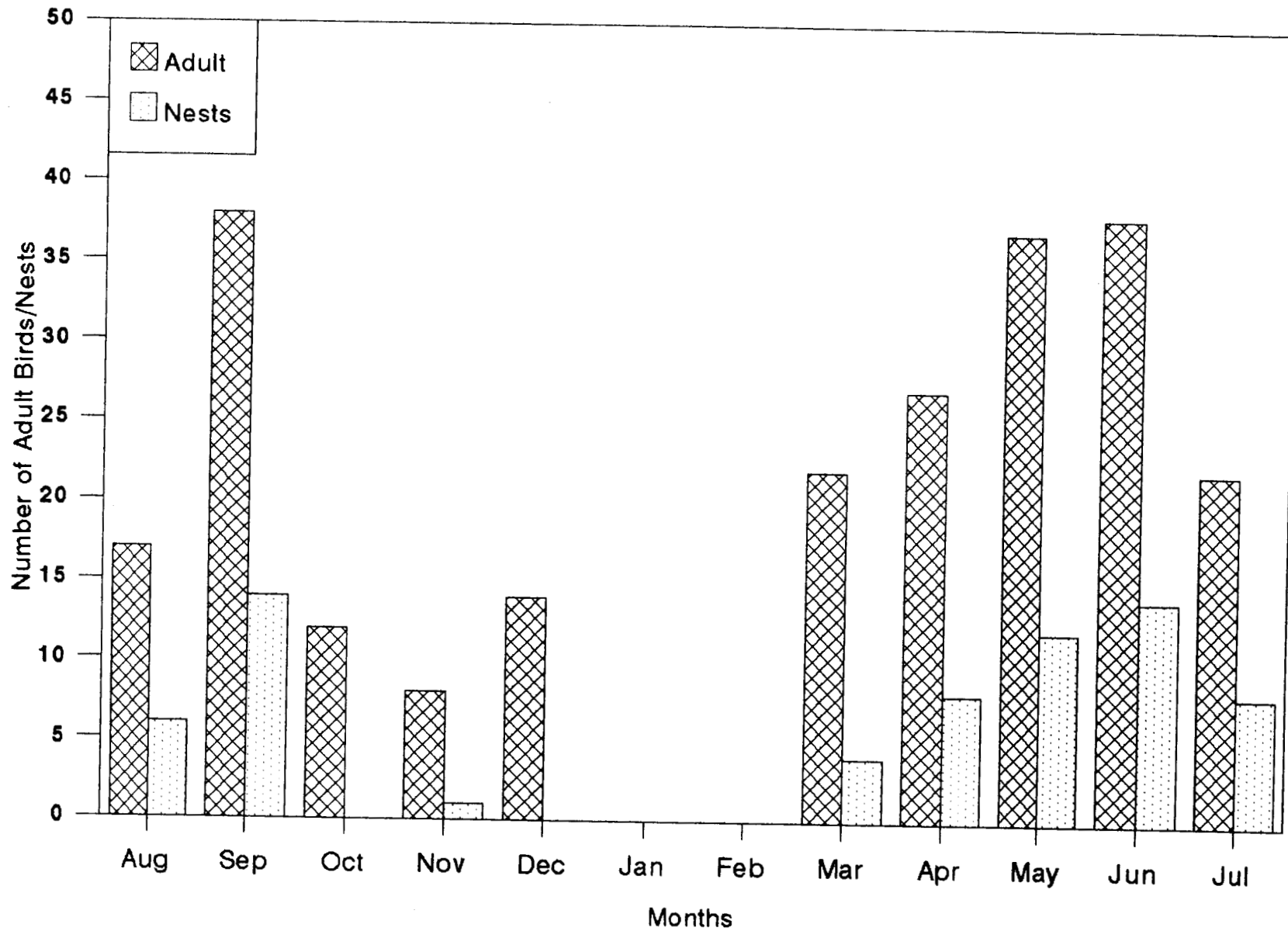


Figure 31 Adult-Nest Ratio of Darters in the Marshy Enclosure 1993-94

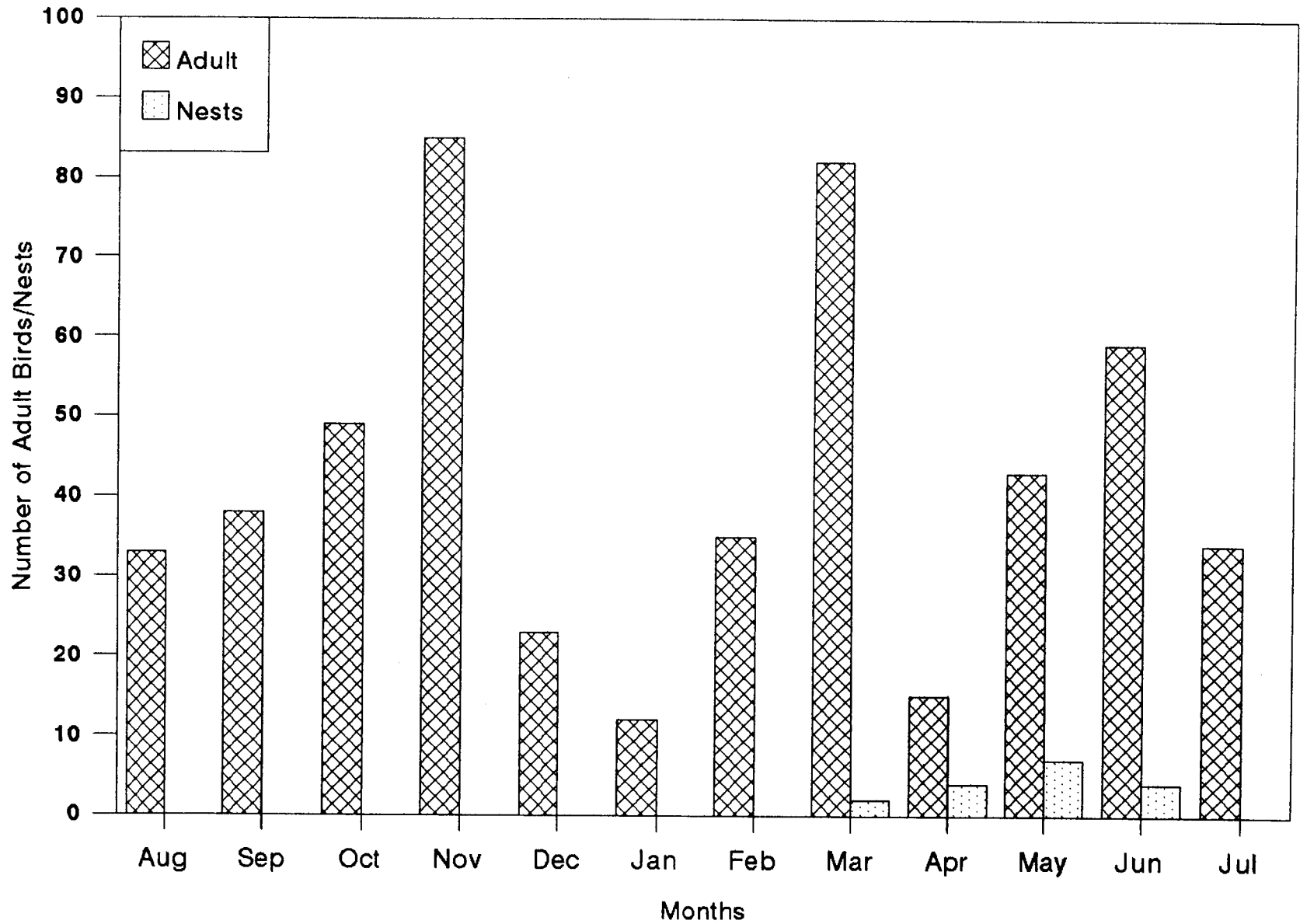


Figure 32 Adult-Nest Ratio of Night Herons in the Marshy Enclosure 1992-93

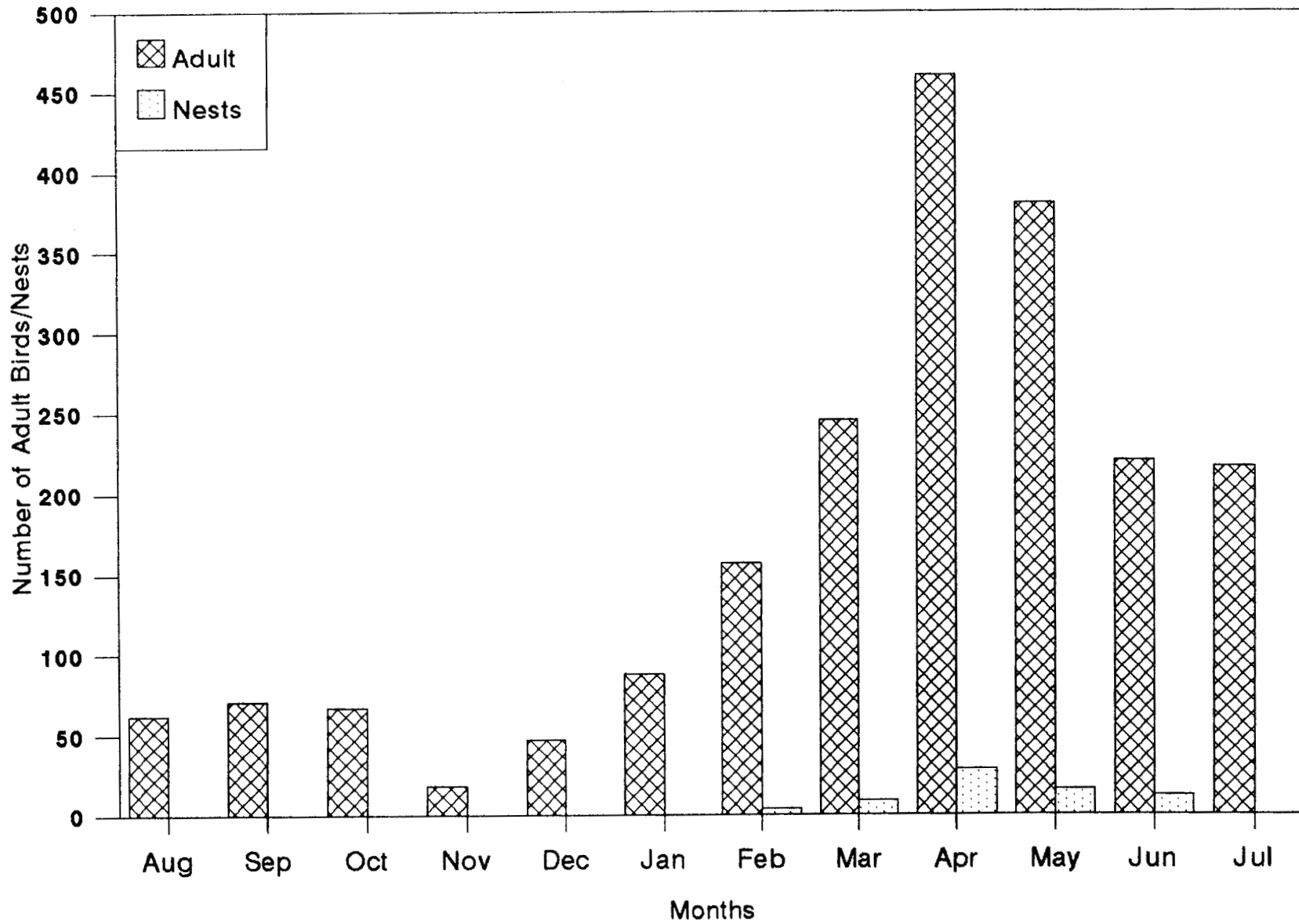


Figure 33 Adult-Nest Ratio of Night Herons in the Marshy Enclosure 1993-94

4.1.2. Baker Estate

Apart from the marshy enclosure, Baker estate has several other places harbouring water birds. The western side of the estate, bordering the Vembanad lake, with its mangrove thickets, support a rich bird population. The birds which frequent this area are *Ardeola grayii* (Pond Heron), *Nycticorax nycticorax* (Night Heron), *Egretta garzetta* (Little Egret) and *Bubulcus ibis* (Cattle Egret). Occasionally *Ardea purpurea* (Purple Heron) is also found. Night Herons use to build nests in the thickets.

There were a number of bamboo thickets in front of the Baker Estate. (Most of them are now cleared). Pond Herons used to roost regularly and build nest among these bamboos. There are two artificial lakes, the largest one now being owned by a star hotel. Trees on the banks of these lakes are occupied by birds like Pond Herons, egrets, king fishers and Little Cormorants. On very few occasions bitterns were also found among the bushes near the lakes. Pied King fisher *Ceryl rudis*, Blue King fisher *Alcedo atthis* and White breasted King fisher *Halcyon smyrnensis* were found on trees near canals and ponds of the estate. White breasted water hen *Amauornis phoenicurus* seeks shelter among the bushes that boarder the many canals in the estate. Being highly secretive, the Water hen and bitterns do not expose themselves for accurate counting. Chestnut Bittern *Ixobrychus cinnamoneus* and Black Bittern *Ixobrychus*

flavicollis were observed twice and thrice respectively when they emerged out from the bushes near the canals of the estate.

Nesting colony of Pond Herons was noted on a rubber tree with entwining *Bougainvillea*, for three consecutive years (1993–95) in May–June. Similarly, a nesting colony of Little Egrets was found on a Bamboo bush in front of the KTDC office. In May–June, 1993 there were two nesting colonies of Pond Herons on the bamboos adjoining the Taj hotel compound. Removal of these bushes stopped the nesting activities of Pond Heron in that area, in the subsequent years. In 1994 and 1995 there were two nesting colonies of Pond Heron in the KTDC premise, one on a large *Polyalthia longifolia* and the other on a Ficus tree; each colony consisting of 30–35 nests.

Nesting colonies of Little Cormorants were noted on three trees in the KTDC office premises, two *Polyalthia* trees and one ficcus tree, in 1993 and 1994. In 1995 there were no nesting colonies on these trees. Darters nested on a *Lagaestromia flos-regina* behind the KTDC office in all the three years (1993–95). At the peak time in 1994 there were 11 nests.

4.1.3. Discussion

The marshy enclosure in the Baker estate is a suitable area for certain marsh birds for shelter and breeding. (Table 35A) However, there are only five species: three species of cormorants, viz., *Phalacrocorax miger* (Little

Cormorant), *Ph. carbo* (Large Cormorant) and *Ph. fuscicollis* (Shag), the Darter *Anhinga rufa* and the Night Heron *Nycticorax nycticorax*. All of them, except the Darters occur in good numbers. Little Cormorants outnumber all other birds (Table-10, 17 and 24). The fluctuation in the density of population of Little Cormorants seems to follow a pattern with a peak in April-July (Table-10, 17 & 24). This fluctuation seems to be correlated to the tree-foliage cycle in the marsh. The branches of trees which give shelter to the cormorants begin to show signs of drying in October and are almost completely withered by January-February. In all the three years of study it has been noted that the birds desert the place during these months. The other two species of cormorants, *Phalacrocorax carbo* and *Ph. fuscicollis* and the Darter *Anhinga rufa* also leave the marsh during January-February (Table-11, 12, 18 and 19). The birds return by March-April when the stumps of trees once again develop branches and foliage.

The withering of trees is probably due to the impact of bird droppings and the summer heat. The stumps of trees or new saplings assume foliage and branches by March-April. The occasional summer rains which use to occur during these months might have helped the trees to sprout new leaves again. However they do not attain their original size or expanse. Thus there is a gradual decline in the large tree population of the marsh and their ability to accommodate birds and their nests become markedly depleted.

Nesting activities of Little Cormorants were noted in most of the months during 1992–93, with a peak during May–June. No nests could be found during January–March period (Table–10, 17). During 1993–94 period nesting activities were less when compared to 1992–93 season. There were no nests during December–March and the number of nests at peak in May–June was less than that of 1992–93 period (Table – 17, 24). Towards the final phase of this study, in 1994–95, very few nests were observed. It seems that the marsh was no longer preferred by the birds for nesting.

The Darters also had a prolonged nesting season in 1992–93 and 1993–94 and the nesting season in 1992–93 and 1993–94 and the nesting months almost coincided with that of Little Cormorants. As the Darters had a smaller population compared to Little Cormorants, the number of nests also were not many—the maximum number noted was 14 (Table–13 and 20). Lesser number of Darters and their nests were observed in 1994–95 indicating a decline in the trend of population (Table–27).

Species such as *Phalacrocorax Carbo*, *Ph. fuscicollis* and *Nycticorax nycticorax* nested from April to June in 1992–93 and 1993–94 periods (Table–11, 12, 14). In 1994–95, *Phalacrocorax carbo* and *Ph. fuscicollis* were not observed nesting in the marsh though *Nycticorax nycticorax* nested as usual. (Table–28).

Outside the marsh there were five nesting colonies of Little Cormorants, three nesting colonies of Pond Herons, one nesting colony of Little Egrets and one nesting colony of Darters on different trees/bamboos, near the KTDC office and Taj hotel in 1993 season (April–June). During the subsequent years, the clearing of bamboos and trees from the premises of the KTDC and Taj has adversely affected the nesting of birds in this area. The nesting site of Night Herons among the mangroves at the edge of the lake seemed to be unaffected.* On the whole the removal of vegetation has led to the decline of the nesting of birds in Baker estate.

Despite the seasonal fluctuations there was a gradual increase in the population size of the Little Cormorants during 1992–94 period. On the other hand a decrease in the population size of Darters was marked during the same period (Tables 10, 11, 12, 17 18 and 19). Having similar habits and habitats, the Darters and cormorants may be competing for the same resources for shelter and food and by virtue of their prolonged breeding season and higher reproductive potential, the Little Cormorants seem to emerge as the successful species.

* In 1996–97 when the area was revisited a major portion of the mangrove belt was found cleared by KTDC management and the Night Herons were not seen in the area.

Darters and Little Cormorants were not found in the marsh in January and February. The cormorants seem to give protection to other birds as they swarm all over the area. Kushlan (1979) has reported that in a mixed colony of foraging group there could be a core species having the largest population which direct the behaviour of other species and give protection to them. It has been noted that no predators or egg pirates dared to come to the area while cormorants virtually filled the space and trees. Predators like kites and egg pirates like coucal, crows and Tree-pie have been observed in the marsh during January–February (Table–31) when the cormorants were absent in the area.

There was a considerable decline of cormorant and darter population during 1994–95 period whereas Night Herons increased in number (Table–24, 26 and 27). The changing ecology of the area might have compelled the cormorants to disperse and form satellite colonies elsewhere. Such satellite colonies could be noted in certain coconut groves at Cheepunkal and Manchadikkary, about 2–3 km away from the Baker estate. It is suggested that from a seed colony many satellite colonies can be formed (Hafner and Fasola 1992) and the seed colony may suffer a set-back by the dispersal of birds. At the beginning of the survey in 1992 there were many tall trees and there was a gradual dwindling of trees during 1993–95 period. The withered trees were not fully replaced and new trees did not attain enough height for the cormorants

and darters to roost and nest. They remain bushy—more suitable for Night Herons.

The habitat decline is further aggravated by the pollution of water in the marsh. The water is stagnant for years together. There is no proper inlet or outlet for this water body even in monsoon. The decayed leaves and branches of trees, large amount of bird droppings and dead birds make the water highly polluted. The sunlight is prevented from reaching the water by floating aquatic weeds such as *Salvinia*. This is quite unsuitable for the survival of aquatic fauna which form the food for birds. During the study only on six occasions the Little Cormorants and once the Darter were found foraging in the marsh.

The lack of food in the roosting ground and its vicinity compels the cormorants and Darters to make frequent foraging trips elsewhere in the Vembanad Lake or in the paddy fields. Kushlan (1979), Fasola (1986) and Marquiss and Leitch (1990) suggested that the marsh birds forage away from their roosting ground and the frequent departure and arrival movements in the roosting places of colonial water birds may be attributed to these foraging trips. However an annual flushing out, probably during monsoon, can make the marsh cleaner and healthier for the bird populations to flourish. Some minor alterations, such as digging some link canals could serve the purpose.

Outside the marsh in the Baker estate the problem is different. Here the bird population is declining due to human intervention. About half of this

estate has been handed over to Taj Group of Hotels where they made alterations suitable for the comfort of the tourists. The entire place has been converted into a modern pleasure resort with many cottages, lawns, parks, paved paths, canals for canoeing etc. Many wild trees and bushes have been removed. Bamboos which were the nesting places of Pond Herons were also cut down. Mangrove belt along the boarder of the Vembanad Lake have been cleared to provide facilities for boat landing. The other half of the Baker estate still retained by the Kerala Tourism Development Corporation is practically untampered. But howlong it can withstand the pressure from the tourism is yet to be seen.

Baker estate with its bird sanctuary has some unique features: it possesses one of the largest cormorant populations in the state; it is one of the few places where a fairly good number of Darters roost and nest and it is a major breeding place of Night Herons. But now, even as the proposal of declaring the place as a protected sanctuary is gaining momentum, things are not much promising. The habitat degradation due to human activities or lack of activities has driven the birds far and wide and the population sizes of even the dominant species of the sanctuary such as cormorants, Darters and Night Herons are decreasing. Unless regulations are imposed on the alteration of the natural habitat of the area this bird refuge which got its publicity because of the birds presence would be a birdless area soon.

4.2. Vembanad Lake and Pathiramanal Island

4.2.1. *Stretch of Vembanad Lake from Baker Estate to Pathiramanal Island*

The stretch of lake extending between Baker estate and Pathiramanal island is about three kilometres across. The area surveyed was roughly 12 km². Birds frequented this area, flying between Baker estate and Pathiramanal, R-block and coconut groves on both sides of the lake. The fortnightly cruising trips were made and many of these trips provided opportunity for day-long observations on the diel activities of the water birds.

The lake surrounding the island is shallow in many places with bottom visible in clear sun-shine. It is an ideal foraging ground for many diving and other aquatic birds. Fishes, clams and shrimps and their larvae and juveniles are abundantly present. The possible prey items for the water birds in the lake are given in Table-6, 6A. *Salvinia mollesta* and *Eichornia crassipes* are the major floating weeds which often are clustered to form "tiny islands" on which certain birds rest and wait for the prey. Wooden and bamboo poles and stumps of trees planted in the lake for marking boat channels and lime collecting areas, also provide perch for the birds.

The birds were counted by line and point transect methods and their numbers observed during different trips are given in table-36 and 37. Little Cormorants were frequently found in the lake. Here they were not found in

groups while foraging but remaining scattered—mostly swimming about and foraging. Some of them were sitting solitarily on wooden poles. Small groups of Little Cormorants—not more than 10 in number perched on branched twigs of trees projecting from the water also could be seen. Since the entire lake could not be surveyed at a time the total number of birds in the lake was only approximately estimated. The maximum number of foraging Little Cormorants was noted in March–June period. The total numbers counted in these months in 1994 were 131, 123, 128 and 42 respectively, while in 1995, they were 38, 48, 112 and 108 (Table 36 and 37). The birds were more frequent in the morning (6.30–9.30 a.m) and evening (4.30–6.00 a.m).

Large Cormorants were found mostly perched on stumps and diving for the catch. Though the number varied from month to month the variation was not consistent in the two years of observation. The maximum number in 1994 was noted in September and October – 40 and 42 respectively. In 1995, June and November recorded the maximum number which were 32 and 34 respectively. (Table 36 and 37).

Shags were very few in number maximum numbers were recorded in October (13 birds) and November (11 birds) in 1994 and November (11 birds) in 1995. (Table 36 and 37).

Darters were found only occasionally and they were observed while flying across the lake. Night Herons also were found occasionally flying across the lake, mostly during early morning and at dusk. In March–June months these birds could be observed carrying twigs for the nest building purpose. The number of Darters and Night Herons in the lake seemed to be of little significance as they were found only in transit—neither foraging nor resting in the lake region and around.

The Pond Herons were mostly found occupying the *Eichornia* weed collections. They foraged from among the weed collections, feeding on small prey items associated with the weeds. The presence of Pond Heron in the lake was only nominal and their number seldom exceeded twenty.

Brown-headed Gull *Larus brunnicephalus* and Black-headed Gull *Larus ridibundus* were found in the lake from September onwards. Lesser black backed Gull appeared in October in 1994 and in September in 1995. All the three species remained in the lake until April. The gulls were mostly found in the vicinity of the Pathiramanal island, either floating in the lake or perched on small twigs and poles. Brown headed Gulls and Black headed gulls were often found together. Brown headed Gulls lead the other two species in number. At peak period in December and January their numbers noted were 59 and 41 in 1994 and 38 and 37 in 1995. Black headed Gulls and Lesser black backed Gulls also had peak populations in December–January, the maximum number

noted for Black headed Gull being 21 (December 1995) and that of Lesser black backed Gull noted being 18 (December 1995) (Table-37).

Terns found in the lake were mainly Whiskered terns *Chlidonias hybridus*. Little Terns *Sterna albifrons* were found in lesser number. Caspian Terns *Hydroprogne caspia*, were observed only twice; in November 1994 and January 1995—one pair on each occasion. (Table 36 and 37). Terns frequently foraged from the lake. But terns were seldom found perching in this part of the lake.

Flocks of migrant teals were found from September to April. Regular flocks were observed from October onwards. During the observation period in 1994 and 1995 they departed early in April and in the second week of April no flocks of teals were found in the lake. But Lesser whistling Teals *Dendrocygna javanica* and Cotton Teals *Nettapus coramandelianus* were exceptions. Small flocks consisting of 4–12 birds were found in the lake in almost all months except June–July when they are reported to be breeding (Zacharias–per. comm.).

During the 1993–'94 and 1994–'95 seasons 14 flocks of teals were observed. Though accurate estimation of the flock size was rather difficult, according to a rough calculation they could be classified as: smaller flocks with birds below one thousand—five flocks; medium sized groups between 1,000–2,000—7 flocks and groups with birds above 2,000—2 flocks.

The birds in each flock were closely adhered together as if to form an island in the lake. The exact composition of the flock was also difficult to assess as the birds would move away at the approach of the boat. However each flock seemed to be consisting of either one species or more than one species. Pin Tails *Anas acuta*, Blue winged Teal (Garganey) *Anas querquedula*, Common Teal *Anas crecca*, Lesser whistling Teal *Dendrocygna javanica* and Cotton Teal *Nettapus coramandelianus* could be identified while they were flying. Specimens retrieved from the nearby fields also confirmed the presence of these species in the Vembanad area. In many groups Pin Tail and Garganey were dominating in number (Table-36 and 37). On one occasion (January-1996) when a closer view could be obtained, the flock was found to consist entirely of female Pin Tails.

The teals arrive at the lake in the early morning. The flock size becomes larger and larger as small groups ranging 6-10 or larger groups of hundreds join the flock. These crepuscular or nocturnal feeders disperse themselves in the evening in small or larger groups to their respective feeding grounds at different paddy fields around.

4.2.2. Birds at Pathiramanal Island

This small island of about 1Km² in area is a roosting ground for many birds. Cormorants and Night Herons use this island as a nesting and roosting

place. The island, once had a few human dwellings, is now uninhabited. People from near-by places use to come here by small country boats for cutting grasses. There is a small belt of mud flat surrounding the island. Grasses, reeds, shrubs, mangroves (along the banks), cashew nut trees, coconut palms etc. constitute the vegetation of the island. Natural and man-made canals, small ponds and water-logged marshes make the place a suitable habitat for water birds.

Studies were carried out in the area from January 1994 to December 1995.

Three species of cormorants, viz., *Phalacrocorax niger*, *Ph. carbo* and *Ph. fuscicollis* were observed roosting and nesting in the island. The Little Cormorants occur in large numbers. They occupy the coconut palms and some tall mangrove trees near the western side of the island. There were altogether eleven coconut palms and eight other trees occupied by these birds. There was a slight increase in the size of population of Little Cormorants from 1994 to 1995. The maximum numbers of birds noted in 1994 was 640 (November) whereas in 1995 July it was 840. Nests were found from May onwards and nesting activities continued till August. In 1994, at the peak of nesting activities in July and August, the number of nests noted were 59 and 55 respectively and in 1995 the numbers were 67 and 69 in the corresponding period. No nests were found on the coconut palms. The Large Cormorants and Shags were

found sharing trees with Little Cormorants for roosting, but they had their nesting colonies on separate trees. The maximum number of nests noted for Large Cormorants was 15 in May–June 1995 and that of shag was 18 in June 1995. The Large Cormorants had a peak population from June to November during which their number rose to 160–190 (Table–38 and 39). The number of Shags in the two years of study was less than 70 at the maximum and the maximum number of nests noted was 13 in May–June period (Table–38 and 39).

Night Herons had a wider distribution in the island. They were found occupying the shrubs and reeds along the canals, coconut palms and various other trees. The monthly variations in the population of these birds were not consistent. However the number varied from 100–200. Nests were observed among the shrubs during April–June. 18 nests were noted but more nests could probably be existing in the deep interior of the dense shrubs.

Little Egrets and Pond Herons were fairly common, but no nests were observed. Median Egret, Cattle Egret and Large Egret seemed to be occasional visitors. Darters were also not regular.

The occurrence of Black-headed Gull and Brown-headed Gull were noted from October to March. They were never inside the island but found perched on wooden spikes where they were taking rest. The number of Brown

headed Gulls in different months varied from 22–68 while that of Brown headed Gull ranged from 12–26.

A few Red-wattled Lapwings *Vanellus indicus* were found in almost all months during the survey. They often were found in pairs. The maximum number observed was four pairs at a time. One or two Yellow wattled Lapwings *Vanellus malabaricus* were also found occasionally. The sand pipers which visited the island from October to march consisted of Common Sand piper *Tringa hypoleucos*, Green Sand piper *Tringa ochropus* and Spotted Sand piper *Tringa glareola*. The number of Spotted Sand piper varied from 4–24; Common Sand piper 2–8 and Green Sand piper 2–4. The sand pipers and lapwings prefer to feed on the mudflats.

The other waterbirds which are not very frequent are Chestnut Bittern, Black Bittern and Yellow Bittern. Chestnut Bitterns were found on three occasions, twice in pairs and once as a solitary bird. Black Bitterns were observed four times and their maximum number noted was four. Yellow Bitterns were found only twice, the first sighting was in March, 1990–94—a single bird and the second sighting in February '95—a pair (Table 38 and 39). The bitterns occupied the shrubs and reeds that grew along the canals of the island. Whiskered Terns, Little Terns and two species of king fisher—*Alcedo atthis* and *Halcyon Smyrnensis* were also among the water associated birds found in the island.

A number of birds which are not strictly water associated were also found in the island. The most frequently found birds are given in the Appendix.

4.2.3. Discussion

Vembanad lake, part of Baker estate and Pathiramanal island constitute the proposed birds sanctuary. However this region is not remarkable for its diversity of bird species. There are altogether 30 species of water birds in this area, of which three species of cormorants (*Phalacrocorax niger*, *Ph. carbo* and *Ph. fuscicollis*), Darter and Night Heron are permanent residents of the area. Cormorants which roost and nest in the Baker estate and Pathiramanal forage in the lake around.

Other common residents of the study area, like egrets, Pond Herons, king fishers and water hens have limited representation in the lake region—their main foraging grounds being the nearby paddy fields and river banks. Concentrations of floating weeds (*Eichhornia* and *Salvinia*) often provide sufficient landing place for birds like Pond Herons. These weed collections also provide them food as many aquatic prey species (Table-8) are associated with these weeds (Ghingran 1982).

Of the two lapwing species, the Red-wattled Lapwing *Vanellus indicus* is found almost throughout the year. They are often seen in pairs though

occasionally present in small groups of 6–8. Yellow-wattled Lapwings *Vanellus malabaricus* are very rare (Table 38, 39). The lapwings seemed to be fond of foraging in the mud-flats around the Pathiramanal island. No nest of lapwings could be found in the study area. Their absence in May–June in the region may be due to the breeding departure—a possible breeding time according to Ali and Repley (1983) being March–August.

The resident teals such as Cotton Teal *Nettapus coramandelianus* and Lesser whistling Teal *Dendrocygna javanica* also are found in the Vembanad region. But they have a smaller population—often less than a hundred (Table 36, 37).

The winter visitors of Vembanad include a variety of teals, gulls, terns and sand-pipers. Vembanad lake is well-known for its population of migrant teals. Common Teal *Anas crecca*, Garganey *Anas querquedula* and Pin Tail *Anas acuta* constitute the teal population that visit the region. They use the lake as a safe resting place during the day time when they gather in thousands and remain floating on the surface. However they seldom forage in the lake. In the evening they depart in large or smaller groups to the nearby paddy fields for their nocturnal foraging.

During the study period, in 1994 and 1995 the first batch of migrant teals appeared by the end of September. Birds continued to come in October and November increasing their population to the peak in December–March

period. By the first week of April their number appeared to be dwindled and by the end of second week of April none could be found.

Garganey and Pin Tail dominated in number—Garganey often exceeding a thousand per flock while Pin Tail a little below thousand (Table 36, 37). On a trip to the lake in the first week of December 1995, a flock of teals could be watched from a closer distance and found to be consisting almost entirely of Pin Tail females. A flock of teals consisting of male Pin Tails only had been found in Bharatapuzha estuary (Zacharias – per. comm.). Such male–female segregation of wintering ducks could be observed in some species (Oelke–Per. Comm.).

Gulls could be found in the lake during October–April period. There were three species of gulls viz. the Black-headed Gull *Larus ridibundus*, Brown-headed Gull *Larus brunnicephalus* and Lesser Black-backed gull *Larus fuscus*. Concentrations of gull populations were noted near and around Pathiramanal and they were not found south of Pathiramanal—the salinity gradient could have affected the distribution of gulls.

Whiskered Terns *Chlidonias hybridus* and Little Terns *Sterna albifrons* are usually found in Vembanad region. Gulls and terns forage only when light is available as they forage while at flight and use only visual cues for locating the prey (Fasola and Canova 1993).

Sand pipers are usually found in the mud flats around Pathiramanal. These mud flats are subjected to tidal variations and hence have a periodical replenishing of food items on which the sand pipers subsist. Spotted Sand piper *Tringa glareola* is leading in number—as many as twenty at a single sighting. The Green Sand piper *Tringa ochropus* has only a nominal presence with a maximum number of four at a single sighting (Table 38, 39). Common Sand piper *Tringa hypoleucos* also occur in the mud flats of Pathiramanal. Sand pipers begin to arrive in September and have a peak population in November–February. By the end of March there were no sand pipers in the Pathiramanal island.

Birds of Vembanad were once (during the pre-operational period of Thanneermukkam barrage) a part of the estuarine ecosystem. A large population of planktons which require higher salinity were noted especially in summer in Vembanad before the commissioning of the Thanneermukkam barrage. But after the commissioning, in 1980 there was a remarkable decrease of 88–100% of salinity in the south of the barrage (Nair and Pillai 1990). Many estuarine species and their larvae or juveniles which form the planktons of the lake suffered a severe set back. Besides the lowering of salinity, the tidal flushout of wastes and insecticides is prevented by the closure of the barrage. Thus the Vembanad becomes a static pool of polluted water. This also leads to the decline of many prey species. The studies conducted by the investigation team of Kerala Agriculture University in 1983 (proceedings of the symposium

on Rice–Wetland Ecosystem 1990) showed that a high mortality of fishes like *Etroplus*, *Mugil* and young ones of cat fishes, crabs like *Scylla serrata*, shrimps like *Macrobrachium* spp. and clams like *Villorita* spp. in the south of Thanneermukkam was mainly due to ammonia and acid pollution caused by the leaching of polluted water from the paddy fields. It has also been shown that the incidence of mortality is more in waters of lower salinity (Nair and Pillai 1990).

The mangrove vegetation which shelters a number of aquatic and semi-aquatic organisms, also is gradually vanishing due to the lowered salinity. The water birds which largely depend on the planktons and other prey species of the lake thus were compelled to seek new venues for their survival.

4.3. Paddy Fields

4.3.1. Reclaimed Paddy Fields ('Kayal Padoms') and Southern Stretches of Vembanad

R-block and blocks of paddy fields such as Rani, Chithira and Marthandom are reclaimed wet lands which remain as isolated islands in the southern reaches of the Vembanad lake. R-block is protected by granite retention walls and is a coconut grove. Thick grasses and reeds fill the interior of R-block. Rani, Chithira and Marthandom are full fledged paddy fields and are protected from the lake by mud-bunds.

This area harbours a rich bird fauna. The lake and paddy fields provide foraging ground while R-block provides site for nesting and roosting. As many as 45 species of water birds (Table 40, 41) and water-associated birds occur here. Twelve of these species are migratory. Seven species may be considered as local migrants as they are not known to breed in the area.

Little Cormorants were found round the year but their number is rather less than that of the northern parts (Pathiramanal-Kavanattinkara) of the lake (Table 40, 41). There were no roosting or nesting place of cormorants in the R-block or anywhere in this part. The birds foraged in the lake and in the paddy fields. Large Cormorants were still lesser and Shags were rare (Table 40, 41). Darters were found on few occasions.

Night Herons were present at all times. Their number recorded (Table 40, 41) may not be indicative of their actual population in the area. The interior of the R-block was always noisy with the chirps of these birds—indicating the presence of a larger number of birds than those were seen. But the thick reeds and grasses render the place inaccessible for observation. No nests could be observed owing to the same reason. But birds were seen carrying nesting materials (twigs etc.) to the interior of R-block during April–May. Grey Herons and Purple Herons also were observed waiting for prey on the bunds of the rice fields. Their populations were not very large. Grey herons *Ardea Cinerea* were seemed to be resident of this area as their presence

was noted almost throughout the year. (Table 40, 41). No Purple Heron *Ardea purpurea* were found from January to March in both 1994 and 1995.

Pond Herons were found foraging in the reclaimed paddy fields almost throughout the year: their maximum number during September–December and lowest number during April–July when they breed. There were no nests of Pond Heron in this area. Little green Herons *Butorides striatus* (*Ardeola striatus*) were found on a few occasions. They used to occupy the shrubs along the bund. Three species of bitterns, the Chestnut Bittern *Ixobrychus cinnamomeus*, the Black Bittern *Ixobrychus flavicollis* and Yellow Bittern *Ixobrychus sinensis* were found rarely in the paddy fields and R-block.

Among the egrets Little Egrets *Egretta garzetta* were found almost throughout the year. Flocks of Little Egrets ranging from 50–70 were observed during September–December period when their number is maximum in these paddy fields. The lowest number of Little Egrets was recorded during April–August months (Table-40, 41). Cattle Egrets *Bubulcus ibis* also were commonly found but in smaller flocks of 20–30 birds (Table-40, 41). No Cattle Egrets were observed during April–July, the months in which they are known to breed in other parts of the state. Their breeding plumage started developing prior to their departure in April. Median Egret *Egretta intermedia* and Large Egret *Egretta alba* were occasionally seen but they were not regularly visiting

the paddy fields. Egrets and Pond Herons were often found foraging together in the paddy fields.

Crakes, rails, waterhens and jacanas were also observed in the paddy fields and interior water bodies within a radius of 2–3 Km. of R-block. Pheasant tailed Jacanas *Hadrophasianus chirurgus* were found in small groups of 3–12 foraging in the partly inundated paddy fields. Bronze-winged Jacanas *Metopidius indicus* were often found as solitary individuals on the aquatic weed collections and at the grass or reed covered edges of the water bodies (Table-41,42). Slaty-legged Banded rail *Rallina eurizonoides*, Blue breasted Banded rail *Rallus striatus*, Ruddy Crake *Porzana fusca*, Kora or Water Cock *Gallicrex cinerea*, Indian Moorhen *Gallinula chloropus*, Purple Moorhen *Porphyrio porphyrio* and White-breasted Water hen *Amauornis phoenicurus* were occasionally found in the area. They were found in smaller numbers. However their population size cannot be assessed from this observation as these comparatively timid birds often take cover at the approach of the observer. Most of these birds were found either singly or in pairs or in small groups of 3–6. Purple Moorhens were found in larger groups, upto 28, but their occurrence was restricted to certain pockets: These birds were regularly found at Neelamperoor, about 3 km. south-east of R-block. (Table 40, 41).

Little Grebes *Podiceps ruficollis* were regularly observed in some interior water bodies from where they seldom leave. Their number also remained more or less constant (Table 40, 41).

Lapwings, plovers and sand pipers were also represented in the locality. Red wattled Lapwings *Vanellus indicus* and Yellow wattled Lapwings *Vanellus malabaricus* were observed mostly in the semidraind water canals that traverse the R-block. The number of Red wattled Lapwing ranged from two to eight while the Yellow wattled lapwings were rarer; one or two in the whole area.

Plovers were observed in the paddy fields and along the banks of canals and rivers during October–March. Little ringed Plovers *Charadrius dubius* were observed in flocks of 60–140. Kentish plovers *Charadrius alexandrinus* also were seen but in smaller numbers of around 20. Both species of plovers foraged together. Sand-pipers were found in the paddy fields from October to April. They seemed to prefer partly inundated and muddy places in the paddy fields. They foraged along with birds like herons, egrets and plovers. Red Shank *Tringa totanus*, Common Sand piper *Tringa hypoleucos*, Green Sand piper *Tringa ochropus* and Spotted Sand piper *Tringa glareola* visited the area during the study period. Of these Common Sand pipers occurred in fairly good numbers—as many as 22 at a sighting (Table–40, 41).

Whiskered Terns were observed in large numbers while Little Terns were rarer. Whiskered Terns were regularly seen lined up on electric lines often in

company with swallows and king fishers. Caspian Terns were observed only once: a group of four birds met with in November, 1994.

Flocks of teals were found from November to March. The flock composition was not clearly discernible; however Pin Tail, Garganey and Common Teal could be identified. As in Northern Vembanad, here also the birds remain in the lake only during day-time. Cotton Teals and Lesser whistling Teals were observed in smaller numbers in certain water bodies in the interior area. There was a single instance of Cotton Teal breeding in the area. This was observed in June 1996 after the completion of regular studies. The nest was found in a hole on a coconut palm situated at the edge of a paddy field near R-block. The female bird went into the hole while a male sat in the vicinity as if on guard. When checked later there were two eggs in the nest. But three days later, there were no eggs and the teals also seemed to abandon the site.

Four species of king fishers were observed in the area. Pied king fishers *Ceryle rudis* were often found in pairs. Stork billed king fishers *Pelargopsis capensis* were found almost throughout the year (Table 40,41). Small Blue king fishers (Common King fishers) and White breasted Kingfishers were also common in the area.

There were unconfirmed reports (by local people including a forest officer) on the occurrence of Flamingoes in the area in October 1993.

4.3.2. Paddy Fields of Kuttanad

Three sample plots were selected in Kuttanad for the study of wet land birds: Plot No.I—a stretch of paddy fields extending along the side of Kottayam–Kumarakom road. The sample plot was about 3 km long from Chengalam to Kumarakom and 1 km wide; Plot No. II—a block of field of about 2 km² near Monkompuzha Rice Research Station (Kerala Agriculture University); Plot No.III—2 km² of paddy fields at Vazhappally near Changanacherry. Plot No.I is very near to Vembanad lake and Kavanattinkara bird sanctuary. Plot No.II at Monkompuzha is the central area of Kuttanad and Plot No.III at Vazhappally is probably the easternmost end of Kuttanad and lies in the proximity of M.C. Road with its heavy traffic. This part of Kuttanad is under the threat of constant human activities.

The peculiarities of the 3 plots are reflected in the avian population also. Many of the birds that are found in the bird sanctuary and northern parts of the lake are represented in Plot No.I, though in lesser numbers. Thus little cormorants, darters, bitterns, teals, plovers, sand pipers etc. were observed in this area. (Table 39, 40). Teals often came to this place for foraging at night.

Sand pipers, plovers and stilts were well represented in this area. Their numerical strength also is better than that of the other two plots. Whiskered terns and little terns are also fairly in large numbers. There were two interior

water bodies where Little Grebes could be found. These water bodies were inundated paddy fields which were left uncultivated for a few years. Isolated water plants like *Eichornia* and *Salvinia* with their associated prey items (Tables-8), small fishes, molluscs and crustaceans provided sufficient food for the birds.

Black winged stilts *Himantopus himantopus* were found at the same particular place in three consecutive winters. These birds could be the same and thus showing site fidelity.

Four species of king fishers—*Alcedo atthis*, *Halcyon smyrnensis*, *Ceryle rudis* and *Pelargopsis capensis* – were found to occur in this area.

In plot No.II cormorants and Darters were comparatively fewer than plot I, while pond Herons and egrets had larger populations. The number of egrets and herons reached the maximum just prior to cultivation when the fields were ploughed and harrowed. A probable reason of the increase in the foraging birds could be the surfacing of the prey items following the turning up of the soil. Mixed flock foraging was also noted at this time—Pond Herons, Little Egrets and Cattle Egrets occupied the same area for feeding.

The diversity of species in Monkompou zone was rather rich. Rails, crakes, water hens, jacanas, stilts etc. are usually found in the locality. Ruddy Crakes and Slaty legged Crakes were found in smaller numbers of 2-4 or even

singly. Purple Moorhens were seen in small groups of 3–16. Water Cock and Indian Moorhens were found either as solitary birds or rarely in pairs (Table-44, 45).

Little Grebes, as in plot No.I, were restricted to certain specific places which were identical to those of plot No.I: there were three such inundated water bodies towards the interior of the paddy fields, occupied by the Little Grebes.

King Fishers were represented by the Common (Small blue) King fisher, White breasted King fisher, Pied King fisher and Stork billed King fisher. Stork billed King fisher however was scantily observed.

The migrant waders are represented by the Red Shank, the Common Sand piper, Green Sand piper, Spotted sand piper, the Little Ringed plover *Charadrius dubius* and Kentish Plover *Charadrius alexandrinus*. Among the waders the Common Sand pipers were regularly seen from October to April and their number ranged from 5–25. The Spotted Sandpiper, Green Sandpiper and Red Shank were rather inconsistent in their appearance in the paddy fields and none of them exceeded ten in number at any time. The plovers almost had a steady population from October to March. The Little Ringed plovers ranged between 25 and 35 in 1994–95 and 35–45 in 1995–'96 season. The Kentish Plovers ranged between 12 and 22 in both '94–'95 and

'95-'96 seasons. The Whiskered Terns and Little Terns are widely spread in the area during September–April.

Plot No.III had the poorest turn out of bird species (Table-46, 47). Pond Herons, Little Egrets and Cattle Egrets dominated the area. They often were found foraging together in the paddy fields. Pond Herons led in the size of population with 40–60 birds at the peak time in September–October period. The number of Little Egrets in the same period was 35–45 and that of cattle Egret 25–35 (Table-46, 47). Stray Little Cormorants were found in all seasons throughout the year. At times one or two solitary Darters also were found. Winter visitors like Common Sandpipers, Little Ringed plovers and Whiskered Terns were observed from September to March. Among King fishers, the Stork billed King fisher was totally absent in the area. Whereas Common King fisher and White breasted King fisher were rather frequent and Pied King fisher appeared rarely. White breasted Water hens were also occasionally seen.

Fluctuations could be noted in the relative size of populations of water birds which foraged in the paddy fields. Pond herons and egrets remained most of the day time in the field. At times, especially in the hot hours of the day they were found retreating to some trees—often coconut palms, at the edges of the paddy field. The frequency of the birds at different time of a bright pre-monsoon day in a paddy field of about 1 km² is given in the table:

Table 48
The Frequency of Pond Herons, Little Egrets and Cattle Egrets at
different time of the Day

Bird	6.00–9.30am	10–12 am	1.00–4.00 pm	4.00–6.30 pm
Pond heron	186	118	72	122
Little egret	132	114	26	84
Cattle egret	78	46	23	52

Pond herons, Little Egrets and Cattle Egrets are the waders which are characteristic birds of the paddy fields in almost all seasons. They are found singly, in pairs, in small groups or in large flocks. Their frequency of flocking in a post-monsoon season (August–December 1994) is given in Table-49a, 49b and 49c.

The largest number of egrets and herons were noted in paddy fields which were being ploughed (wet poughing). At this time the field is extremely muddy and the aquatic prey items would swarm in on the surface. This seems the best opportunity for feeding for marsh birds. Mixed flock foraging could be noted on such occasions. Pond herons, Cattle Egrets, and Little Egrets (in a few instances, Median Egrets also) were found actively foraging together. However at the time of departure the egrets and herons fly away almost in their own separate groups.

Table 49
Birds Foraging together in an Area of 150 m² (In Kuttanad)

(a) Pond Heron	
Number of birds	Number of sightings
1	16
2	19
3-10	27
11-20	11
21-35	8
36-50	5
Above 50	3
(b) Little Egret	
1	21
2	32
3-10	19
11-20	14
21-35	7
36-50	8
Above 50	4
(c) Cattle Egret	
1	41
2	22
3-10	9
11-20	4
21-35	3
36-50	1
Above 50	1

It could be noted that the distribution of Pond Herons and egrets in the paddy field had direct relationship to the stages of cultivation of paddy plants. As noted above the maximum number of these waders could be found in a field which was freshly ploughed. The peak number was at the time of ploughing by a tractor. Mixed flock feeding also was very spectacular. Birds were fairly abundant when the young seedlings were just coming up also. But

as the paddy plants grew and filled the field the birds became less frequent. They usually remained at the edges and bunds of the field. The next crowding of birds occurred when the fields remain fallow and partly inundated. The least number was noted when the paddy plants were ripe and ready for harvest.

There are two crops in Kuttanad; the one starting from October/November, harvested in January/February and a second crop (only in about 1/3 paddy fields) starting in June and harvested in September. The frequency of waders was at its peak in October/November (Figure 10).

Baya Weever Bird *Ploceus philippinus* was found nesting in the vicinity of canals and paddy fields of Kuttanad. Hundreds of nests were seen hanging from coconut palms and other trees during March–August months.

4.3.4. Discussion

4.3.4.1. Southern reaches of Vembanad and Reclaimed Paddy fields

The southern reaches of Vembanad with its reclaimed paddy fields ('Kayal padoms') could be considered as a junction between two habitats—the fresh water Kuttanad paddy fields and the brackish water Vembanad lake. The salinity is often less than 1%. Estuarine birds very seldom visit this place probably due to the low salinity, while birds which feed on fresh water prey species frequent the place. However this region has a greater diversity of bird species, compared to the other places of the study area. Altogether there were

47 species of birds of which 27 were residents which breed here or elsewhere in the study area. Thirteen winter visitors also were observed in the region. Breeding status of the rest is uncertain.

Of the resident birds, Little Cormorants frequently forage in the lake and paddy fields. In 1994 and 1995 the fluctuations of population showed a more or less similar pattern. There were two peaks in each year—the first in March–May period and the second in September–November. At the peak time there were around 200 birds. In June–August period the population size showed a sharp decline. The size of population when compared to that of the Baker estate, their major breeding ground, was rather smaller. But their presence was noted in all seasons in this place whereas in Baker estate their consistent absence was noted in January–February period (Table-40, 41). Large Cormorants, shags and Darters only occasionally foraged in the southern Vembanad (Table-40, 41). Cormorants and Darters did not roost or nest in this place—the probable reason being the absence of suitable tall trees for nesting.

Night Herons had a few roosting places in the R-block. Their population size was more or less consistent—ranging between 15–25 birds. They nested among the shrubs in the central part of the R-block.

Purple Herons and Grey Herons were seen foraging in the paddy fields. Purple Herons were present in the area from April to November

(Table-40, 41). There were no evidences of their breeding in this place. According to Ali and Repley (1983) the Purple Heron in S. India has a breeding season from November to March. Their absence in this area from December to March could be attributed to their departure to the breeding sites elsewhere.

Grey Herons were only casually seen. Altogether there were five sightings—three in 1994 and four in 1995—each time there were 1–3 birds. Pond Herons and egrets forage in the reclaimed paddy fields in all seasons. Pond Herons, Little Egrets and Cattle Egrets had peak populations from September to November. Another short burst was seen in February–March. May–August period showed a marked decrease in the population (Table-40, 41). The increase in number of birds in September–November period might be due to the favourable conditions of the paddy fields. Prior to the major 'Puncha' crop during September–October, the fields are either partly indated or wet-ploughed. With plenty of prey species, this is an optimum condition for foraging. In late October and early November the young seedlings are not tall or thick enough to obstruct foraging. The decrease in population of Pond Heron and Little Egrets during May–August is associated with the monsoon when the fields are flooded. The total absence of Cattle Egrets in April–July period is due to their departure for breeding—they do not breed in the study area or anywhere in the vicinity.

Median Egrets and Large Egrets are sometimes found foraging with Pond Herons and other egrets. But often one or two of them were only found. Large Egrets appeared only four times during the two years of observation and each time there was only a single bird. Chestnut Bittern, Black Bittern, Yellow Bittern and Little Green heron are all represented in the region but their frequency of appearance suggests that their population size is smaller here.

Birds such as White breasted Water hen, Moor Hen, crakes, rails etc. which usually avoid human presence find good shelter and cover in the area. There are several marshy places, not far away from the lake, which provide foraging facility for birds like Indian Moorhen, Water Cock (Kora) and Ruddy Crake. Jacanas also seem to prefer similar habitats. R-block also provides shelter and roosting and nesting ground for these birds. White breasted Water hens have nests all over the area. Others are more or less confined to the R-block and other isolated and reed covered marshes for breeding.

The extensive and thick reed covered interior of R-block gives shelter and protection to many water birds such as water hens Jacanas and crakes. At the same time the birds and their nests are exposed to the threat of snakes especially cobras which also inhabit in the same area. Many crushed shells of eggs found in the vicinity of the reeds indicate the extensive damage caused by the predators to the eggs.

Waders such as sand pipers and plovers arrive by the end of October or early November and remained here till April. Little ringed Plovers come in flocks of 50–150. In 1994 they arrived in the first week of November and stayed till April first week. Kentish Plovers also were seen mixed with the flocks of Little ringed Plovers. At the peak time in January–March the population size of Little ringed Plover were 130–140 in a block of paddy field of about 1 km² where as the maximum number of Kentish Plover in the same period was only 25–30 (Table-40, 41).

The sand pipers move about and forage in the paddy fields either singly or in small groups. Common Sand pipers occur in good numbers: at the peak time in December–January they had a population size of 20–25 individuals while Green Sandpiper, Spotted Sandpiper and Red Shank had populations of 5–10 birds each. Green Shank was represented by one or two birds (Table-40, 41).

Teals arrive in large numbers in September/October and they stayed till second week of April. The time of 'Puncha' crop (the major paddy crop in Kuttanad) coincides with this period, i.e., the teals are present in the paddy fields from sowing to reaping. They cause considerable damage to the paddy crop by feeding on the germinating seeds and by landing in large numbers on paddy plants. Farmers, in turn, soak grains in poison before sowing. Large number of birds die in the fields. The dead birds are collected immediately;

the crop is removed and the meat is sold in toddy shops and meat market. Teals have also been trapped and shot down for their meat. If the inhospitable attitude towards these visiting birds continues, it may in the long term cause considerable damage to the migrant teal population. This matter needs serious attention. Some alternate and ingenious devices to scare away the birds from the paddy fields should be developed. Protection and awareness-tactics should also be taken up as part of the management of teals.

The increase of birds in number and diversity may be due to the abundance of prey species and adequate shelter offered by shrubs and reeds. Many tributaries of rivers like Pamba, Manimala and Achenkovil join the lake at this region. These rivers bring a lot of detritus and nutrients which support a number of aquatic prey species. Small and large enclosures of marshy places in the vicinity are likely to promote bird population. The disturbances and habitat degradation affecting the northern part of Vembanad do not seem to exist in similar extends in the southern stretches which could explain its larger bird diversity and population.

4.3.4.2. Discussion—Kuttanad

Since the construction of the Thanneermukkam barrage the salinity in Kuttanad is practically nil and the region has been mostly a fresh water habitat. The occurrence of birds in this habitat seems to depend on factors like stages of paddy crop, availability of water, rain fall and human intervention. The

fluctuations in the populations of Pond Herons and egrets seem to be influenced by the various stages of the paddy crop. The major crop in Kuttanad starts in October or November when the fields are partly inundated. The ploughing prior to sowing is done in wet soil. As a result the fields assume the nature of a marsh. Aquatic prey species aggregate on the surface. Birds exploit this opportunity and they flock in large numbers. This period may be considered as the first peak of water bird population (Figure 10). Mixed flocks of Pond Herons, Little Egrets, Cattle Egrets, Median Egrets and migrant waders like sand pipers and plovers can be observed feeding at this time. The number of birds gradually decreases as the paddy grows (December/January) and gets ready for harvest (January/February). Usually there is little or no rain during this period and the fields are almost dry. The water birds retreat to the sides of small canals that traverse the fields.

The paddy fields in the post-harvest period become partly inundated by the summer/pre-monsoon rains (in April-May). The second peak of water birds in Kuttanad is observed at this time (Graph). With the onset of South-West monsoon in June-July the fields become flooded—a condition unsuitable for the wader-type birds. The migrant waders are already left and the resident water birds retreat to more interior areas where the water level is rather low. They seem to prefer water edges and receding water lines.

Apart from the seasonal fluctuations in the bird populations, there seems to be a circadian fluctuation in the flocking of birds. Maximum number of birds are seen foraging in the fields in the early morning (Table-46). According to Fasola 1986 and Master 1992 the early morning-flocking of birds is because of the 'super-abundance' of prey items in the morning. Fishes, molluscs, crustaceans and worms aggregate at the surface after the hypoxic condition of the night (Lack 1971, Waite 1984, Master 1992). Temperature could be another factor that regulates the foraging and other activities of water birds. Most of the birds seek shelter in the noon and afternoon when the temperature is very high.

Altogether twelve species of migratory water birds were observed in the Kuttanad area: two species of plovers, one species of stilt, four species of sandpipers, two species of terns and three species of teals. The Little ringed Plovers and Kentish Plovers are regular winter visitors. Sandpipers are represented by Red Shank, Common Sandpiper, Green Sandpiper and Spotted Sandpiper. Sandpipers and plovers are often seen in mixed flocks with resident birds such as egrets and herons. Black winged Stilts were consistent in number (Table 42-43, 44-45) and found to occupy specific places in each locality in successive years. The stilts found year after year in the same place could be the same—showing site fidelity. A pair of Black winged stilts was observed in a small paddy field near Medical College, Kottayam (outside the study area) for four consecutive years. This also endorses the possibility of site fidelity in the

species. In the second week of June, 1996, after the completion of the study, twelve White Ibises *Threskiornis aethiopica* were found in a paddy field at Kumarakom. Hitherto there was no sight record of the White Ibis from Kumarakom or the surrounding areas.

The winter visitors are found spending more time for foraging than local migrants and residents. Obviously the migrants need more energy for the imminent homing flight.

Teals usually do not visit the paddy fields at day time. They come to the fields in large numbers for feeding at night. Early in the morning teals in small or larger groups could be seen flying from different paddy fields towards Vembanad lake. Some of the Cotton Teals and Lesser whistling Teals are found foraging in the interior water bodies during day time. Cotton teals and Lesser whistling Teals are found almost throughout the year. Nesting of Lesser whistling Teal was not observed in the study area though it was reported from Calicut (Zacharias-Per. Com.). Cotton Teals were found nesting in Kuttanad area.

The study on bird population of different sectors of Kuttanad shows that man is an important factor in the habitat-preference of birds. Most birds avoid human proximity. Paddy fields which are remote and far away from human settlements support a rich bird fauna both in number and diversity of species. For example the central sector of Kuttanad (Monkompu region) with extensive

stretches of paddy fields harbour the largest bird population (Table-44,45) Chengalam-Kumarakom stretch comes second (Table-42, 43). In this region also the human settlements are far away from the paddy fields and the only major source of disturbance is the Kottayam-Kumarakom road with its fairly heavy traffic. The third sample plot, Vazhappally region, though in all other aspects similar to the other two plots has an almost urban atmosphere. The Changanacherry municipal town is very close to this area which is never free from human presence and activities. The negative impact is well reflected in the bird diversity and population (Table-46, 47).

More timid birds like water hens, crakes, rails and jacanas do not expose themselves in the open paddy fields. The Pond Herons, egrets and cormorants which are not much scared of human presence, frequent the paddy fields, even those fields which are closer to the roads and human settlements. This is probably because poaching is not a threat to these birds there. On the other hand, water hens, crakes and rails are considered to be delicious and are hunted for their meat. These birds are hence compelled to keep away from human presence and take cover in the bushes.

The small state of Kerala has to support a large human population. So practically all possible land and water resources have been channelled to the maximum utility to human welfare. Thus many of the natural habitats and reserves have been replaced by what we call agro-ecosystems. Kuttanad

paddy fields are part of such agro-ecosystem. It is natural that interests of wild life and agriculture clash between in agroecosystems. Kuttanad is however no exception.

Teals often cause considerable damage to the paddy plants. Their arrival coincides with the timing of the major crop in Kuttanad. They eat the seedlings and trample the plants. Water hens, rails and crakes are also said to cause local damage to the crop by trampling while they probe for food. So these birds are met with the hostility of farmers and eventually fall victims to the retaliating measures such as pesticide poisoning, shooting and trapping. On the other hand Pond Herons, cormorants and egrets thrive well in the paddy fields of Kuttanad. They do not make much damage to the crops. The farmers even consider them as 'friendly' since they prey on crabs which cause damage to the bunds. They also increase the fertility of the soil by their droppings. But even these birds are now confronted with the potential dangers caused by the new agricultural practices. viz. the use of pesticides and chemical fertilisers. The construction of roads, bunds and bridges, the conversion of bushlands and shrub-thickets into coconut groves, the reclamation of extensive areas of marshlands for residential purpose and several other developmental projects could put stress on water bird population.

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Chapter 5

SUMMARY

Vembanad lake and adjoining Kuttanad paddy fields constitute an ideal wetland ecosystem. The water resources and marshes with adequate vegetation and abundant prey items such as fishes, crustaceans, molluscs, worms etc. support diverse water birds. Recently the changing ecology of the area due to intensive cultivation using chemical fertilisers and pesticides, reclamation of lakes and marshes for cultivation, destruction of vegetation and commercially oriented tourism development has made the place less suitable for water birds to thrive.

Altogether 54 species of water birds are observed in the study area. Of these 18 species are migrants visiting this place from September/October to March/April.

Seasonal fluctuations in the population size of different bird species are noted. Little Cormorants lead the list of resident water birds in number and dispersion. They are concentrated in the northern regions of Vembanad especially in the Baker estate and Pathiramanal island where they roost and nest. But these birds spread throughout in the low-lands of Central Kerala for foraging. Shags, Large Cormorants and Darters occur in lesser numbers and are almost restricted to the northern Vembanad region in a smaller foraging

radius. They also roost and nest in Baker estate and Pathiramanal. Night Herons thrive well throughout in the Vembanad region. They nested in Baker estate, Pathiramanal and R-block.

Little Egrets, Cattle Egrets and Pond Herons dominate the paddy fields of Kuttanad and are frequent throughout in the study area. Little Egrets and Pond Herons nested in Baker estate whereas Cattle Egrets did not nest in Vembanad-Kuttanad region and they were absent in the area in May-June presumably departed for breeding elsewhere.

Birds like White breasted Water hen, Indian Moorhen, Water Cock, Jacanas, rails and crakes are present in smaller numbers. They concentrate in the southern regions of Vembanad and Lower Kuttanad but are found foraging all over Kuttanad area. They nested in the Kuttanad, mostly in and around R-block.

Red wattled Lapwing, Yellow wattled Lapwing, Little Grebe, Black Bittern, Chestnut Bittern, Median Egret, Large Egret, Grey Heron and Purple Heron are the other prominent resident water birds of this area. These are not found nesting in the area. Some of them seem to be local migrants. Among the two residential teals, viz. the Lesser Whistling teal and Cotton Teal which frequent this place, the cotton Teal was found nesting in the area.

Four species of King fishers are commonly found here. Little Blue King fisher and White breasted King fisher are found throughout the place. Pied

Kingfisher and Stork-billed Kingfisher seem to have a more restricted distribution—usually found foraging along the water edges of lower Kuttanad.

Migrant birds arrive in September or October and depart by April. A few migrants stay up to May. The migrant duck/teal population consists of Pintail, Garganey and Common Teal. They are usually located in the lake, south of Thanneermukkam barrage during day-time. Gulls such as Black headed Gull, Brown headed Gull and Lesser Black backed gull are usually found in the lake near and around Pathiramanal. Terns are found throughout Vembanad and Kuttanad region. Plovers visiting Kuttanad during winter in good numbers consisted of Little ringed Plover and Kentish Plover. They have a wide distribution in the lower Kuttanad. Sandpipers and other waders comprise Red Shank, Green Shank, Common Sandpiper, Green Sandpiper and Spotted Sandpiper. Black-winged Stilt and Painted Snipe are found in certain specific areas every year. Species diversity is at its peak during October–April period when the migratory birds join the resident birds of Kuttanad–Vembanad region. Lowest number of species is observed during monsoon in June–July.

The water birds of Vembanad–Kuttanad region confront many problems and threats. The stress of agricultural development on one side and that of tourism development on the other seem to have adversely affected the birds in the area. The neglect from the part of concerned authorities and vandalistic attitude of common man make the things worse. There was a marked decrease

in population of many birds over a period of 3–4 years. (1992–1996). Birds like rails, crakes, water hens etc. which need cover for retreat have suffered much due to clearing of bushes and reeds. These birds are also caught in large numbers and sold in the markets and toddy shops.

The migrant teal population is facing a more grave situation. Arrival of these birds coincides with the crop period here and they are known to do considerable damage to the paddy crop. Farmers resort to massive killing of these birds using grains soaked in poison. If the trend continues the Vembanad area will soon be deprived of one of its most attractive features—the annual migrant teal population.

The degradation of habitat by the chemical pollution due to pesticides and chemical fertilisers and loss of vegetation also are serious problems. The hatching failure of many water–birds is attributed to a large extent to the pesticide residues in the eggs.

Baker estate is a traditional breeding ground of Cormorants, Darters, Night Herons, Little Egrets and Pond Herons. The estate and Vembanad lake are now getting popular attention as a tourist spot. A star hotel has already come up in the area to cater the needs of the tourists. Artificial canals and ponds, lawns, cottages, gardens and boat landings have altered the natural landscape and affected the bird habitat adversely. The mangroves and other naturally grown trees have been cut down to make way to the artificial land–

scaping programme which is still in progress. The loss of habitat and disturbances have reflected in the decreasing population of water birds in the area.

If Kuttanad and Vembanad region is to retain or regain its traditional charm of migrant and resident birds suitable measures are to be taken without delay. Some suggestions are:

- i. Increase legal protection for the proposed Vembanad lake bird sanctuary and bring it under an autonomous authority which has its own resources and power to check trespassing and poaching and to regulate tourist activities in the area. It should be responsible for the maintenance of the sanctuary. An advisory body consisting of scientists and nature-lovers should be constituted to advise this authority.
- ii. Hunting and poaching should be completely prevented in Vembanad-Kuttanad area. Serving meat of water birds in hotels and toddy shops should be strictly banned.
- iii. Kerala Agriculture University is already involved in the agricultural development of Kuttanad. There are two major research stations of KAU in this area. Through these stations effective training programmes can be rendered to the farmers of Kuttanad, in order to create awareness for bird conservation and habitat-protection. To avoid birds

which cause damage to crops, some innovative measures of scaring away the birds (rather than killing them) should be resorted.

- iv. In Baker estate the expansion of tourist hotels should be checked and the clearing of mangroves by them and by the KTDC should be prevented. Use of speed boats and helicopters also should be prohibited in the area.
- v. The canals connecting the marshy enclosure (Bird sanctuary) and Vembanad lake are almost clogged by weeds, mud and wastes. A periodic cleaning of these canals can effect a flush out of the marsh at least during monsoon. Careful measures should be taken to maintain the flora of the marsh and also of the Baker estate as a whole.

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APPENDIX

CHECK LIST OF BIRDS FOUND IN VEMBANAD-KUTTANAD REGION

Or. Podicipediformes

Fam. Podicipedidae

- | | |
|-----------------|----------------------------|
| 1. Little Grebe | <i>Podiceps ruficollis</i> |
|-----------------|----------------------------|

Or. Pelicaniformes

Fam. Phalacrocoracidae

- | | |
|---------------------|----------------------------|
| 2. Little Cormorant | <i>Phalacrocorax niger</i> |
| 3. Indian Shag | <i>P. fuscicollis</i> |
| 4. Large Cormorant | <i>P. Carbo</i> |

Fam. Anhingidae

- | | |
|-------------------------------|---------------------|
| 5. Indian Darter (Snake Bird) | <i>Anhinga rufa</i> |
|-------------------------------|---------------------|

Or. Ciconiformes

Fam. Ardeidae

- | | |
|------------------------|------------------------------|
| 6. Night Heron | <i>Nycticorax nycticorax</i> |
| 7. Pond Heron | <i>Ardeola grayii</i> |
| 8. Grey Heron | <i>Ardea cinerea</i> |
| 9. Purple Heron | <i>A. purpurea</i> |
| 10. Little Green heron | <i>Ardeola striatus</i> |
| 11. Little Egret | <i>Egretta garzetta</i> |

12. Median Egret	<i>E. intermedia</i>
13. Large Egret	<i>E. alba.</i>
14. Cattle Egret	<i>Bubulcus ibis</i>
15. Chestnut Bittern	<i>Ixobrychus cinnamoneus</i>
16. Black Bittern	<i>I. flavicollis</i>
17. Yellow Bittern	<i>I. Sinensis</i>

Fam. Threskiornithidae

18. White Ibis	<i>Threskiornis aethiopica</i>
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Fam. Phoenicopteridae

19. The Flamingo	<i>Phoenicopteurs roseus</i>
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Or. Anceriformes

Fam. Dendrocygnidae

20. Lesser whistling Teal	<i>Dendrocygna javanica</i>
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Fam. Anatidae

21. Cotton Teal	<i>Nettapus coramandelianus</i>
22. Common Teal	<i>Anas crecca</i>
23. PinTail	<i>A. acuta</i>
24. Garganey	<i>A. querquedula</i>

Or. Falconiformes

Fam. Accipitridae

25. Pariah Kite	<i>Milvus migrans</i>
26. Brahminy Kite	<i>Haliastur indus</i>

27. Marsh Harrier *Circus aeruginosus*

28. Osprey *Pandion haliactus*

Or. Gruiformes

Fam. Rallidae

29. Slaty legged
banded Crake *Rallina eurizonoides*

30. Blue breasted
banded Rail *Rallus striatus*

31. White breasted
Water hen *Amauromis phoenicurus*

32. Ruddy Crake *Porzana fusca*

33. Water Cock (Kora) *Gallixrex cinerea*

34. Purple Moorhen *Porphyrio porphyrio*

35. Indian Moorhen *Gallinula chloropus*

Or. Charadriiformes

Fam. Jacanidae

36. Pheasant tailed Jacana *Hydrophasianus chirurgus*

37. Bronze winged Jacana *Metopidius indicus*

Fam. Charadriidae

38. Little ringed Plover *Charadrius dubius*

39. Kentish Plover *C. alexandrinus*

40. Lesser Sand plover *C. mongolus*

41. Redwattled Lapwing *Vanellus indicus*

42. Yellowwattled lapwing *V. malabaricus*

Fam. Scolopacidae

43. Red Shank	<i>Tringa totanus</i>
44. Green Shank	<i>T. nebularia</i>
45. Common Sandpiper	<i>T. hypoleucos</i>
46. Green Sandpiper	<i>T. ochropus</i>
47. Spotted Sandpiper	<i>T. glareola</i>

Fam. Rostratulidae

48. Painted Snipe	<i>Rostratula benghalensis</i>
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Fam. Recurvirostridae

49. Blackwinged Stilt	<i>Himantopus himantopus</i>
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Fam. Laridae

50. Blackheaded Gull	<i>Larus ridibundus</i>
51. Brownheaded Gull	<i>Larus brunnicephalus</i>
52. Lesser blackbacked Gull	<i>L. fuscus</i>
53. Whiskered Tern	<i>Chlidonias hybridus</i>
54. Caspian Tern	<i>Hydroprogne Caspia</i>
55. Little Tern	<i>Sterna albifrons</i>
56. Gullbilled Tern	<i>Gelochelidon nilotica</i>
57. Large Crested Tern	<i>Sterna bergii</i>
58. Lesser Crested Tern	<i>S. benghalensis</i>

Or. Columbiformes**Fam. Columbidae**

- | | |
|----------------------|-------------------------------|
| 59. Blue rock Pigeon | <i>Columba livia</i> |
| 60. Spotted Dove | <i>Streptopelia chinensis</i> |

Or. Psittaciformes**Fam. Psittacidae**

- | | |
|-------------------------|--------------------------------|
| 61. Roseringed parakeet | <i>Psittacula cyanocephala</i> |
| 62. Indian Lorikeet | <i>Loriculus vernalis</i> |

Or. Cuculiformes**Fam. Cuculidae**

- | | |
|------------------------|-----------------------------|
| 63. Piedcrested Cuckoo | <i>Clamator jacobinus</i> |
| 64. Indian Cuckoo | <i>Cuculus micropterus</i> |
| 65. Koel | <i>Eudynamys scolopacea</i> |
| 66. Crow Pheasant | <i>Centropus sinensis</i> |

Or. Stringiformes**Fam. Stringidae**

- | | |
|----------------------|-----------------------|
| 67. Mottled Wood Owl | <i>Strix ocellata</i> |
|----------------------|-----------------------|

Or. Apodiformes**Fam. Apodidae**

- | | |
|-----------------|-------------------------|
| 68. House Swift | <i>Apus affinis</i> |
| 69. Palm Swift | <i>Cypsiurus parvus</i> |

Or. Coraciiformes**Fam. Alcedinidae**

- | | |
|------------------------------|-----------------------------|
| 70. Common Kingfisher | <i>Alcedo atthis</i> |
| 71. Storkbilled Kingfisher | <i>Pelargopsis capensis</i> |
| 72. Whitebreasted Kingfisher | <i>Halcyon smyrnensis</i> |
| 73. Pied Kingfisher | <i>Ceryle rudis</i> |

Fam. Coraciidae

- | | |
|-------------------|------------------------------|
| 74. Indian Roller | <i>Coracias benghalensis</i> |
|-------------------|------------------------------|

Fam. Meropidae

- | | |
|--------------------------|---------------------------|
| 75. Bluetailed Bee-eater | <i>Merops philippinus</i> |
| 76. Green Bee-eater | <i>Merops orientalis</i> |

Or. Piciformes**Fam. Capitonidae**

- | | |
|------------------------|--------------------------|
| 77. Small Green barbet | <i>Megalaima viridis</i> |
|------------------------|--------------------------|

Fam. Picidae

- | | |
|-----------------------------|-----------------------------|
| 78. Goldenbacked Woodpecker | <i>Dinopium benghalense</i> |
|-----------------------------|-----------------------------|

Or. Passeriformes**Fam. Hirundinidae**

- | | |
|------------------------|------------------------|
| 79. Common Swallow | <i>Hirundo rustica</i> |
| 80. Wiretailed Swallow | <i>H. smithii</i> |

Fam. Lanidae

- | | |
|------------------|-------------------------|
| 81. Brown Shrike | <i>Lanius cristatus</i> |
|------------------|-------------------------|

Fam. Oriolidae82. Golden Oriole *Oriolus oriolus*83. Blackheaded Oriole *O. xanthornus***Fam. Dicruridae**84. Black Drongo *Dicrurus adsimilis*85. Grey Drongo *D. leucophaeus***Fam. Artamidae**86. Ashy Swallow-shrike *Artamus fuscus***Fam. Sturnidae**87. Greyheaded Myna *Sternus malabaricus*
*malabaricus*88. Blyth's Myna *S. m. blythii*89. Common Myna *Acridotherus tristis*90. Jungle Myna *A. fuscus***Fam. Corvidae**91. Indian Tree-pie *Dendrocitta vagabunda*92. House Crow *Corvus splendens*93. Jungle Crow *C. macrorhynchos***Fam. Campephagidae**94. Common Wook Shrike *Tephrodomis pondicerianus*95. Blackheaded
Cuckoo-Shrike *Coracina melanoptera*

Fam. Irenidae

96. Jerdon's Chloropsis *Chloropsis cochinchinensis*

Fam. Pycnonotidae

97. Redwhiskered Bulbul *Pycnonotus jocosus*
 98. Redvented Bulbul *P. cafer*

Fam. Muscicapidae

99. Jungle Babbler *Turdoides striatus*
 100. Whiteheaded Babbler *T. affinis*
 101. Paradise Flycatcher *Terpsiphone paradisi*
 102. Plain Wren Warbler *Prinia subflava*
 103. Blyth's Reed warbler *Acrocephalus dumetorum*
 104. Paddyfield Warbler *A. agricola*
 105. Magpie Robin *Copsychus saularis*
 106. Tailor Bird *Orthotomus sutorius*

Fam. Motacillidae

107. Greyheaded
 Yellow Wagtail *Motacilla flava*
 108. Large Pied Wagtail *M. maderaspatensis*

Fam. Dicaeidae

109. Tickell's Flower pecker *Dicacum erythrorhychos*

Fam. Nectarinudae

- | | |
|---------------------------|-----------------------------|
| 110. Purplerumbed Sunbird | <i>Nectarinia zeylonica</i> |
| 111. Small Sunbird | <i>N. minima</i> |
| 112. Loten's Sunbird | <i>N. lotenia</i> |
| 113. Purple Sunbird | <i>N. asiatica</i> |

Fam. Ploceidae

- | | |
|-----------------------------|------------------------------|
| 114. House Sparrow | <i>Passer domesticus</i> |
| 115. Yellowthroated Sparrow | <i>Petronia xanthocollis</i> |
| 116. Weaver Bird | <i>Ploceus philippinus</i> |
| 117. Whitebacked Munia | <i>Lonchura striata</i> |
| 118. Spotted Munia | <i>L. punctualata</i> |
| 119. Blackheaded Munia | <i>L. malacca</i> |

Additional List (Birds found in the study area after the study period)

Or. Anseriformes**Fam. Anatidae**

Spotbill Duck	<i>Anas poecilorhyncha</i>
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(Found near R. block on 07.12.1997)

TH

Or. Gruiformes

NB 2356 598 1768
BAB/E

Fam. Rallidae

Coot	<i>Fulica atra</i>
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(Found near R. block on 14.12.1997)

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