

# Biodiversity of Pokkali Fields at Kadamakkudy, Ernakulam District, Kerala, India

Mumthaz.K.M.<sup>1</sup> and Dr. John George.M.<sup>2</sup>

<sup>1</sup>Research Scholar, Zoology Dept. Mar Thoma College, Thiruvalla

<sup>2</sup>Retd. Reader & Research Guide, Mar Thoma College, Thiruvalla  
[Mumthazansari33@gmail.com](mailto:Mumthazansari33@gmail.com) [johngeorgem1956@gmail.com](mailto:johngeorgem1956@gmail.com)

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**Abstract**—Kerala, a unique state with undulating terrain ranging in altitude from below mean sea level to above 2000m msl has a proud culture of paddy cultivation for the past 3000 years. Pokkali cultivation is a traditional indigenous method of rice-fish rotational cultivation practiced in the coastal belts. The variety of paddy used for this type is locally known as Pokkali, which is salt-tolerating and usually tall. Pokkali fields are tidal wetlands, the tide that occur twice a day play an important role on fertility and productivity of the agro-ecosystem. Here, the retention of tidal flow during the post rice season causes inundation of brackish water into the fields, and the live feed generated form the basis of perpetual renewable bio-energetic resources for alternate production of rice and prawn in the fields (Purushan,2002). The paddy fields after paddy crop harvest are usually used to trap high tide water through sluices along with prawns mainly and then the water is let out through the filters during low tide. Pokkali Rice Farming reduces the cost of cultivation of subsequent prawn farming by providing natural feed, such prawns are healthy and less prone to diseases. As Pokkali rice variety is cultivated using organic farming methods, it has high export potential and medicinal value. The organic Pokkali Rice is famed for its special taste and high protein content as well. It also provides adequate energy to fishermen to stay in the sea the whole day without consuming any other food.

The present study was carried out in the pokkali fields at Kadamakkudy situated in the Kadamakkudypanchayath of Ernakulam district of Kerala. The study was conducted for one year period from July 2010-June 2011 and the study revealed the presence of rich biodiversity which enlisted 70 species of birds, belonging to 15 orders and 28 different families with major proportion of insectivorous and granivorous birds besides 35 species of fishes belonging to 8 orders and 19 different families and revealed the high dominance of Order Perciformes over others. About 18 species of mangroves belonging to 6 different families were recorded, besides small amphibians, crustaceans and reptiles. Rich fauna help to maintain the ecological stability and homeostasis of the ecosystem while mangrove soils emit relatively low levels of methane due to the saline conditions and therefore represent highly effective, longer term (millennial) carbon stores. Diversified fauna and flora provide significant ecosystem services like pest control, pollination, seed dispersal, nursing and breeding ground for small fishes and animals.

## 1. INTRODUCTION

Pokkali system is an integrated agriculture method in which rice crop cultivation is followed by fish or prawn cultivation. Pokkali fields are prepared for paddy cultivation from (April 15th) every year. By this month, the bunds are being strengthened and sluices repaired for regulating water level. Fields are then drained during low tide and the sluices are closed. When the soil in the field becomes dry, mounds of 1 m base and 0.5 m height are formed. This facilitates the washing down of the dissolved salts from the surface of the mounds, which are ultimately removed from the field by tidal action. This is the best method to prepare the fields which enhances the integration of the toxic contents of the soil with rainwater.

When the soil and weather conditions become favourable for sowing, the mounds in the field are raked up and top is leveled. The sprouted seeds are sown on the top of mound. The mounds act as elevated in situ nursery and protect the seedlings from flash floods. When the seedlings reach a height of 40-45 cm (in 30-35 days), the mounds are cut into pieces with a few seedlings, which are uniformly spread in the field. In the month of October, when the paddy is mature, only the panicles are cut off, leaving the stubbles in the field to decay and this forms the basic natural feed for the prawns. Adjacent to the paddy fields lay the prawn fields where the waters from the backwaters are regulated through the sluice gates.

Tidal water is allowed to enter into the fields twice a day during high tides by regulating the flow rate with the help of the shutter planks of the wooden sluice. Prawns in Pokkali fields subsist on organic matter from decayed stubble, drying water weeds etc., and in turn the fields are enriched in manure and the excreta of organic wastes from fish and prawns. As Pokkali rice variety is cultivated using organic farming methods, it has high export potential and medicinal value.

## 2. STUDY AREA

Kadamakkudy is situated in the coordinates of 10.06519°N 76.2451386°E in the Ernakulam district of Kerala state in India. Three sites were selected for the study, of which the first two sites were cultivating fields while the third one is non-cultivating one. Area of three sites were 20,20 and 10 acres respectively separated by motorable roads and bridge. The study was carried out from July 2010- June 2011 during which observations and sampling was carried out in the morning hours between 8-10, each month fortnightly.

## 3. METHODOLOGY

Total count method and direct observation methods was adopted for studying the bird diversity. Various sampling methods and fishing gears such as cast net, scoop net, gill nets of varying mesh sizes were also used for sampling fishes. Direct observation method was employed for collecting mangroves and got identified by senior experts.

## 4. RESULTS AND DISCUSSIONS

### 4.1. Birds

Birds are useful biological indicators of broad scale habitat changes and environmental contaminants. About 70 species of birds belonging to 15 orders and 28 different families was reported in the present study (Table.1.) . Of these birds, 13 species are migrant birds, which migrate from their native areas to the study area during specific months based on the availability of food, breeding period and area etc., while 3 species were Local Migrant birds which migrate only to short extent within and around the area while the rest 54 species were Resident species that fully utilise the area for their life processes.

**Table 1: Checklist of birds observed during the study period**

No	Common Name	Scientific Name	Status
<b>Order Pelecaniformes</b>			
<b>Family Phalacrocoracidae</b>			
1.	Little cormorant	Phalacrocoraxniger	R
2.	Great cormorant	Phalacrocoraxcarbo	R
<b>Order Ciconiiformes</b>			
<b>Family- Ardeidae</b>			
3.	Indian Pond Heron	Ardeolagrasyii	R
4.	Little Egret	Egretta garzetta	R
5.	Median Egret	Mesophoyxintermedia	R
6.	Large Egret	Casmerodius albus	R
7.	Cattle Egret	Bubulcus ibis	R
8.	Purple heron	Ardea purpurea	R
9.	Black bittern	Ixobrychus flavicollis	R
10.	Grey heron	Ardea cinerea	LM

<b>Order Falconiformes</b>			
<b>Family-Accipitridae</b>			
11.	Brahminy Kite	Haliasturindus	R
12.	Common Pariah kite	Milvus migrans	R
<b>Order- Charadriiformes</b>			
<b>Family-Laridae</b>			
13.	River tern	Sterna aurantia	M
14.	Whiskered tern		M
15.	Common tern	Sterna hirundo	M
16.	Little tern	Sterna albifrons	M
<b>Family Cuculidae</b>			
17.	Asian Koel	Eudynamis scolopacea	R
<b>Family-Charadriidae</b>			
18.	Little ringed plover	Charadrius dubris	M
19.	Grey plover	Pluvialis squatarola	M
20.	Kentish plover	Charadrius alexandrinus	M
<b>Order Columbiformes</b>			
<b>Family-Columbidae</b>			
21.	Spotted dove	Streptopelia chinensis	R
22.	Emerald dove	Chalcophaps indica	R
<b>Order Suliformes</b>			
<b>Family-Anhingidae</b>			
23.	Oriental Darter	Anhinga melanogaster	R
<b>Order Psittaciformes</b>			
<b>Family - Psittacidae</b>			
24.	Roseringed parakeet	Psittacula krameri	R
25.	Blue winged parakeet	Psittacula columboides	R
<b>Order Cuculiformes</b>			
<b>Family - Cuculidae</b>			
26.	Indian cuckoo	Cuculus micropterus	R
27.	Asian Koel	Eudynamis scolopacea	R
<b>Order Strigiformes</b>			
<b>Family - Strigidae</b>			
28.	Spotted Owlet	Athene brama	R
29.	Barn Owl	Tyto alba	R
<b>Order Apodiformes</b>			
<b>Family- Apodidae</b>			
30.	Palm swift	Cypsiurus parvus	R
31.	House swift	Apus affinis	R
<b>Order Gruiformes</b>			
<b>Family Rallidae</b>			
32.	White breasted waterhen	Amurornis phoenicurus	R
33.	Purple moorhen	Porphyrio porphyrio	R
34.	Common moorhen	Gallinula chloropus	R
35.	Slaty legged crane	Rallina eurizonoides	R
<b>Order Coraciiformes</b>			
<b>Family- Alcedinidae</b>			
36.	White breasted kingfisher	Halcyon smirnenis	R
37.	Stork billed kingfisher	Halcyon capensis	R
38.	Lesser pied kingfisher	Ceryle rudis	R
<b>Family - Meropidae</b>			
39.	Small green bee eater	Merops orientalis	R
40.	Blue tailed bee eater	Merops philippinus	LM

<b>Family:- Upupidae</b>			
41.	Common hoopoe	Upupaepops	R
<b>Family-Scolopacidae</b>			
42.	Marsh sandpiper	Tringastagnatitidis	M
43.	Common sandpiper	Actitis hypoleucos	M
44.	Wood sandpiper	Tringaglareola	M
45.	Little stint	Calidris minima	M
<b>Order Piciformes</b>			
<b>Family- Picidae</b>			
46.	Lesser golden black woodpecker	Dinopium javanensis	R
<b>Order Passeriformes</b>			
<b>Family – Nectarinidae</b>			
47.	Purple sunbird	Nectarinia asiatica	R
48.	Loten's sunbird	Nectarinia lotenia	R
<b>Family - Sturnidae</b>			
49.	Common Myna	Acridothera tristis	R
50.	Grey headed Myna	Sturnus malabaricus	LM
<b>Family - Oriolidae</b>			
51.	Golden Oriole	Oriolus oriolus	R
52.	Black headed oriole	Oriolus xanthornus	M
<b>Family - Dicuridae</b>			
53.	Black drongo	Dicurus macrocercus	R
54.	Ashy drongo	Dicurus leucophaeus	R
55.	Racket tailed drongo	Dicurus paradiseus	R
<b>Family - Corvidae</b>			
56.	Indian tree pie	Dendrocitta vagabunda	R
57.	House Crow	Corvus splendens	R
58.	Jungle Crow	Corvus macrorhynchos	R
<b>Family- Muscicapidae</b>			
59.	Magpie robin	Capschus auratus	R
60.	Indian robin	Saxicoloides fulvatus	R
<b>Family - Pycnonotidae</b>			
61.	Red whiskered bulbul	Pycnonotus jocosus	R
62.	Red Vented Bulbul	Pycnonotus cafer	R
<b>Family - Passeridae</b>			
63.	Yellow wag tail	Motacilla flava	R
64.	House sparrow	Passer domesticus	R
<b>Family - Sylviidae</b>			
65.	Jungle Babbler	Turdoides striatus	R
66.	Ashy prinia	Prinia socialis	R
67.	Plain prinia	Prinia inornata	R
68.	Common Tailor bird	Orthotomus sutorius	R
<b>Family-Ploceidae</b>			
69.	Baya Weaver	Ploceus philippinus	R
<b>Order Galliformes</b>			
<b>Family:- Phasianidae</b>			
70.	Common Quail	Coturnix coturnix	M
Status: R-Resident, M-Migrant, LM- Local migrant			

Major portion of their food constitute insects, fishes and grains which reveal us the dominant nature of insectivorous and picivorous birds which help to control the insect population on the crops thereby enhancing the growth and minimalizing the crop damage. Granivorous birds present help in the dispersal

of seeds and also pollination. Besides these, birds help to regulate the nutrient cycling within the ecosystem thereby maintaining the homeostasis.

Mary (2002) reported 59 species of birds belonging to 6 families and 12 orders from paddy fields adjacent to Vembanad lake, Kerala. Among the 59 species, 14 species were migratory.

#### 4.2. Fishes

A total of 35 species of fishes belonging to 8 orders and 19 different families were recorded from the present study, depicted in Table 2.

**Table 2: Checklist of fishes found during the study period**

Order	Family	Scientific name	IUCN
Anguilliformes	Anguillidae	Anguilla bengalensis bengalensis	NT
		Anguilla bicolor bicolor	NT
	Ophichthidae	Pisodonophis borro	LC
Clupeiformes	Clupeidae	Dayellamalabarica	LC
Gonorynchiformes	Chanidae	Chanoschanos	LC
Cypriniformes	Cyprinidae	Catla catla	LC
		Cyprinus carpio	VU
		Labeo rohita	LC
		Labeo dussumieri	LC
		Puntius filamentosus	LC
		Puntius ticto	LC
		Puntius vittatus	LC
		Puntius melanostigma	NE
Cyprinodontiformes	Aplocheilidae	Aplocheilichthys lineatus	LC
		Aplocheilichthys blockii	LC
Mugiliformes	Poeciliidae	Gambusia affinis	LC
		Mugil cephalus	NE
Perciformes	Ambassidae	Ambassis cambersoni	LC
		Parambassis thomasi	LC
		Parambassis dayi	NE
	Gerreidae	Gerres morpho setifer	NE
		Gerres filamentosus	NE
	Scatophagidae	Scatophagus argus	LC
	Cichlidae	Etroplus maculatus	LC
		Etroplus suratensis	LC
	Gobiidae	Glossogobius aureus	LC
	Anabantidae	Anabas testudineus	DD
	Channidae	Channa marulius	LC
		Channa striata	LC
Siluriformes	Bagridae	Mystus armatus	LC
		Horabagrus brachysoma	VU
	Siluridae	Wallago attu	NT
	Clariidae	Clarias fuscus	NT
	Ariidae	Arius arius	LC

LC- Least Concern, NT - Near Threatened, VU – Vulnerable, NE - Not Evaluated.

About 23 species of fishes enlisted belonged to Least Concern category, 4 species were Near Threatened ones, 2 species were vulnerable ones while 5 species come under Not Evaluated category and 1 species was Data Deficient one (IUCN categorisation). Further studies had to be made in detail regarding the distribution, breeding, migration and ways of conservation of threatened fishes of this group.

It was found that Order Perciformes was the most dominant order with maximum number of species, followed by Order Cypriniformes, Siluriformes, and least by three orders like Clupeiformes, Gonorynchiformes and Mugiliformes (fig.1.) Among these species, *Pisodonophisboro* (Ham- Buch) a critically endangered species was reported from the pokkali wetland habitat.

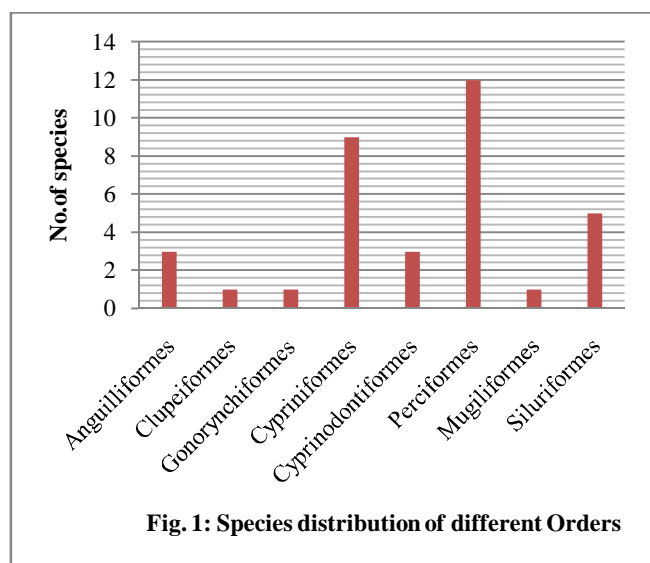


Fig. 1: Species distribution of different Orders

CED (2003) reported 175 species of fishes from the wetlands in Kerala. They noticed that the dominant family was Cyprinidae. ATREE (2009) reported 65 species of fin fishes and 14 species of shell fishes from Vembanad lake, Kerala. Jose *et al.* (1987) conducted preliminary experimental studies on selective culture of *Penaeus indicus* in pokkali fields and revealed that it was much more advantageous than the traditional prawn culture in terms of both yield and economy.

#### 4.3. Mangroves

Pokkali fields are interspersed by stretches of mangroves which form a unique ecosystem. These plants have special adaptations to cope with their saline intertidal environment and form an important habitat for a wide range of animals, plants and other organisms. As productive nurseries for a range of marine species, mangroves support fish populations including commercially valuable fisheries such as shrimps and crabs; Mangroves are interconnected with adjacent sea-grass beds, intertidal mud and sand flats, facilitating the presence and health of associated ecosystems.

Assessment of their diversity was done and found 18 species of mangroves belonging to 6 families (Table.3). Of these, two species come under Near Threatened category while the rest 16 species were Least Concerned ones.

Table 3: List of mangroves observed during the study period

Family	Scientific name	IUCN status
Rhizophoraceae	<i>Rhizophoramucronata</i>	LC
	<i>Kandeliacandel</i>	LC
	<i>Bruguieragymnorhiza</i>	LC
	<i>Rhizophoraapiculata</i>	LC
	<i>Bruguieracylindrica</i>	LC
	<i>Bruguieraparviflora</i>	LC
	<i>Ceriopstagal</i>	LC
	<i>Ceriosdecandra</i>	NT
Avicenniaceae	<i>Avicenniagerminans</i>	LC
	<i>Avicenniaofficinalis</i>	LC
	<i>Avicennia alba</i>	LC
Combretaceae	<i>Lumnitzera racemosa</i>	LC
	<i>Laguncularia racemosa</i>	LC
	<i>Conocarpus erectus</i>	LC
Lythraceae	<i>Sonneratiacaseolaris</i>	LC
	<i>Sonneratia apetala</i>	LC
Acanthaceae	<i>Acanthus ebracteatus</i>	LC
Aegialitiaceae	<i>Aegialitis rotundifolia</i>	NT

LC – Least Concern, NT – Near Threatened

## 5. CONCLUSION

Pokkali farming is an integrated rice- prawn farming practiced at Kadamakkudy area of Ernakulam District, Kerala, which involved sequential changes in the field conditions during various stages of cultivation produced marked effect on bird species composition. The pokkali field supported rich fauna of 70 species of birds and 35 species of fishes which include 1 Critically Endangered species and 4 Near Threatened species. About 18 species of mangroves were found in the nearby marshy areas.

Paddy fields and marsh fields need proper management for biodiversity conservation. Availability of non-cultivated marsh lands near paddy fields ensure uniform distribution of birds and thus reduce the conflict between birds and farmers. Maintenance of this wetland is essential for the conservation of migratory and local birds, as majority of them act as bio control agents of many pest species of paddy that affect the total yield. Thus Pokkali fields form a haven to diversified fauna and flora which helps to maintain homeostasis of the ecosystem as well as beneficial ecological roles in pest control, breeding ground, carbon stores, etc.,.

These traditional pokkali rice varieties are vanishing today in Kerala due to various reasons such as low yield, promotion of high yielding variety seeds, high-cost in continuing the cultivation with traditional seeds. The reasons for fast decline of Pokkali Rice Farming were acute shortage of farm hands for harvesting, increased weed problems, shift to monoculture

of prawn farming from rice- prawn farming system and other anthropogenic reasons such as conversion of Pokkali fields for other purposes like roads, bridges, residential or commercial activities, over exploitation of fish and prawn etc.

As the Pokkali rice have unique ecosystem values, special nutritional values and genetic values many studies have been conducted on agronomic, plant breeding and soil science aspects of it. Hence keeping in view of the alarming situation of threat for Pokkali farming and deficit of studies, the current study has been taken up to unearth the significance of Pokkali Rice farming in ecology.

## 6. ACKNOWLEDGEMENTS

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