

## Avian Biodiversity Indices and Comparative Chronobiology of Uppalapadu and Nelapattu Bird Protected Areas of Andhra Pradesh, India

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**Abstract :** Biodiversity indices, ornithological and ecological comparison of Nelapattu and Uppalapadu bird protected areas of Andhra Pradesh, India is described. The mean Simpson Diversity indices for Nelapattu and Uppalapadu bird protected areas are 0.78 and 0.67 respectively. Uppalapadu and Nelapattu bird protected areas are very ideal for roosting and breeding. Nelapattu has no space constraint but water constraint during non-migratory bird season from May to September, unlike Uppalapadu where space is a constraint and space partitioning problems exist but water in Uppalapadu protected area is present in all seasons. Thus chronobiology and periodism is different compared to Nelapattu. In Nelapattu birds are seen throughout the year for roosting like “musical chairs” fete due to perennial water storage. The feeding ground for Nelapattu is a well known for many centuries, namely Pulicat Lake brackish water lagoon. For Uppalapadu it is presumed to be Kolleru, the largest fresh water body in India and also a few coast line water bodies and irrigation tanks. It is recommended that for Nelapattu bird sanctuary, Telugu ganga water source may be supplied, for ecosustainability and attraction of birds only when particularly monsoon fails. However, the trees in the midst of tank surrounded by water is a protective mechanism to prevent predators in both bird reserves. Birds in both protected areas move to distant locations for feeding and also to feed their chicks. The plantation of *Prosopis juliflora* trees by Andhra Pradesh Forest Department is an innovative concept as a roosting habitat for migratory birds. The diversity indices suggest that species variety contributes to diversity and not population.

**Key words:** Biodiversity index · Nelapattu and Uppalapadu Bird Protected Areas · Migratory birds  
· Comparative Ecology Chronobiology · Pelicans and Painted Storks

### INTRODUCTION

Uppalapadu is a tiny village in Guntur district. In this village a reservoir is located having an area of approximately 14 acres. About 7 acres of reservoir within 14 acres is declared as a protected area of Department of Forests, Government of Andhra Pradesh. A tank bund separates seven acres of reservoir with a number of *Prosopis juliflora* plants at center of reservoir where more than one thousand five hundreds Pelicans nest from September/October to April/May months. Uppalapadu is not far away from Kolleru sanctuary (arial flying distance within 125km) where these migratory birds were visiting. As Kolleru sanctuary was converted into a number of fish farms

with change in aquatic bird habitat and physiographic change caused by humans raising pisciculture, the bird migration and their nesting subsequently disappeared. Now with Andhra Pradesh Government intervention, Pelicans started coming in small number. Meanwhile, Uppalapadu which provides an ideal habitat i.e., thorny plants surrounded by water throughout the years (7 acres of land), Pelicans, Open bill storks, a large number of Painted storks and other birds have stabilized and nesting and roosting seasonally (September through April/May) and with feeding grounds probably at Kolleru and other aquatic bodies. Besides the other local and long distant migrants are Darters, Cormorants, Egrets, Ibis, Herons and a variety of waders and ducks.

Nelapattu bird sanctuary is one of the largest Pelicanry in South-East Asia, with more than 1500 Pelicans (*Pelicanus philippensis*) breeding every year. Nelapattu bird sanctuary was established in 1976. Out of an extent of 458.92 Ha (1133 acres) of reserved forest area 82.56 Ha (202.93 acres) consist the irrigation area [1-4]. Birds are found on trees (*Prosopis julifera*) present on tank bund and also on *Barringtonia* sp. trees present inside the tank. Many winter migratory birds visit this sanctuary. It is a breeding ground for some of the rare and endangered species Pelicans and also local migrants Open billed storks, Little Cormorants, Spoon bills, White Ibises, Night Herons etc. A wide variety of birds like Egrets, Terns, Ducks, Waders etc., roost here [2]. Nelapattu bird sanctuary is well known as one of the biggest Pelicanry due to presence of more than one thousand Pelicans and about 800 chicks of Pelicans and a variety of birds feed in Pulicat Lake [2-4]. The Pelicans roost on both *Barringtonia* sp. trees and also on *Prosopis julifera* planted by Department of Forest.

A comparison of chronobiology and diversity index of both Nelapattu and Uppalapadu is made for the reason that Nelapattu bird season lasts from September to April and water persists in the irrigation tank only from September to May. The water is used for irrigation for centuries. Whereas in Uppalapadu water persists throughout the year because only a part of the irrigation tank (7 acres) is used for irrigation and remaining 7 acres of tank separate the water persists throughout the year where birds roost. However birds are sparse in May/June. The biodiversity index namely Simpson Index, Simpson Biodiversity Index are calculated year wise for four years from 2006-2010 and compared for the benefit of

ornithologists, environmentalists and naturalists to enable periodical monitoring of diversity index because any change in indices would indicate either new addition of bird species or absence in these bird sanctuaries or major environmental or ecological impact or changes [5, 6]. Excellent protection is offered by Department of Forest in both Nelapattu and Uppalapadu.

## MATERIALS AND METHODS

The birds were identified as per Ali and Repley [7]. Field work was undertaken from October through April/May from 2006-2010. Simpson diversity index was calculated as described by Kolstrom and Pitkanen [5] and Peet [6]. Binoculars were used for close observation and digital camera was employed for photography. Bird counts were made in the morning and evening with co-operation of Ranger, Divisional Forest Office Staff of Forest Department, Government of Andhra Pradesh.

## RESULTS AND DISCUSSION

**Nelapattu Bird Sanctuary:** The check listing of birds of Nelapattu (Table 1) was carried for the years 2006-2010 for the months September/October to April/May during bird migratory season [2-4]. The listing of birds was done morning/evening. The table 1 shows 20 species of birds with different population densities with highest number of Pelicans, followed by Open bill storks with least number of Moorhen, Night heron, Red wattle lapwing etc as listed in Table 1. Vertical gradient and resource partition was reported earlier [2].

Table 1: Listing of migratory birds of Nelapattu bird sanctuary during December/January from 2006-2010. The chick numbers are not counted which are observed mostly in January.

Sl.No.	Birds	2006-07	2007-08	2008-09	2009-10
1	Grey Pelicans	800	1405	964	1391
2	Open bill storks	670	1050	996	992
3	White ibis	350	1180	305	328
4	Cormorants	450	1210	300	591
5	Large Egrets	150	360	18	11
6	Little Egrets	120	360	37	198
7	Cattle Egrets	250	400	46	200
8	Grey Heron	20	30	19	
9	Indian Moorhen	3	2	8	18
10	Coot	4	40	12	28
11	Dab Chicks	4	25	8	31
12	Pond Heron	4	6	7	31
13	Red Wattle Lap wing	4	3	4	15
14	Pin tail	8	10	36	14
15-18	Other bird species (Pochard, Teal, Gadwals, Tern etc.,)				
	Total	2857	6101	2780	3888

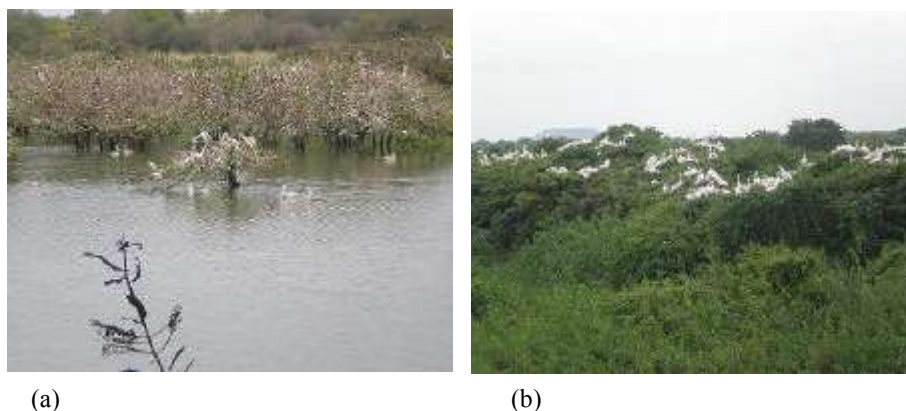


Fig. 1a-b: a) A closer view of Pelicans and Open bill storks on Barringtonia sp. trees in Nelapattu  
 b) A long view of Pelicans on Prosopis juliflora in Nelapattu

Table 2: Listing of migratory birds of Uppalapadu protected area from 2006-2010. The chick numbers are not counted.

Sl.No.	Birds	2006-07	2007-08	2009-10
1	Grey Pelicans	2200	1800	2700
2	Painted storks	700	450	850
3	Open bill storks	1000	100	720
4	White ibis	900	500	1200
5	Glossy ibis	100	200	250
6	Darter	4	3	4
7	Other six bird species	80	82	89
	Total	4984	3135	5813

The number of bird species varies in each year for the period recorded from 2006-2010. In the year 2007-2008 (September to April) highest numbers of birds were recorded followed by 2009-2010 [3]. The statistically significant association of Pelican numbers to rainfall was also reported earlier [3]. The total rainfall in 2007-2008 and 2009-2010 was comparatively higher than other years i.e., 2006-2007 and 2008-2009 [3]. The total population number of 20 bird species (occasionally other species) for the year 2007-2008 was 1601, followed by 3888 in 2009-2010 and for the year 2006-2007 and 2008-2009 it was 2857 and 2780 respectively (Table 1). It should be noted that though different bird population numbers were varying there was not much variation in Simpson Index and Simpson Diversity Index. The Simpson Diversity Indices were 0.82, 0.83, 0.73 and 0.77 for the years 2006 to 2010 and corresponding Simpson Indices were 0.18, 0.17, 0.27 and 0.23 (Table 3). The mean Simpson Diversity Index of Nelapattu for four migratory seasons was 0.78 and Simpson Index was 0.21. It is very interesting to note that though bird species population variation existed, the biodiversity index did not alter appreciably obviously indicating role of species variation in biodiversity index. The Figure 1 (a,b) shows Nelapattu Sanctuary birds.

**Uppalapadu Bird Protected Area:** Uppalapadu is mentioned generally as a protected area and not sanctuary as it is yet to be declared as sanctuary under Wild Life Act of India. It was observed that though Uppalapadu is comparatively a small protected area [1] compared to Nelapattu, the total population of birds comparatively was very high per unit area than Nelapattu. The Painted storks are contrastingly present in Uppalapadu and are totally absent in Nelapattu bird sanctuary. Similarly Darters (*Anhinga melanogaster*) are present in small numbers. The check listing of birds for Uppalapadu is given in table 2. The Simpson indices for the years 2006-2007, 2007-2008 and 2009-2010 were 0.29, 0.38, 0.30 and Simpson Diversity Indices were 0.71, 0.62 and 0.70 respectively thus showing less variations in Simpson Diversity Index (Table 3). The Figure 2 (a,b) shows Uppalapadu birds. Due to crowding and space partitioning problem a few Pelicans have chosen Gyarapadu/Ramachandra palem 2km away from uppalapadu as an alternative site (Fig. 2c).

**A Comparison of Nelapattu and Uppalapadu Chronobiology:** Very contrasting geobiomorphological, hydrological, ecological and chronobiological differences are observed in both the protected areas as given below in Table 4.

It is concluded from above Table 4 that Uppalapadu and Nelapattu bird protected areas are ideal for roosting and breeding. Nelapattu has no space constraint but water constraint during non-migratory bird season from May to September, unlike Uppalapadu which has space constraint and space partitioning problems but water in protected area of tank is present in all seasons. The feeding ground for Nelapattu is a well known for many centuries, namely Pulicat Lake Brackish water lagoon.

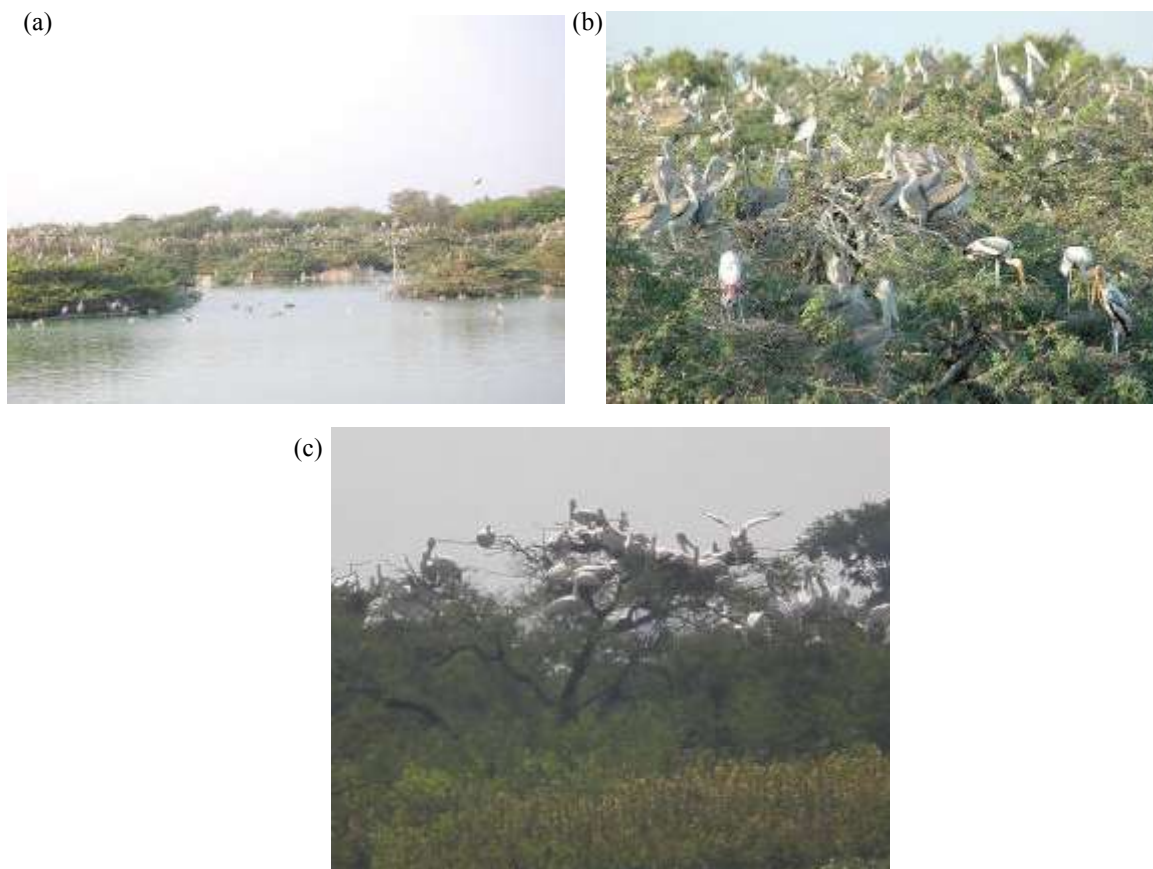


Fig. 2a-c: a) A long view of Uppalapadu bird reserve with check listed birds (see table) with perennial water support system  
 b) A closer view of Pelicans and Painted storks on *Prosopis juliflora*  
 c) Gyarapadu/Ramachandra palem, an alternative site for Pelicans 2km away from Uppalapadu due to crowding and space partition problem

Table 3: Simpson Indices and Simpson Diversity Indices of Nelapattu and Uppalapadu.

Year	Nelapattu				Mean
	2006-07	2007-08	2008-09	2009-10	
Simpson Index	0.18	0.17	0.27	0.23	0.21
Simpson Diversity Index	0.82	0.83	0.73	0.77	0.78
Year	Uppalapadu			Mean	
	2006-07	2007-08	2009-10		
Simpson Index	0.29	0.38	0.30	0.32	
Simpson Diversity Index	0.71	0.62	0.70	0.67	

For Uppalapadu it is presumed to be Kolleru the largest fresh water body in India and also small water bodies like irrigation tanks. It is recommended that for Nelapattu bird sanctuary Telugu ganga water source may be supplied for attraction of birds

only when monsoon fails. However, the trees with water body around are a protective mechanism to prevent predators. Birds in both protected areas move to distant locations for feeding and also to feed their chicks.

Table 4: Geobiohydrological and Ecological differences of Nelapattu and Uppalapadu

NELAPATTU BIRD SANCTUARY	UPPALAPADU BIRD SANCTUARY
Protected irrigation tank area 202.93 acres with reserved forest area of 1133 acres.	Total irrigation tank 14 acres extent and tank protected area 7 acres. No reserve forest.
Two water tanks with <i>Barringtonia</i> sp. trees and Tank bund with <i>Prosopis juliflora</i> and <i>Acacia</i> sp. trees.	Absence of <i>Barringtonia</i> . Only <i>Prosopis juliflora</i> and <i>Acacia</i> sp. trees.
Birds season lasts from September to April/May only due to absence of sufficient water or dry water tank from June to September. Water is used for irrigation.	Bird season lasts almost throughout the year except a brief period (May 15 <sup>th</sup> to June 15 <sup>th</sup> ). Due to storage of water throughout the year birds roost and breed on rotational basis.
Conspicuous absence of Painted Storks. Painted storks nest in Sriharikota Island and Vedurupattu away from Nelapattu.	Conspicuous presence of Painted Storks, Darters.
Open bill storks arrive June/July early and depart early (November).	Open bill storks arrive (August/ September) early and depart early (March/April).
Pelicans arrive in late October/November and only a small number over stay upto May.	Pelicans arrive late October/November and a small number over stay upto May.
Feedings grounds of Nelapattu birds are Pulicat Brackish water lake and paddy fields.	Feeding grounds may be Kolleru or irrigation tanks and small brackish water pools along South East Andhra Pradesh and paddy fields.
Darters are rare or absent.	Darters are present in small numbers (4 or 5).
Space is not a constraint. Space partitioning is seen with vertical gradient [2] with Pelicans on canopy with Open bill storks second strata followed by Cormorants, Egrets and Herons. Whereas <i>Prosopis juliflora</i> on tank bund dominated by Pelicans.	Space is a constraint. Pelicans, Open bill storks and Painted storks equally share the upper stratal levels. But Cormorants, White Ibis, Egrets, Herons occupy lower stratal levels of <i>Prosopis juliflora</i> and <i>Acacia</i> plants. A few plants are nested and occupied by either Pelicans or Painted storks or Open bill storks only. Other plants show mixed nesting sites.
No alternative site adjacent to Nelapattu for Pelican roosting as space is not a constraint.	Gyarapadu/Ramachandra palem irrigation tank within 2 km adjacent to Uppalapadu is an alternative site occasionally or rarely.
Opend bill storks, White ibis, Glossy ibis are absent in June.	Open bill storks, White Ibis and Glossy Ibis are seen from June onwards.
Water is a constraint in May to September	Water is not constraint and present throughout the year
Biodiversity: Mean Simpson diversity index is 0.78.	Biodiversity: Mean Simpson diversity index is 0.67. Artificial structure is adaptable for roosting due to space constraint (see Fig. 2 a,b)
Artificial structure is no good for roosting.	

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