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Status of avifaunal diversity in saline marsh and swampy habitats of Visakhapatnam coastal environments

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Abstract

The salt water marshes and marshy swamps which are influenced by tidal periodicity in the coastal areas support diversified habitat conditions for the distribution of variety of avifaunal diversities. Ecological studies related to avifaunal associations and their interactions with characteristic vegetation of these wetlands could provide insights for formulating suitable conservation and management strategies for protection and restoration of these fragile habitats of important birding sites.

A total of 54 bird species belonging to 18 families of aquatic habitat and 69 species of terrestrial origin consisting 31 families were enumerated from the three study sites. From these 34 species enumerated from aquatic habitat. Among these the bird species: Pintail (*Anas acuta*); Cotton Teal (*Nettapus coromandelianus*); Common Teal (*Nettio crecca*); Shoveller (*Spatula clypeata*) and Brahminy duck (*Tadorna ferruginea*) total fifteen were winter migrants. While five species were local migrant category and remaining thirty four species were resident birds utilized the habitats for their feeding and shelter.

Based on avifaunal diversity and present ecological status, these sites have been recommended for Integrated Protected Area Management Systems (IAPMS) Network of Andhra Pradesh Forest department to develop as "Urban Wildlife Refuges" for protection of winter migrants and terrestrial avifauna associated to these wetland habitats.

Keywords: Avifauna, ecological studies, marshy swamps, wetlands, Visakhapatnam

1. Introduction

Wetlands are the transitional areas between aquatic and of terrestrial ecosystems classified according to their location and origin in to marine (coastal salt marshes), riverine (flood plains and large fresh water lakes), nature of water (saline or freshwater) and characteristic vegetation (herbaceous or woody). Salt water marshes and marshy swamps of coastal environments which are influenced by tidal periodicity are the important wetland habitats supporting for distribution of diversified avifaunal categories.

Bird's fauna associated in these wetland habitats of coastal regions and their interplay to the associated vegetation is an important study to formulate conservation plans for their ecological restoration and management. Moreover the Andhra Pradesh forest department has recognized some of the wetland sites of fragile nature in the vicinity of urban areas to develop as new sites for the Integrated Protected Area Management Systems (IPAMS) Net Work

In this context the present study has been taken to evaluate the ecological status, habitat values and associated avifaunal diversity of the lesser known wetlands of the Visakhapatnam coastal region for inclusion in the Andhra Pradesh Forest Department priority list as new sites for utmost protection and conservation of the habitats as well as associated avifaunal diversity.

2. Materials and Methods

2.1 Study Area and Geography:

During the erstwhile British rule the Vizagapatam (now calling as Visakhapatnam) was a small fishermen hamlet on the east coast of India situated between 17° 15' to 18° 32' Latitudes and 18° 54' to 83° 30' (Figure 1). In the past most of its geographical environments are endowed with diversified habitats of deciduous scrub forests on the hilly slopes and down valleys, estuarine swamps and marshy saline in coastal low lands to sand dunes and rocky cliffs shore line's harbor wildlife of all categories.

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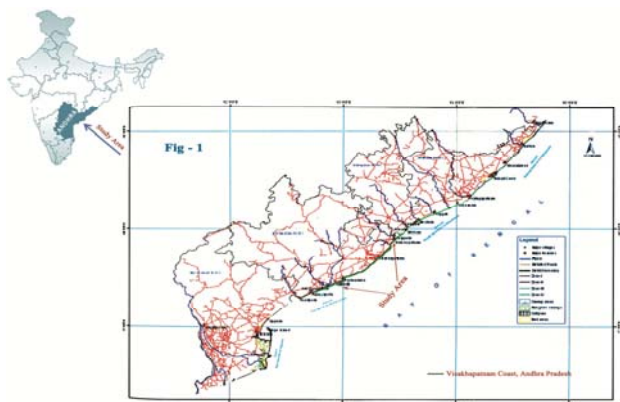


Fig 1: Study area: Visakhapatnam

Table 1: Geography and Habitat Features of Visakhapatnam Coastal Wetland Sites

S. No	Name of the site	Geography and Habitat features	Ecological status
1	Bangarmpalem	Intertidal mangrove swamp forest at Sarada and Tandava rivers confluence point. Vegetation consists of mangrove trees, shrubs and herbaceous communities of halophytic category.	Semi-degraded
2	Pudimadaka	Creek based mangrove swamp of shallow nature. Vegetation of the swamp belongs to degraded mangrove stands of trees and halophytes.	Degraded
3	Gangavaram	Intertidal marshy swamp of very shallow in nature. Vegetation is dominated by Reed mace (<i>Typha latifolia</i>), Mangrove trees and dense growth of halophytes.	Degraded

Habitat features were analyzed in the above wetland sites, based on their geographical location, vegetation types and plant species associations. We covered 52km along the coast, the avifauna of the habitats was also observed seasonally by using binoculars of focal length 10 x X 50^x and 8^x X 40^x Identification of the bird species has been done as per descriptions in ornithological publications catalogues pictorial diagrams of various authors (Ali & Ripley, 1993; Ali, 1996; Greywall, 1995 and Grimmit *et al.* 1999) ^[1, 2, 7, 9]. The field visits were conducted in these areas twice in a month with acquainted local community members and students. All the observations were made by foot as well as by boat on some palaces. Some of evidences of study findings were recorded with help of SLR. At each survey area, observations were made in two phases in the morning 0500 to 11hrs and evening 1500 hrs to 1800 hrs, as the avifauna is usually most active in early morning and late evening hrs (Emlen, 1974) ^[6]. Nocturnal fauna was observed in full moon lights. Systematic survey has been made into the areas of three habitats and all were entered into field note book.

Each bird species status was determined based on their frequency of occurrence and relative abundance in the study areas were assigned into: >5 sightings = Rare, 5-25 sightings = Un Common (UC); and <5 sightings defined as Very Rare (VR) while >25 sightings were categorized as Common (C).

As per their seasonal occurrence and duration of stay of each bird species, the bird species habitat utilization patterns were classified into feeding, breeding, or both purposes. Each bird's species were categorized into Resident (Re); Local Migrant (LM); and Winter Migrant (WM).

2.2 Observations

2.2.1 Vegetation communities

Vegetation of the marsh and swampy areas is characterized by mangroves and halophytic species with a few terrestrial species of sporadic appearance in marginal areas. The three habitat areas were represented by a total 21 of species 3

The maritime coastal plains and interior elevated Eastern Ghats's slopes of Visakhapatnam coastline have facilitated with diversified wetland sites (coastal and inland) of the following categories at three different locations. In recent times due to rapid industrialization and urbanization many of these ideal wildlife habitats have become prime targets for the development and disappeared rapidly. However a few remnants of salt water marshes and back water swamps are still in existence. The following three sites of Visakhapatnam coast were enumerated the ecological status and associated avifaunal diversity. The geographical and habitat on features of Visakhapatnam coastal wetland sites are given below in Table 1.

species of mangrove trees; 13 species of halophytic shrubs and 5 species of marshy herbs belongs to 16 families. Maximum number of plant species richness of 19 in number exhibits by Bangarmpalem mangrove swamp followed by Pudimadaka and Gangavaram shows with 12 species richness (Table 3).

Habitat use patterns of the avifauna are apparently shown as different bird groups occupying different foliage heights and densities in both the woodland forest habitats. Whereas the canopy supports the highest number of bird species rather than shrubby growth of ground level (species). It was observed that the predatory birds (carnivorous and scavengers) used middle strata (branches, tree trunks, foliages) of dense woody trees of 15 to 25 meters height for their perching, roosting and nesting.

The mangroves of Visakhapatnam provide a habitat for many bird species. The shallow waters and exposed mudflats of the mangroves make this habitat ideal for probing shoreline birds such as plovers and sandpipers. Long-legged wading birds utilize these and deeper waters along mangrove-lined waterways. Herons, Egrets, bitterns, curlews, sand pipers ibis are among the wading birds that visit mangroves in search of food.

2.2.2 Status of Avifauna

A total of 54 bird species belongs to 18 families of aquatic habitat and 69 species of terrestrial birds consisting 31 families associated to wetlands were recorded in these three study sites. Among the recorded avifauna resident category 34 species; local migrants, 15 species and winter migrants 5 species. Aquatic habitat as per distribution status, 25 species are found to be common occurrence in three habitats and 5 species were local migrants visiting the marshes and swamps occasionally 3 species coming either for feeding and breeding purposes. Besides these, winter migrants of 15 species are utilized the habitats for either feeding or breeding activity during winter months.

The resident bird species like: *Anhinga melanogaster*, *Ardeidae grayei*, *Egretta garzetta*, *E. intermedia*, *E.alba*, *Vanellus indicus*, *Ceryle rudis*, *alcedo atthis*, *Halcyon smyrnensis* and *H. pileata* are conspicuous in their presence and found in abundance in the habitats regularly at all seasons. Among the local migrant category species; *Ardea cinera*, *Podiceps ruficollis*, *Fulica atra*, *Rostratula bengalensis* and *Ibis leucocephalus* are visit the wetland sites from the nearby places for feeding and breeding activity.

The migrant species: *Anas acuta*, *Nettapus coromondellanus*, *Nettiao crecca* and *Spatula clypeata*, *Amaurornis phoenicurus*, *Nemenius arguata*, *Tringa hypoleucus* and *Calidris minutes*, *Himantopus himantopus* utilizes the

marshes and swamps as transit sites during migration in winter months between November and February. Aquatic and marshy bird's fauna (52 species) found relatively in highest numbers at these habitat areas classified in to three categories: Resident category in highest dominance (62.7%) associated to these habitats most of the time for feeding, nesting and shelter.

In lesser abundance (28.1%) the local migratory category appeared only a limited period of time for shelter and feeding, while migrant species found in lowest abundance (9.2 %) used the habitats as transit sites during winter months for feeding and shelter.

Table 2: Checklist and status of avifauna in salt marshes and swamps of Visakhapatnam coast

S. No	Common Name	Scientific Name	Status		
Family : PODICIPEDIDAE					
1	Little Grebe	<i>Tachybaptus ruficollis</i>	A	Re	F
2	Great crested Grebe	<i>Podiceps cristatus</i>	VR	M	F
Family: PHALACROCORACIDAE					
3	Cormorant Great	<i>Phalacrocorax carbo</i>	C	Re	F
4	Little Cormorant	<i>Phalacrocorax niger</i>	A	Re	F/B
Family : ANHINGIDAE					
5	Darter or Snake Bird	<i>Anhinga melanogaster</i>	C	Re	F/B
Family : ARDEIDAE					
6	Grey Heron	<i>Ardea cinerea</i>	C	Re	F/B
7	Purple Heron	<i>Ardea purpurea</i>	C	Re	F
8	Indian Pond Heron	<i>Ardeola grayii</i>	A	Re	F/B
9	Large Egret	<i>Casmerodius albus</i>	C	Re	F/B
10	Cattle Egret	<i>Bubulcus ibis</i>	A	Re	F/B
11	Smaller Egret	<i>Egretta intermedia</i>	A	Re	F/B
12	Little Egret	<i>Egretta garzetta</i>	A	Re	F/B
13	Yellow Bittern	<i>Ixobrychus sinensis</i>	R	Re	F
14	Western Reef Egret	<i>Egretta garzetta</i>	R	M	F
Family: CICONIIDAE					
15	Painted Stork	<i>Mycteria leucocephala</i>	R	LM	F/B
16	Asian Open bill Stork	<i>Anastomus oscitans</i>	R	LM	F/B
Famiy : ANATIDAE					
17	Brahminy Shelduck (Duck)	<i>Tadona ferruginea</i>	R	M	F/B
18	Common Pochard	<i>Aythya ferina</i>	R	M	F/B
19	Lesser whistling- Duck	<i>Dendrocygna javanica</i>	C	R	F/B
20	Northern Pintail	<i>Anas acuta</i>	C	M	F/B
21	Cotton Pygmy-goose	<i>Nettapus coromandelianus</i>	C	Re	F/B
Family: ACCIPITRIDAE					
22	Brahamimy Kite	<i>Haliastur Indus</i>	C	Re	F/B
23	White bellied sea eagle	<i>Haliaeetus leucogaster</i>	C	Re	F/B
24	Eurasian Marsh Harrier	<i>Circus aeruginosus</i>	R	M	F
Family: FALCONIDAE					
25	Common kestrel	<i>Falco tinnunculus</i>	C	Re	F/B
Family :STERNIDAE					
26	Indian river tern	<i>Sterna aurantia</i>	C	Re	F/B
Family: RALLIDAE					
27	White Breasted water hen	<i>Amaurornis phoenicurus</i>	C	Re	F/B
28	Water Cock	<i>Gallixrex cinerea</i>	C	Re	F
29	Common(Indian) Moorhen	<i>Gallinula chloropus</i>	C	Re	F/B
30	PURPLE Moorhen	<i>Porphyrio porphyrio</i>	A	Re	F/B
31	Common Coot	<i>Fulica atra</i>	A	Re	F/B
Family: JACANIDAE					
32	Bronze-winged Jacana	<i>Metopidius indicus</i>	R	Re	F/B
Family: RECURVIROSTRIDAE					
33	Black-winged Stilt	<i>Himantopus himantopus</i>	C	Re	F
Family: CHARADRIIDAE					
34	Red wattled lapwing	<i>Vanellus indicus</i>	C	Re	F/B
35	Yellow wattled lapwing	<i>Vanellus sp.</i>	C	Re	F/B
36	Sand Plover	<i>Charadrius leschenaultia</i>	VR	M	F/B
37	Common Ringed Plover	<i>Charadrius hiaticula</i>	C	Re	F
Family: SCOLOPACIDAE					
38	Wood Sandpiper	<i>Tringa glareola</i>	R	LM	F/B
39	Common Sandpiper	<i>Actitis hypoleucos</i>	R	LM	F/B
40	Little Stint	<i>Calidris minuta</i>	R	LM	F/B
41	Curlew sand piper	<i>Calidris ferruginea</i>	C	Re	F/B
42	Green sandpiper	<i>Tringa ochropus</i>	C	Re	F/B

43	Eurasian curlew	<i>Numenius arquata</i>	VR	M	B
44	whimbrel	<i>Numenius phaeopus</i>	R	M	F/B
Family: CARIDAE					
45	Brown Headed Gull	<i>Larus brunicephalus</i>	R	M	F
46	Black Headed Gull	<i>Chroicocephalus ridibundus</i>	R	M	F
47	Gull-billed Tern	<i>Gelochelidon nilotica</i>	R	M	F
48	Black billed Tern	<i>Sterna acuticauda</i>	R	M	F
49	Little Tern	<i>Sterna albifrons</i>	R	M	F
Family : PASSERIFORMES					
50	Paddy filed pipit	<i>Anthus rufulus</i>	C	Re	F/B
Family: ALCEDINIDAE					
51	Lesser Pied Kingfisher	<i>Ceryle rudis</i>	C	Re	F/B
52	Small blue Kingfisher	<i>Alcedo atthis</i>	C	Re	F/B
53	White breasted kingfisher	<i>Halcyon smyrnensis</i>	C	Re	F/B
Family: THRESKIORNITHIDAE					
54	Oriental white ibis	<i>Threskiornis melanocephalus</i>	A	M	F/B

A – Abundant; C –Common; R- Rare; VR – Very Rare; Re – Resident;

M – Migrant; LM – Local Migrant; F – Feeding; B – Breeding;

<5 sightings = Very Rare; >5 = Rare; 5-25 sightings = Uncommon > 25sightings = Common

Table 4: Checklist and status of Avifauna associated to coastal salt marshes and swamps of Visakhapatnam coast

S. No	Common Name	Scientific Name	Status		
Family: ACCIPITRIDAE					
1	Crested Shikra (Indian Shikra)	<i>Accipiter badius</i>	C	Re	F/B
2	Black kite(Pariah Kite)	<i>Milvus migrans</i>	C	Re	F/B
3	Black Winged Kite	<i>Elanus caeruleus</i>	C	Re	F/B
Family : COLUMBIDAE					
4	Blue Rock Pigeon	<i>Columba livia</i>	A	Re	F/B
5	Eurasian Collared Dove	<i>Streptopelia decaocto</i>	C	Re	F/B
6	Laughing Dove	<i>Streptopelia senegalensis</i>	C	Re	F/B
7	Spotted Dove	<i>Streptopelia chinensis</i>	A	Re	F/B
Family: PISTTACIDAE					
8	Rose Ringed Parakeet	<i>Psittacula krameri</i>	A	Re	F/B
9	Alexandrian parakeet	<i>Psittacula eupatria</i>	C	Re	B
Family: CUCULIDAE					
10	Pied Crested Cuckoo	<i>Clamator jacobinus</i>	R	M	F/B
11	Indian Cuckoo	<i>Cuculus micropterus</i>	C	Re	F/B
12	Drongo Cuckoo	<i>Surniculus lugubris</i>	C	Re	F/B
13	Asian Koel	<i>Eudynamis scolopacea</i>	C	Re	F/B
14	Southern Coucal	<i>Centropus parroti</i>	C	Re	F/B
Family: STRIGIDAE					
15	Spotted Owlet	<i>Athene brama</i>	C	Re	F/B
Family: APODIDAE					
16	House Swift	<i>Apus affinis</i>	C	Re	F/B
17	Asian Palm Swift	<i>Cypsiurus balasiensis</i>	C	Re	F/B
Family: MEROPIIDAE					
18	Small Bee-eater	<i>Merops orientalis</i>	C	Re	F
Family: CORACIDAE					
19	Indian Roller	<i>Coracias benghalensis</i>	C	Re	F/B
Family: UPUPIDAE					
20	Common Hoopoe	<i>Upupa epops</i>	C	Re	F/B
Family: CAPITONIDAE					
21	Coppersmith Barbet	<i>Megalaima haemacephala</i>	C	Re	F/B
Family: PICIDAE					
22	Lesser Golden backed Woodpecker	<i>Dinopium benghalense</i>	C	Re	F/B
Family: ALAUDIDAE					
23	Red-winged Bush-lark	<i>Mirafra erythroptera</i>	C	Re	F/B
24	Ashy-crowned sparrow-lark	<i>Eremopterix grisea</i>	C	Re	F/B
25	Rufous tailed Finch lark	<i>Ammemamea phoenicurus</i>	C	Re	F/B
26	Indian Short-toed lark	<i>Calandrella raytal</i>	C	Re	F/B
27	Common Crested Lark	<i>Galerida cristata</i>	C	Re	F/B
28	Eastern-Sky lark	<i>Allauda gulugula</i>	C	Re	F/B
Family: HIRUNDINIDAE					
29	Common Swallow	<i>Hirundo rustica</i>	C	M	F/B
Family: LANIIDAE					
30	Bay-backed Shrike	<i>Lanius vittatus</i>	C	LM	F/B
31	Rufus Backed Shrike	<i>Lanius schach</i>	C	LM	F/B
Family: DICRURIDAE					
32	Black Drongo	<i>Dicrurus macrocercus</i>	A	Re	F/B
33	White-Bellied Drongo	<i>Dicrurus caeruleus</i>	C	LM	F/B
Family: ARTAMIDAE					
34	Ashy Swallow Shrike	<i>Artamus fuscus</i>	C	LM	F
35	Long tailed shrike	<i>Lanius schach</i>	C	M	F
36	Brown shrike	<i>Lanius cristatus</i>	R	M	B

Family: STURNIDAE					
37	Rosy Starling(Rosy Pastor)	<i>Stur nus roseus</i>	C	LM	F
38	Grey Headed Starling(Myna)	<i>Sturnus Malabaricus</i>	C	LM	F
39	Common Starling	<i>Sturnus vulgaris</i>	C	LM	F/B
40	Asian Pied Starling(Pied Myna)	<i>Sturnus contra</i>	C	Re	F/B
41	Common Myna	<i>Acridotheres tristis</i>	A	Re	F/B
42	Bank Myna	<i>Acridotheres ginginianus</i>	C	Re	F/B
Family : ORIOLIDAE					
43	Eurasian golden oriole	<i>Oriolus oriolus</i>	R	M	F/B
Family: CORVIDAE					
44	House Crow	<i>Corvus splendens</i>	A	Re	F/B
45	Jungle Crow	<i>Corvus Macrorhynchos</i>	C	Re	F/B
Family: CAMPEPHACIDAE					
46	Common Wood Shrike	<i>Tephrodornis pondiceria</i>	C	Re	F/B
47	Large Cuckoo Shrike	<i>Coracana novachollandiae</i>	C	Re	F
Family: PYCNONOTIDAE					
48	Red vented Bulbul	<i>Pycnonotus cafer</i>	C	Re	F/B
Family: TIMALINAE					
49	Spotted Babbler	<i>Pellorneum ruficeps</i>	C	Re	F/B
50	Common Babbler	<i>Turdoides caudatus</i>	C	LM	F
51	Rufus-bellied Babbler	<i>Dumetia hyperythra</i>	R	Re	F/B
Family: MUSCICAPINAE					
52	Tickell's Blue-Flycatcher	<i>Cyornis tickelliae</i>	R	Re	F/B
Family: MONARCHINAE					
53	Asian Paradise-Flycatcher	<i>Terpsiphone paradise</i>	R	Re	F/B
Family: SYLVIINAE					
54	Ashy Prinia	<i>Prina socialis</i>	C	Re	F/B
55	Chestnut-crowned Bush Warbler	<i>Cettia major</i>	C	Re	F/B
56	Common Tailor Bird	<i>Orthotomus sutorius</i>	C	R	F/B
57	Paddy Field Warbler	<i>Acrocephalus Agricola</i>	C	Re	F/B
Family: TURDINAE					
58	Oriental Magpie Robin	<i>Copsychus saularis</i>	C	Re	F/B
59	PIED Bush Chat	<i>Saxicola caprata</i>	C	Re	F/B
60	Indian Robin	<i>Saxicoloides fulicata</i>	C	Re	F/B
61	Blue Rock Thrush	<i>Monticola solitaries</i>	R	LM	F
Family: MOTACILLIDAE					
62	Yellow Wagtail	<i>Motacilla flava</i>	R	M	F
63	Yellow Headed Wagtail	<i>Motacilla citreola</i>	R	M	F/B
Family: NECTARINIIDAE					
64	Purple-Rumped Sunbird	<i>Nectarinia zeylonica</i>	C	Re	F/B
65	Purple Sunbird	<i>Nectarinia asiatica</i>	C	Re	F/B
Family: PASSERINAE					
66	House Sparrow	<i>Passer domesticus</i>	A	Re	F/B
Family: PLOCEINAE					
67	Baya Weaver	<i>Polceus philippinus</i>	C	Re	F/B
Family: ESTRILDIDAE					
68	Spotted Munia	<i>Lonchura punctulata</i>	C	Re	F/B
69	Scaly-breasted munia	<i>Lonchura punctulata</i>	C	Re	F/B

Table 3: Checklist of mangroves and associate marshy plant species of Visakhapatnam coastal wetland sites.

S. No	Botanical name	Common name	Habitat	Occurrence
1	<i>Avicennia officinalis</i>	Nallamanda	Tree	1,2,3
2	<i>Avicennia marina</i>	Tellamada	Tree	1,2,3
3	<i>Avicennia alba</i>	Chinnamada	Shrub	1,2
4	<i>Excoecaria agallocha</i>	Tilla	Tree	1,2
5	<i>Acanthus ilicifolius</i>	Alchi	Shrub	1,2,3
6	<i>Salicornia brachiata</i>	Leakedu	Shrub	1,2
7	<i>Suaeda maritime</i>	Gollakura	Shrub	1,2
8	<i>Suaeda monoica</i>	Gollakura	Shrub	1,2
9	<i>Typha angustata</i>	Bull rush	Shrub	3
10	<i>Typha australis</i>	Lesser reed mace	Shrub	3
11	<i>Ipomoea pescaprae</i>	Sea side potato	Shrub	1,2,3
12	<i>Petalium murex</i>	Pedda Palleru	Shrub	1,2,3
13	<i>Tribulus terrestris</i>	Chinna Palleru	Shrub	1,2,3
14	<i>Pendanus fascicularis</i>	Screw pine	Shrub	1,2,3
15	<i>Derris heterophylla</i>	Nallateega	Shrub	1,2
16	<i>Clerodendron inerme</i>	Pisingi	Shrub	1,2
17	<i>Aeluropus lagopides</i>	Flower grass	Herb	1,2,3
18	<i>Cynodon dactylon</i>	Nut grass	Herb	1,2,3
19	<i>Cyperus rotundus</i>	Grass	Herb	1,2,3
20	<i>Cyperus killinga</i>	Blade grass	Herb	1,2,3
21	<i>Themeda triandra</i>	Blade grass	Herb	1,2,3

1-Bangarampalem; 2- Pudimadaka; 3- Gangavaram

3. Discussion

In general birds are one of the most predominant visible faunal components of salt marshes and tidal swamps classified them into aquatic species are purely dependent on these habitats for feeding and nesting activity. In particular the wetland marshes and swamps provide an abundant and continuous source of food to the nesting water birds (Burger, 1985) [4] while the terrestrial species occasionally visited these areas for food and shelter (Remold, 1977) [8]

There is a definite relationship between bird's distribution and interplay to vegetation in salt marsh and swampy habitats (Beefink, 1977) [3]. They are utilized the species of marshy plants and marine invertebrates cringe to plants are important food resources, while others use this marshy vegetation for lofting and roosting. In addition to the endemic and migrants several other water birds utilize coastal marshes on sporadic basis. In recent times due to rapid industrialization and urbanization many of these wild life habitats have disappeared and only a few important habitats of salt marsh and estuarine swamps exist in these areas.

Large flocks of gulls and terns roost on the marshy vegetation and waders such as the herons and egrets feeding on crabs, small fish and frogs from the tidal creeks and brackish water

streams. Utilization of these habitats was at maximum during winter months (November to March) by the migratory birds (sea gulls, terns, teals, goose and ducks) are outnumbered the resident and local migrant species.

For birds nest site selection plays an important role in the reproductive success and survival of the birds. In recent times due to lack of suitable nesting sites or the presence of few sites they are attracting towards colonial nesting sites may be are to nonspecific attraction (nesting of other aquatic birds like storks, herons and egrets) by the migratory species is an important phenomenon affects the selection of nesting sites and feeding grounds. Wetlands particularly marshes and swamps provides an abundant and continuous source of food to nesting water birds.

Thus the coastal wetlands especially the saline marshes and swamps are the important sites for inclusion in the Integrated Protected Area Management Systems (IPAMS) net work to develop as "Urban Wetland Refuges" for conservation of associated avifauna of all categories. Based on present ecological status and anthropogenic impacts the following conservation plans have been suggested for ecological restoration of these important wetland habitats of threatened migratory bird fauna (Table 5).

Table 5: Human Impact Factors and Conservation Strategies for Ecological Restoration of Wetland Habitats.

S. No	Habitat Name	Human Impact Factors	Suggested Conservation Measures
1.	Bangarampalem	Mangrove swamps encroached for shrimp farming practices, agriculture, fire wood collection, cattle grazing, salt manufacturing units and collection of mollusc shells (bivalves) for lime (CaCO ₃) making industry.	Intensive mangrove afforestation may be taken up in the degraded areas.
2.	Pudimadaka	Fire wood collection, shrimp farming practices, salt harvest and manufacturing units, conversion of swampy areas for growing of Casuarina plantations.	Propagation of emergent vegetation on creek banks and reclamation of marshy land occupied for the shrimp farming practices may be taken up.
3.	Gangavaram	Harvesting of Reed mace and Elephant grass for cattle fodder and housing. Fire wood collection and salt harvesting	Sustainable harvesting measures of fire wood collection, thatched grasses, fodder may be encouraged.

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