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BREEDING SUCCESS AND MORTALITY RATES IN THE SPOT-BILLED PELICAN (*PELECANUS PHILIPPENSIS*), AT TELINEELAPURAM BIRD PROTECTED AREA, (AN IBA SITE; IN 229) SRIKAKULAM DISTRICT, ANDHRA PRADESH, INDIA

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ABSTRACT

Breeding success and mortality rates of migratory birds are mainly depends on the available food resources, safe nesting sites and mortality of chicks. Present study revealed the breeding success and chick mortality in Spot-Billed Pelicans (*Pelecanus philippensis*), over a period of five years from 2008-2013, undertaken at a pelicanery of village Telineelapuram. The Spot-Billed Pelican (*Pelecanus philippensis*) is one of the important migratory birds visiting regularly for last 20 years. Overall breeding success during study period is considerable; however year wise statistics are differing. The recruitment percentage had ranged from a low of 24.44% in the year 2010 to a maximum of 47.11% in the year 2012 with an average success rate during five years study is 39.34%. At the same time, the rate of chick mortality was also high at Telineelapuram, due to the influence of different factors (namely Cyclones, Perching activity, Predations and Falling of chicks). The number of dead young birds during different years of the study period had ranged from 33 to 82. Highest mortality (82 individuals) was observed during the year 2010. The average mortality rate of chicks at Telineelapuram is 18.72% and detailed results were projected.

Key words: Breeding, Hatching, Mortality, Nesting, Village pelicanery.

Introduction

Across much of Asia, the Indian sub-continent particularly, wetlands are being rapidly lost due to encroachments, pollution and several other factors like industrial establishments, aquaculture, salt pans and agricultural activities (Sebastian *et al*., 2012). Yet, several crucial aspects of wetland ecology, more precisely the role of birds in their functioning remained largely unexplored (Urfi, 2011). India is an important part of the CAF (Central Asian Flyway) and supports 257 species of water birds, including 81 species of migratory birds of CAF conservation concern, of these, three are critically endangered species, six are endangered species and 13 are near threatened species (GOI, MoEF, 2005).

The Spot-Billed Pelican (*Pelecanus philippensis*) is one of such species for which India is an imperative region through supporting good habitats and is recognized as 'Near Threatened' category by the IUCN (IUCN 2014). Spot-Billed pelicans distributed in Southeast Asia over a range of territory between 129,000 and 181,000 Km^2. The remaining populations are in India, Sri Lanka, southern Cambodia, and Sumatra along coastal areas. Breeding, however, is currently confined to Sri Lanka, parts of south-eastern India, and Cambodia (Stattersfield and Capper, 2000).

About 25 sites in India are associated with wetlands support to Spot-Billed Pelicans (Subrahmanya, 2005 and Urfi, 2011). Most of these sites are in south India, especially in the states of Andhra Pradesh (AP), Tamil Nadu (TN) and Karnataka. In Andhra Pradesh, currently two sites (namely Uppalapadu of Guntur district; and Telineelapuram of Srikakulam district) are known to support. The present study area Telineelapuram village of Srikakulam district, AP is a recognized IBA site, (No. 229) and belongs to A1 category (Globally threatened species) and support breeding of Spot-Billed Pelicans.

Unless immediate efforts are taken to protect and conserve ecology of the Telineelapuram IBA site, including its foraging sites, this nearly threatened species may lose one of their major breeding habitats. Towards this a fair understanding of these populations and their breeding ecology is fundamental. So far, only few anecdotal studies on the birds of Telineelapuram were reported (Srinivasulu, 2008 and Murugesan, 2011), while there was no prolific and concomitant study from this IBA site. To comprehend those gaps the present study is an attempt and was carried out in this direction.

The present study, during the years 2008-12 has been perceived the Mean annual recruitment; it was 39.34 ± 8.79% at Telineelapuram. This indicates that fairly good recruitment is taking place.

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Material and Methods

Study area

The study area, Telineelapuram village is situated in Tekkali mandal of Srikakulam district, Andhra Pradesh, India (18^{0}57' of North latitude and 84^0 26' of East longitude) (www.google.co.in/ search?q=telineelapuram+ geographical+coordinates&oq). The village is about 5 km northwest from Naupada railway station on the Chennai-Howrah track; and is 7 km south east from Tekkali on NH-5, the National Highway from Chennai to Kolkata and thus, is well connected by road and railways. The village is about 65 km north of Srikakulam town, which is the district headquarters (Source: District forest office, Srikakulam). Google maps of the study area were used, along with the Survey of India Topo maps and the village map from the revenue records. (www.google.co.in/search?q=maps& source) (Fig.1).

The village is bounded by Naupada salt pans and flooded fields on the east, Talagam and Ijjavaram villages on the north and northeast, Vemulavada village on the north-west, Srirangam, Ravivalasa and Yemalapeta villages on the west, Yemalapeta and Kasipuram villages on the south-west and south. Bhavanapadu Mangrove swamps are located at a distance of 10 km southeast from the village.

The terrain is plain with an altitude of about < 27 m asl, and with a gentle slope towards southeast. Based on the satellite images and topo maps, four types of land uses (namely Agricultural lands; Wetlands; Wastelands and Habitations) were identified in the study area. The excess waters from the agricultural fields drain into the low lying areas called 'Parra', flooded fields and finally join with Tekkali creek that opens in to the Bay of Bengal at Bhavanapadu.

Thus, the study village, Telineelapuram is surrounded by several major wetlands, which serve as major foraging

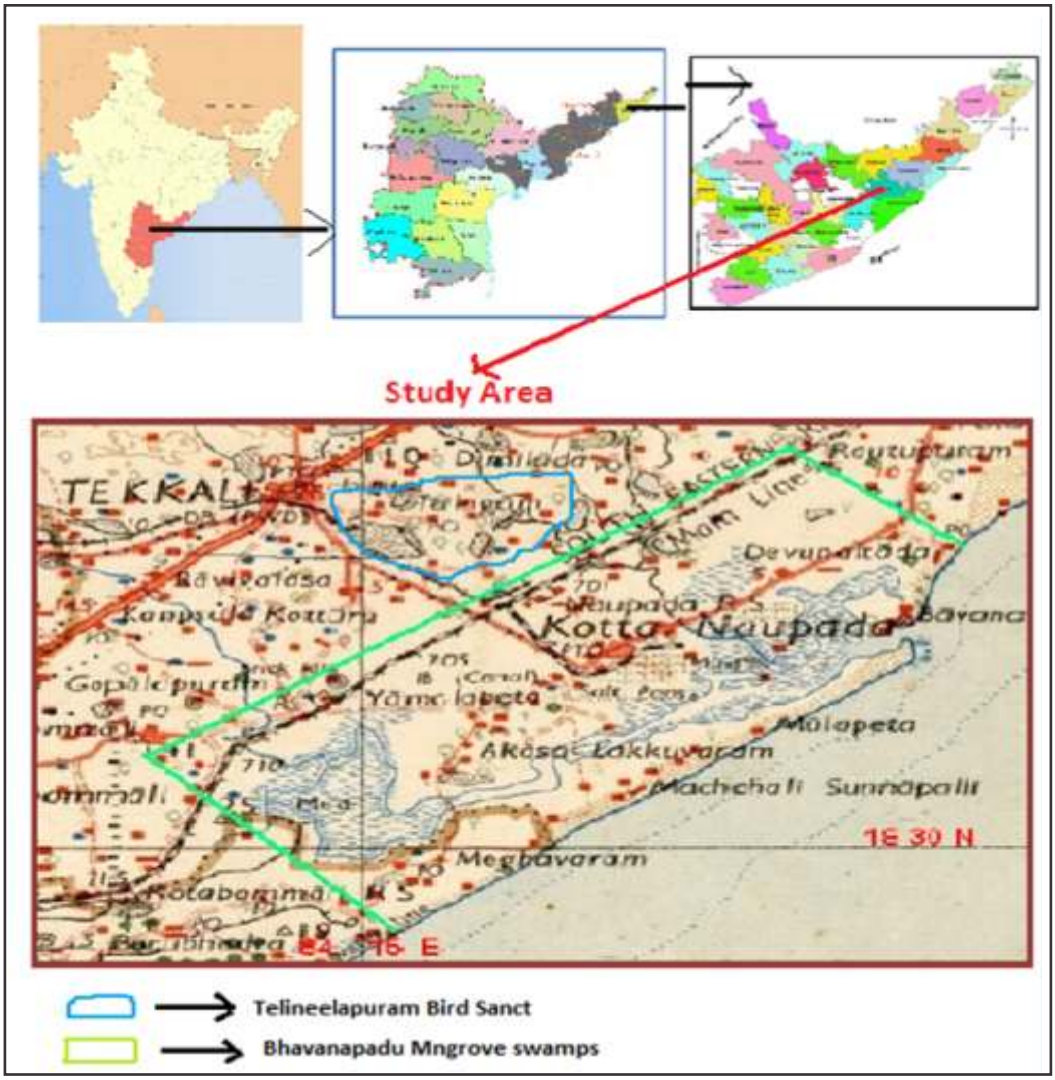

Fig. 1: Map showing the study area of Telineelapuram along with Forage Sites.

sites for several water bird species. This feature of having several wetlands (of both freshwater and brackish water types) around has made the study area a good site for the Pelicans, which nests close to the human habitations.

The climate is more or less characterized as humid throughout the year. In general the mean annual maximum temperature is 31.4^{0}C and minimum temperature is 23.2^{0}C. The maximum temperature normally occurs in the month of May and minimum temperature in the month of January. The annual rainfall is 937.6 mm during the year 2004-05 as against normal rainfall 1274 mm. During study period (2008-13) the mean annual maximum temperature is 32.7^{0}C recorded in the year 2010 and minimum temperature is 21.8^{0}C recorded in the year 2008. The annual maximum rainfall is 1653.4 mm recorded in the year 2010 as against normal rainfall 1274 mm at the study site.

All the flowering plant species of the study area, 108 species of angiosperms belonging to 48 families were recorded from the different land use types of Telineelapuram village and the surrounding (15 km radius) region. Of these, 50 were herbs, 23 were shrubs and 35 were tree species. There were no endemic or endangered or threatened plant species in the region. The fauna of the study area were identified; the vertebrate species of amphibious and terrestrial were recorded. The faunal inventory shows that in the entire Telineelapuram area has only two species of birds protected under Schedule-I of the Wildlife (Protection) Act, 1972. All other species are mostly common species, which are widely distributed in India. There were no endemic species in the region.

The present study was carried out during August 2008 to May 2013 at Telineelapuram village of Tekkali Mandal, Srikakulam district, Andhra Pradesh. Observations were made on Spot-Billed Pelican (*Pelecanus philippensis*), for about 7 to 8 months, from August/September to March/April, every year. Observations on the birds and their arrival patterns were recorded for five consecutive years. Different combinations of methods like flush count, line transact and point transact (point counts) are preferred survey methods in many situations to count birds, but certain limitations like counting instructions to the observer, walking speed, distance estimation, overlapping in counting etc., was observed. Total count method is also a best suited method however, studied all the methods for validating the data, while the principal method being direct observations with the assistance of the Forest Department field staff and three village volunteers, since the study area is under colonies of migratory birds. The entire study area is made into one single unit 250 m in diameter and made counts from a vantage point through direct observations with binoculars and camera on requirement.

Observations on arrival of birds were started from August/September and continued up to end of December, every year. Assistance of three village volunteers was taken to inform the arrivals of the birds on daily basis. On every day of arrival, the number of trees inhabited by the birds, and the number of birds colonized on each tree was recorded. The trees were numbered and their particulars were recorded on a separate data sheet. Every Sunday, between 7 am and 9 am, the bird, nest counts were made and recorded colony and tree wise. As the bird colonizing trees are very close to the human habitations, several colonies could be easily watched closely, even without a binocular. However, few colonies needed the binoculars to watch from a vantage point (Observatory Tower or a 2-storied building).

Bird counts were made immediately after noticing a newly arrived colony. The numbers of adults and sub-adults could be made based on their distinct size differentiation, while the sex of the birds could not be determined for the arrival colonies. Sex-ratio of the adult birds was made from the colonies specifically selected for the monitoring. Male birds develop bright yellow color around its eye during breeding season and also perform courtship displays. In addition to this, different activities like, courtship behavior; nest construction; egg-laying; clutch size; nest guarding; juvenile feeding and fledging were recorded from selected nests and bird pairs of the 7 colonies selected. During the egg-laying period, observations were continued on all the days till the clutch sizes are realized.

Nest construction period was determined based on the focused observations on two pairs of birds from each of the colonies monitored, nest counts were made colony wise. However, for the purpose of determining the egg-laying period, clutch size and hatching success, 8-12 specific nests were monitored every year, selecting one from each colony. These nests were monitored daily at 7 am and 5 pm, till the eggs are hatched. Specific observations, once in a week during the dawn and dusk phase times, were made to study nest guarding behavior.

For the purpose of focused observations on breeding and other different activities of the birds, 7 colonies were selected every year for monitoring closely. Of these three were from C_S (Small Colony); three from C_M (Medium Colony); and one from either C_L (Large Colony) or C_G (Giant Colony) were selected and nests were also selected from these colonies for close monitoring and observation, considering the availability of access to closely watch them from a vantage point. Most of these colonies were monitored from a Watch Tower with a height of 27 m constructed as Bird Observatory Centre by

the Andhra Pradesh Forest Department.

Owing to lack of permission from the Chief Wildlife Warden, any collection of the eggs or refused eggs; or dead birds were not made. However, with the assistance of supporting staff information on the damaged nests, or fallen eggs from the nests (Plate: 1); dead hatchlings (Plate: 2); or other disturbances were recorded as and when the incidents occurred and a chronological record for every year was maintained.

A Nikon make digital SLR, with 300 mm zoom camera and a binocular of 8-16x40 Zoom of Olympus make were the main gadgets used for the observations. Statistical tools were used to understand the relationship between rainfall and the bird arrivals; rain fall and the hatching success; and colony size and hatching success or mortality of hatchlings etc.

Plate: 1

Plate: 2

Results and Discussion

Pelicans at Telineelapuram, within a week after their arrival initiated breeding activity. Focused observations were made on Two C_M (Medium Colony) size colonies to understand the number of birds participating in the breeding activity. In one colony of 28 adult birds, only 9 have paired, while 2 of the 11 males and 8 of the 17 females did not participate in the breeding activity. In the second colony with 24 adult birds, only 8 were paired, while 2 of the 10 males and 6 of the 14 females have not participated in the breeding activity. Thus, it appears that nearly 19% of the adult males and nearly 45% of the females were not participated in the breeding activity.

Breeding Success

Based on the results of the monitoring of colonies, nests and hatchlings, estimates for the post breeding population for the study years were made, and annual recruitments were inferred. With the exception of the number of dead hatchlings or young birds, for all other details related to (1) the number of females nested; (2) no. of eggs laid; (3) no. of eggs unhatched; (4) no. of recruits (hatchlings survived) and (5) percent recruitment were the projections made from the monitoring data. The details are presented in Table 1.

The recruitment percentage had a range from a low of 24.44% in the year 2010 to a maximum of 47.11% in the

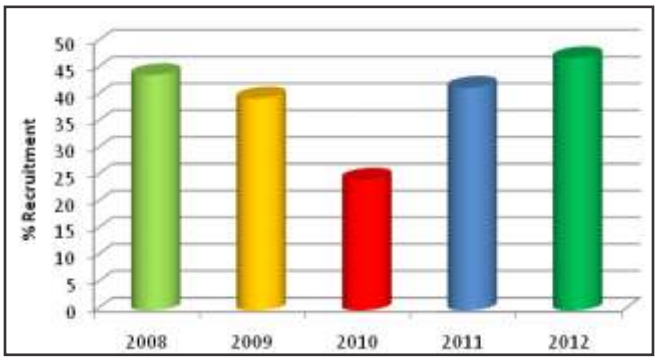

Fig. 2: Recruitment to the arrival population of pelicans at Telineelapuram during 2008-2012.

Table 1: New recruitment and post breeding populations of pelicans at Telineelapuram.

Year	Population arrived	No. of colonies	No. of nesting females	No. of eggs laid	No. of eggs not hatched	No. of eggs hatched	No. of hatchlings died	No. of recruits to population	% New recruits	Post breeding population
2008	587	14	170	378	79	299	41	258	43.95	845
2009	505	13	133	295	62	233	33	200	39.60	705
2010	491	12	113	255	53	202	82	120	24.44	611
2011	565	14	151	340	71	269	34	235	41.59	800
2012	588	16	179	400	84	316	39	277	47.11	865

year 2012. The annual variations was very wide is illustrated in (Fig. 2).

Mortality rate

During the nesting period, some of the hatchlings or young birds were fallen from the nests. It was observed that adult birds did not show any efforts to help to these fallen young ones. However, if any such fallen young birds are noticed, native villagers rescued them, and with the help of the staff of the forest department, these birds were kept in a small enclosures and rear till they are able to fly, but in most incidents such birds observed as dead (Plate 1 & 2). Despite the villager's efforts, some young birds were found dead and during the five year period, about 229 such incidences were recorded.

The number of dead young birds during different years of the study period had a range from 33 to 82 is presented in (Fig. 3). Highest mortality (82 individuals) was observed during the year 2010. Of these, nearly 38 young birds were died in a span of 3 days during a severe cyclonic storm.

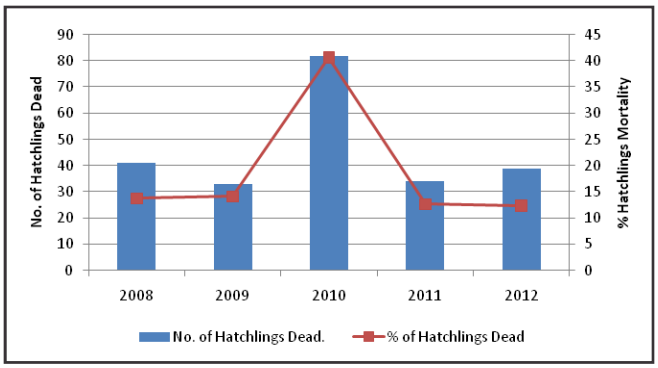

Fig. 3: Mortality of the pelican hatchlings at Telineelapuram during 2008-2012.

Spot-Billed Pelican (*Pelecanus philippensis*) is one of the important bird species which is globally threatened and vanishing fast due to loss of their habitats in their distributional range of South Asia. The arrivals of the SBP largely depend upon their breeding season and the breeding season slightly differed from site to site as reported by several studies (Pathak, 2011; Bird Life International, 2001; Subramanya, 2005; Gokula, 2011; Sharma and Raghavaiah, 2002; Nanda Kumar *et al*., 2011; Vijayan *et al.,* 2006-2011 and Murugesan, 2011). A comparison of the breeding season of SBP at different sites is presented as Table 2.

Only a single report was available on the breeding season of SBP in north India (Pathak, 2011) *i.e*. from Gujarat, where the breeding season commenced during (February) and ended in (April). In the remaining breeding sites (of South India) the season commenced during the last phases

Table 2: Comparision of the breeding season of SBP at different study sites of India.

S.No.	Earlier Studies	Area	Breeding season
1	Pathak (2011)	Thol bird sanctuary (Gujarat)	Feb.-April
2	Bird Life International (2001)	Kokkare Bellur (Karnataka)	Oct./Nov. to March/April
3	Subramanya (2005)	Koonthakulam (Tamil Nadu)	Oct.-May (Dec.-Jan.)
4	Gokula (2011)	Karaivetti bird sanctuary (T.N)	Sept.-June (Nov.-March)
5	Gokula (2011)	Vedanthangal & Karikili (T.N)	Sept.-March
6	Sharma and Raghavaiah (2002)	Nelapattu (A.P)	Sept.-March (Nov.-Jan.)
7	Nanda Kumar *et al*. (2011)	Nelapattu (A.P)	Sept.-April
8	Vijayan *et al*. (2006-2011)	Uppalapadu (A.P)	Oct.-March
9	Nanda Kumar *et al*. (2011)	Uppalapadu (A.P)	Sep./Oct.-April/May
10	Murugesan (2011)	Telineelapuram (A.P)	Oct.-April/ May
11	Present Study	Telineelapuram (A.P)	Aug.-March (Oct.-Dec.)

** Periods in parenthesis are the peak season.*

of the southwest monsoon (September-October) and lasted till the beginning of the summer (March).

As reported by (Gokula, 2011), in the present study also it was recorded that only a part of the adult birds participated in the breeding activity. Pai (2009) recorded about 350-450 breeding individuals of Pelicans at Kokkare Bellur (Karnataka). Around 1,600-2,000 breeding birds were present in Tamil Nadu, while the biggest colony at Koonthakulam had 450 breeding birds (Kannan and Manakadan, 2005). Vijayan *et al*. (2006-2011) reported about 283 nests at Uppalapadu (A P). In the present study at Telineelapuram, it was estimated that nearly 19% of the adult males and nearly 45% of the females of SPB were not participated in the breeding activity.

Different studies have reported varying clutch sizes of SBP, while a close analysis suggest that the clutch size varies from individual to individual depending upon the age of the bird, or perhaps the phase of the breeding season. Sharma and Raghavaiah (2002) reported a clutch size of 1-2 eggs at Nelapattu (Andhra Pradesh); Gokula (2011) recorded 2-3 eggs laid in a gap of 2 to 3 days at Karaivetti (TN) and Pathak (2011) recorded 3-4 eggs laid within one week after the nest construction at Thol (Gujarat). In the present study, clutches of all these sizes were recorded from different nests, while a majority (46.81%) of the nests had 2 eggs, followed by 3 eggs (25.53%).

The hatching time of SBP is around one month, as was also reported by several authors (Pathak, 2011; Gokula, 2011 and Sharma and Raghavaiah, 2002). The hatching time reported for SBP was presented below along with the observations of the present study:

#	Earlier studies	Area	Incubation period
Spot-billed Pelicans			
1	Pathak (2011)	Thol (Gujarat)	4 weeks
2	Gokula (2011)	Karaivetti (T.N)	25-36 days
3	Sharma and Raghavaiah (2002)	Nelapattu (A.P)	30 days
4	Present Study	Telineelapuram (A.P)	29-35 days

On the basis of observations on the frequency of hatching times in the present study, a majority of the eggs hatched on 30th day. It seems that the actual incubation time of the eggs could be 30 days. As all the eggs are not laid at a time, and the egg laying period is varying from 4 to 7 days for a maximum clutch size of 4 eggs, hatching of the eggs also appear to occur from 29th day to 35th day or so. Perhaps, any studies in captivity could throw more light on this.

Environmental conditions during 4 to 5 weeks period of hatching are crucial. Any cyclonic storms or strong winds can cause dislocation of eggs from their nests may fall down. Egg predation by House Crow (*Corvus splendens*) was also observed by the volunteers. A sizable number of eggs remained unhatched till the end of hatching period, as was evident from the results of the hatching success in the monitored nests. These unhatched eggs are perhaps unfertiled/ eggs, and further studies are needed to understand the cause of this. Similarly, fledging period is also a crucial period that determines the survival rate of siblings hatched. The fledging period in SBP at Tamil Nadu was reported as 90 to 102 days Gokula (2011), while a similar range of 95 to 105 days was recorded in the present study.

Mortality of the chicks of SBP was recorded in some of the earlier studies. Gokula (2011) reported a mean of 2.3 young fledged per nest and out of 68 studied nests observed, the nesting success rate was 90.28% during 2007-10 at Karaivetti (Tamil Nadu); (Pathak, 2011) recorded at Thol Sanctuary (Gujarat), only one young survived per nest and reported that chick mortality in SBP is mainly during perching activity, when they fall from nest due to high wind velocity, or get one of the legs trapped in tapered branches die hanging on the nest trees. Similar incidences were also observed in the present study, especially during the year 2010, when a severe cyclone killed several SBP chicks.

During 2008-12, the number of dead young birds differed in different years of the study period, ranged from 33 to 82, indicating that the vulnerability of SBP during the fledging period is low. The proportion of unhatched eggs, egg-mortality and chicks mortality, finally determines the recruitment to the population.

Recruitment to the population has rarely been estimated and reported for SBP populations in India. In the present study an attempt has been made in this direction. The mean annual recruitment was 39.34 ± 8.79 % indicates that fairly good recruitment is taking place at Telineelapuram. By the end of the fledging period, all successful chicks were able to stand at their own, and were able to take up the flights along with the adult birds. As the summer was progressing, the colonies of the SBP started departing from Telineelapuram, and within a span of 4 to 6 weeks, the emigration process was completed.

Conservation issues and conclusion

Some of the results of the present study, like nesting on new tree species during the year 2012-13 by the species; increasing nesting density from the third year and chicks mortality (> 10%) by falling from the nests due to overcrowding, indicate that the nesting habitat is shrinking. Similarly, heavy mortality of eggs and chicks during the cyclone of 2010 exposed the vulnerability of the nesting sites to the cyclones.

Thus, conservation activities need to be adopted to protect and develop the nesting habitat. The crown cover is declining with the increasing anthropogenic pressure at Telineelapuram, as was evident from the gradual increase in the nesting density over the five years. Evidently, some of the branches of the nesting trees were pruned resulting in the declined crown cover.

Telineelapuram village of Srikakulam district, AP was a recognized IBA site and support breeding colonies of the species, Spot-Billed pelicans and some other species in good numbers. However, increasing population and industrialization in the surrounding region are posing major threats in the recent times. So far, only few anecdotal studies on the birds of Telineelapuram were reported, while there was no long term study from this IBA site.

Pelicans preferred to colonize on: (i) Trees within a distance of 20m from the human dwellings; and (ii) Only one tree species (*Tamarindus indica*) was selected for colonization during all the years, and only in the fifth year (2012-13) an adjacent tree species (*Prosopis juliflora*) was also used for colonization. Pelican's emigration has commenced from mid-February and lasted till the end of the first week of April every year.

टीलिनीलापुरम पक्षी संरक्षित क्षेत्र (एक आई बी ए स्थल; आई एन 229) श्रीकाकुलम जिला, आन्ध्र प्रदेश, भारत में स्पॉट-बिल्ड पेलिकन (*पीलीकेनस फिलिपेन्सिस*) में प्रजनन सफलता एवं मर्त्यता दर

एच. रामामोहन एवं के. कामेश्वरा राव

सारांश

प्रवासी पक्षियों की प्रजनन सफलता एवं मर्त्यता दरें उपलब्ध खाद्य संसाधनों, सुरक्षित नीड़न स्थलों एवं चूजों की मर्त्यता पर मुख्यत: निर्भर हैं। वर्तमान अध्ययन में हीलिनीलापुरम गाँव की पेलिकेनरी में किए गए 2008 से 2013, तक पाँच वर्ष की अवधि में स्पॉट-बिल्ड पेलिकन (*पीलीकेनस फिलिपेन्सिस*) में प्रजनन सफलता और चूजों की मर्त्यता का पता चला। स्पॉट-बिल्ड पेलिकन (*पीलीकेनस फिलिपेन्सिस*) गत 20 सालों से नियमित रूप से भ्रमण करने वाले महत्वपूर्ण प्रवासी पक्षियों में से एक है। अध्ययन अवधि के दौरान समग्र प्रजनन सफलता पर्याप्त है, तथापि वर्षवार सांख्यिकी में विभिन्नता है। भर्ती प्रतिशतता 2010 में निम्न 24.44 प्रतिशत से वर्ष 2012 में अधिकतम 47.11 प्रतिशत तक थी, जो पाँच वर्षों के अध्ययन के दौरान एक औसत सफलता दर के साथ 39.34 प्रतिशत है। विभिन्न कारकों (यथा- चक्रवात अड्डे पर बैठने की क्रिया, चूजों का परभक्षण एवं पातन) के प्रभाव के कारण टीलिनीलापुरम में चूजों की मर्त्यता की दर भी उच्च थी। अध्ययन अवधि के विभिन्न वर्षों के दौरान मृत युवा पक्षियों की संख्या 33 से 82 तक थी। उच्चतम मर्त्यता (82 एकल) वर्ष 2010 के दौरान प्रेक्षित की गई। टीलिनीलापुरम में चूजों की औसत मर्त्यता दर 18.72 प्रतिशत है और विस्तृत परिणामों को प्रक्षिप्त किया गया।

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