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continued on the back inside cover

Cover: Nile Crocodile *Crocodylus niloticus* regulating body temperature on a warm day. Digital art on Procreate by © Aakanksha Komanduri.



## Rapid increase in artificial-substrate nesting by White-bellied Sea Eagle *Haliaeetus leucogaster* (Gmelin, 1788) (Aves: Accipitriformes: Accipitridae) in Tamil Nadu, India

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**Abstract:** White-bellied Sea Eagle *Haliaeetus leucogaster* is a coastal apex predator whose nesting ecology is associated with the availability of tall trees along water bodies. An increase in anthropogenic pressure along the southeastern coast of India has led to nesting adaptations, including the use of artificial substrates. Here, unusual observations on four nests constructed on artificial structures within a single breeding season (2025–2026) in Ramanathapuram District, Tamil Nadu, of which three were successful are reported. Only one artificial substrate nest was recorded in the previous decade. This represents a notable increase compared to previous records from the region and suggests a potential behavioural shift. Nesting activity patterns, breeding success, and conservation implications in the context of habitat modification and ecological traps are discussed.

**Keywords:** Apex predator, breeding, coastal wetland, electric pylon, nest-site selection, raptor, Ramanathapuram.

The White-bellied Sea Eagle (WBSE) *Haliaeetus leucogaster* is a large, diurnal raptor distributed across the coastal regions of the Indian subcontinent, southeastern Asia, and Australia (del Hoyo et al. 1994). As a sentinel species of ecosystem health, its presence and breeding success are key indicators of thriving coastal and wetland habitats (Amal & Roshnath 2025). Traditionally, WBSEs exhibit high nest-site fidelity, constructing large, stick-platform nests (eyries) in the upper canopies of tall, mature trees, which provide security from terrestrial predators and afford optimal vantage points for foraging (Azman et al. 2013). WBSE accounts of nesting on

communication towers or windmills are reported from Australia and Thailand, but documentation from the Indian subcontinent remains scarce (Palei et al. 2014). Although with increasing frequency of nesting from Odisha (Pattnayak et al. 2025a) and Tamil Nadu (Byju et al. 2023a), they prefer to nest on electric pylons and telecommunication towers. Habitat loss resulting from the decline of mature coastal trees due to urbanization, cyclones, and shoreline development has forced the species to increasingly adopt artificial nesting substrates (Byju et al. 2023a; Pattnayak et al. 2025a). Artificial nesting may represent behavioural plasticity, emerging evidence suggests that these structures may function as ecological traps, often associated with lower breeding success and higher mortality risks (Pattnayak et al. 2025a). This study documents an unusual clustering of nests on artificial substrates in Ramanathapuram, contributing to the growing body of evidence on this adaptive shift and its conservation implications.

### Study area

The observations were made along the coastal belt of Ramanathapuram District, southeastern Tamil Nadu (Figure 1). The region comprises a mosaic of tidal creeks, mudflats, aquaculture ponds, and fragmented coastal vegetation. The area has undergone substantial

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land-use change, including the loss of mature nesting trees, expansion of aquaculture and increased human settlement and infrastructure. Such changes are likely influencing nesting site selection by WBSEs.

## METHODS

Field observations were carried out during the breeding season (November–March) of 2025–2026, following roadside surveys as described in the previous study (Byju et al. 2023a). Nests built on artificial substrates ( $n = 4$ ) were monitored at least once every 10 days to assess occupancy, breeding activity (pair presence, incubation, and nestling rearing), outcomes (success/failure), and fledging rates. Behavioural observations included nest-building, prey delivery, and defensive responses. A nest was considered successful if at least one chick survived the fledging stage (~80 days for WBSE), which represents a key threshold for independent survival (Debus 2008; Dennis et al. 2012), irrespective of parental care. Nests were classified as unsuccessful if they were abandoned during any stage or if no nestlings reached fledging. Observations

were made from 50 m to 100 m using binoculars and spotting scopes to mitigate disturbance. Abandonment was confirmed when repeated visits showed no adult presence, absence of nest maintenance, and no evidence of chicks (Liu et al. 2009).

## RESULTS AND DISCUSSION

### Nest distribution and success

A total of four nests (N1–N4) were recorded on artificial substrates within a relatively small spatial extent. Three nests were active and successful, producing chicks (Table 1). One nest (N4) functioned as a secondary or alternate nest. This represents an unusually high density of artificial-substrate nesting for the region within a single breeding season. The height of the nest in the pylon and towers was approximately 18 m from ground level (Byju et al. 2023a).

### Behavioural observations

Adults were observed reinforcing nests with sticks, indicating prolonged prior use of certain nests (N1) before egg-laying, whereas the other nests appeared to

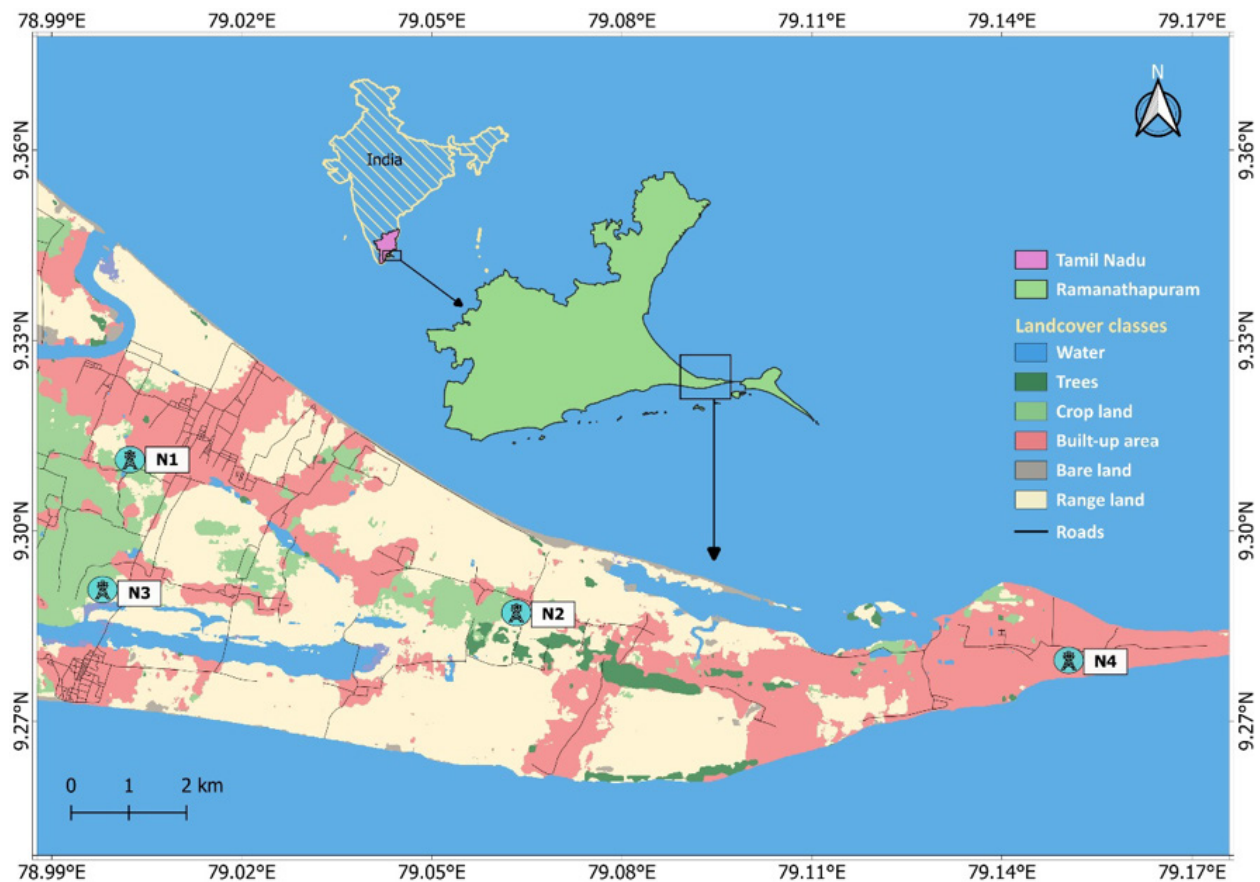


Figure 1. Map showing the four nesting locations of White-bellied Sea Eagle in the Ramanathapuram District.

**Table 1. Four nests of White-bellied Sea Eagle with their breeding biology and nest locations.**

Nest ID	Substrate type	Status	Breeding cycle	Outcome	Notable behaviour	GPS location
N1	Electric	Active (same nest as in 2022–2023)	Chick reared -2	Successful	Strong territorial defense	9.289° N, 78.998° E
N2	Telecommunication tower	Active	Chick reared -2	Successful	Regular prey delivery (fish)	9.285° N, 79.064° E
N3	Telecommunication tower	Active	Chick reared -1	Successful	Nest repair observed	9.310° N, 79.003° E
N4	Telecommunication tower	Secondary	Nest built; no eggs	Unsuccessful	Secondary/inactive	9.278° N, 79.152° E

Note: Active nests have egg-laying confirmed.

have been constructed in the months leading up to egg-laying. Use of multiple nests (including a non-breeding 'false nest') was recorded in the first observation (Byju et al. 2023a), likely as a predator avoidance strategy, and was not recorded in the current year's observations. Feeding consisted predominantly of fish, consistent with the species' foraging behaviour.

### Breeding success

Interestingly, 75% nesting success (3/4 nests) in this observation contrasts with larger-scale studies indicating a lower fledging success on artificial structures and up to 39% failure rates on pylons (0.87 fledglings per attempt) compared to near 100% (higher productivity, 1.74 fledglings per attempt) in natural trees (Pattnayak et al. 2025b). This discrepancy may be due to proximity to productive foraging habitats, lower disturbance levels at specific sites and early-stage adaptation before long-term negative effects manifest. Higher fledgling rates may be due to the proximity of a water body adjoining the nests (N1 and N2 had two chicks compared to N3 with one chick). In principle, a closer foraging site can reduce foraging time and energy expenditure, enhance the delivery of fish or other aquatic prey to the nest, and thus increase nestlings' survival (Pattnayak et al. 2025b).

### Artificial structures as potential ecological traps

The shift in nesting patterns is likely driven by the decline of mature coastal trees due to developmental activities and cyclone impacts. At the same time, expanding infrastructure has introduced elevated artificial structures that offer alternative nesting sites. Similar trends have been reported from eastern India, where habitat alteration influences raptor breeding ecology (Palei et al. 2022). Breeding outcomes differ markedly between natural and artificial sites, suggesting that many artificial structures function as ecological traps (Pattnayak et al. 2025a). These sites are often located in disturbed environments, closer to roads and human settlements, where increased disturbance can

elevate stress, disrupt foraging and lower long-term reproductive success (Bilney & Emison 1983). Therefore, although artificial structures may compensate for the loss of nesting sites in the short term, they are unlikely to sustain healthy population growth over the long term.

### Conservation implications

The observations highlight both opportunity and concern. The opportunities include **alternative nesting substrates** in landscapes where natural sites are irrevocably decreased or lost; these structures can provide essential nesting platforms, potentially preventing local breeding collapse. This can lead to **conservation partnerships** with infrastructure companies (power utilities, telecom). This can be leveraged for collaborative conservation, such as 'raptor-friendly' infrastructure design.

Meanwhile, severe threats include electrocution as a paramount risk. WBSEs have large wingspans (~1.8–2.2 m). Nesting on or taking off from live power pylons poses a high probability of wing-to-conductor or conductor-to-ground electrocution, a leading cause of mortality for raptors globally (Jenkins et al. 2010; Manigandan et al. 2021). Collisions with wires supporting communication towers are often invisible to fast-flying birds, leading to fatal strikes. Chicks are at risk of falling or exposure to extreme weather from nest platforms on towers, which are often smaller, more exposed, and less stable than those of natural tree nests.

### Recommendations

Proactive, evidence-based management is required, including an urgent need for a district-wide systemic survey to map all WBSE nests (natural and artificial) to assess the scale of artificial nests. To mitigate risk at nest sites, collaboration with electricity distribution companies (e.g., TANGEDCO) can enable retrofitting of active pylon nests with insulated covers or perch deterrents on live components. For communication towers, bird-flight diverters on guy wires can be



**Image 1.** White-bellied Sea Eagle *Haliaeetus leucogaster*: Nest 1 (N1)—adult in the nest | Nest 2 (N2)—parents with two chicks | Nest 3 (N3)—adult in nest | Nest 4 (N4)—abandoned nest. © N. Raveendran.

installed. A promising strategy is the erection of purpose-built, safe artificial nest platforms (ANPs) on tall poles in secure locations near foraging areas. These ANPs can be designed to be more attractive (stable, spacious) and

safer than power towers. Long-term conservation must focus on protecting and restoring mangrove corridors with large, old trees to support natural nesting, as this region is already having the first Asian record

of Light-mantled Albatross *Phoebastria palpebrata* (Byju & Raveendran 2022), breeding of Noddy (Byju et al. 2025a), Terns (Byju et al. 2025b) and regional endemic Hanuman Plover *Anarhynchus seebohmi* (Byju et al. 2023b). Continuous engagement with local communities, fisherfolk, and infrastructure managers is crucial to building stewardship and reporting nesting activity.

## CONCLUSION

The documentation of four nests of WBSEs on artificial structures, with three successful breeding attempts, represents a significant and possibly emerging trend in Ramanathapuram. While this behaviour reflects adaptability to changing landscapes, it also signals underlying habitat degradation. It is a clear ecological signal of habitat transformation and species adaptability. Understanding whether such nesting strategies represent a sustainable adaptation or a potential ecological trap is critical. Continued monitoring and targeted conservation interventions are essential to ensure the long-term survival of this iconic coastal raptor.

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## Articles

**Asiatic Elephant conservation as a driver of forest carbon stock stabilization and avoided degradation in India**

– Tarun Kathula & Tanu Jindal, Pp. 29003–29009

**Genetic polymorphism of Dhofar Toad *Firouzophrynus dhufarensis* (Parker, 1931) (Amphibia: Bufonidae) across central Saudi Arabia**

– Rawan Al-Shehri, Mohammed F. Albeshri & Ehab Eid, Pp. 29010–29019

**Fish diversity in selected urban, suburban, and rural wetlands of Vellore District, Tamil Nadu, India**

– Annie Pushpa Isaac, Sherrie Jesulyn David, Deepak Samuel Vijay Kumar & Nirmal Magadalenal Nathaniel, Pp. 29020–29035

**Macrofungal species richness, composition, distribution, and ecological preference along the elevation gradient in Agasthyamala Biosphere Reserve, southern Western Ghats, India**

– Kurunna Kandy Akshaya, Arumugam Karthikeyan, Arunachalam Rajasekaran, Binai Nagarajan & Cheravengat Kunhikannan, Pp. 29036–29051

**Efficacy of 5% neem seed kernel extract against ectoparasites in six captive wildlife species at Rajiv Gandhi Zoological Park, India**

– S.B. Kendre, P.D. Pawar, R.V. Jadhav, U.M. Tumlam, A.Y. Doiphode, V.G. Nimbalkar, P.K. Bhangale, V.C. Priyal & S.M. Meshram, Pp. 29052–29066

**A comparative web-traffic analysis of three renowned wildlife conservation organisations - International Union for Conservation of Nature (IUCN), Wildlife Conservation Society (WCS) and World Wide Fund for Nature (WWF)**

– Saswat Pati & V. Vijay Kumar, Pp. 29067–29078

## Communications

**First photographic record of the Himalayan Red Panda *Ailurus fulgens* (Mammalia: Carnivora: Ailuridae) in Yordi Rabe Supse Wildlife Sanctuary, Arunachal Pradesh, India**

– Yomto Mayi, Shantabala Devi Gurumayum & Salvador Lyngdoh, Pp. 29079–29084

**Lotus *Nelumbo* cultivations of Beehama Ganderbal offer novel habitats for diversity and seasonal variation of wetland birds**

– Sheikh Tanveer Salam, Fayaz Ahmad Ahanter & Showkat Ahmad Wani, Pp. 29085–29092

**Mating behavior of the Oaxacan Oak Anole *Anolis quercorum* (Squamata: Sauria: Anolidae) on a shade coffee plantation in Sierra Madre del Sur of Oaxaca, Mexico**

– Jesús García Grajales, Alejandra Buenrostro Silva, Gibran Aldair Amador Larios, Diana Andrea Nieves Rocha & Ixil Pineda Ibarra, Pp. 29093–29097

**Evidence for the local extirpation of the Dehradun Stream Frog *Amolops chakrataensis* Ray, 1992 from the type locality, Chakrata in western Himalaya, India, and associated threats: a call for urgent conservation action**

– Vishal Kumar Prasad, Kumudani Bala Gautam, Devendra Singh, Amit Badola, Abhilasha Shrivastava, K.P. Dinesh & Amaël Borzée, Pp. 29098–29105

**First record of the genus *Berlandina* Dalmas, 1922 (Araneae: Gnaphosidae) from India, with notes on *B. plumalis* (O. Pickard-Cambridge, 1872) and its synonymy**

– Subhash I. Parmar, Dhruv A. Prajapati & Pranav J. Pandya, Pp. 29106–29113

**First record of leucosiid crab *Lyphira perplexa* Galil, 2009 (Decapoda: Brachyura: Leucosiidae) from the eastern coast of India in West Bengal**

– Prabir Sahoo, Sagar Samanta, Avik Bhanja, Manas Das & Pijush Payra, Pp. 29114–29119

**An evasive naticid surfaces in India: first confirmed report of *Gennaosinum perobliquum* (Dautzenberg & Fischer, 1907) (Gastropoda: Naticidae)**

– Aparna Mishra, Sanjaya Dalai, Roberto Ardochini, N.V. Subba Rao & Dipti Raut, Pp. 29120–29126

## Review

**Taxonomic reassessment of *Ompok hypophthalmus* (Bleeker, 1846) (Actinopterygii: Siluriformes: Siluridae) in Indonesia with global implications**

– Dinesh Nalage, Tejswini Sontakke, Ashwini Biradar, Vidya Pradhan & P.S. Kudnar, Pp. 29127–29132

## Short Communications

**Recent sighting of Black Baza *Aviceda leuphotes* Dumont, 1820 (Aves: Accipitriformes: Accipitridae) in Nandhaur Wildlife Sanctuary, Uttarakhand, India**

– Prashant Kumar, Inder Singh Rautela, Chandan Kumar, Pawan Koranga, Deepak Dharmashktu & Kundan Kumar, Pp. 29133–20137

**Rapid increase in artificial-substrate nesting by White-bellied Sea Eagle *Haliaeetus leucogaster* (Gmelin, 1788) (Aves: Accipitriformes: Accipitridae) in Tamil Nadu, India**

– H. Byju, N. Raveendran & H. Maitreyi, Pp. 29138–29142

## Notes

**A photographic record of the Chinese Pangolin *Manis pentadactyla* (Linnaeus, 1758) (Mammalia: Pholidota: Manidae) from Pakyong District, Sikkim, India**

– Prashanti Pradhan, Jampal Dorjee Bhutia, Prem Kumar Chhetri & Bharat Kumar Pradhan, Pp. 29143–29145

**First camera-trap records of three wild carnivores from Corbett Tiger Reserve, India**

– Mridula, Kamakshi S. Tanwar, Anurag Nashirabadkar, Sudip Banerjee, Anindita Bidisha Chatterjee, Shikha Bisht & Yadvendra V. Jhala, Pp. 29146–29149

**Photographic record of the Eastern Bronzeback Tree Snake *Dendrelaphis cf. proarchos* (Wall, 1909) from Dudhwa Tiger Reserve, Uttar Pradesh, India**

– Vipin Kapoor Sainy, Aqsa Jaseem, Rohit Ravi, Apoorva Gupta, H. Raja Mohan, R. Jagadeesh & Kirti Chaudhary, Pp. 29150–29153

***Rhododendron pendulum* (Ericaceae) from Singalila National Park: an addition to the flora of West Bengal, India**

– Sulaxana Baraily & Projjwal Chandra Lama, Pp. 29154–29158

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