Wetland Vegetation Shifts and Their Role in Modulating Mugger Nest Micro-climates

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Research Article

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Abstract

Wetland vegetation plays a crucial yet often overlooked role in shaping the thermal and moisture conditions of crocodilian nesting habitats. At the Bhor Saidan Crocodile Breeding Centre in Haryana, India, noticeable shifts from native emergent macrophytes (Typha angustifolia, Phragmites karka, Cyperus rotundus) to invasive floating plants such as Eichhornia crassipes and Ipomoea aquatica have raised concerns about their effects on Marsh Mugger (Crocodylus palustris) reproduction. This study investigated how these vegetation transitions influence nest micro-climates during two consecutive breeding seasons (2023–2024). Continuous measurements of nest-core temperature, relative humidity, and soil moisture were collected from 48 nests distributed across emergent-dominated, floating-dominated, and mixed vegetation zones. Nests surrounded by emergent vegetation maintained more stable thermal regimes (mean 30.1 ± 1.3°C) and higher humidity (74 ± 4%) compared with floating-dominated sites, which exhibited greater daily thermal fluctuations and reduced moisture retention. Hatchling success correlated positively with emergent vegetation cover ($r = 0.71$, $p < 0.01$). These results highlight that the replacement of emergent vegetation by invasive floating weeds can compromise optimal incubation conditions, potentially lowering reproductive success. Conserving and restoring emergent plant assemblages is therefore critical to maintaining micro-climatic stability in nests and safeguarding Marsh Mugger populations under changing climate and habitat pressures.

Introduction

Wetland ecosystems that support Marsh Mugger crocodiles (Crocodylus palustris) are undergoing rapid vegetation changes due to fluctuating water levels, climate variability, nutrient enrichment, and human interventions such as embankments and dredging. These shifts in aquatic and riparian plant communities alter shading, soil porosity, moisture retention, and canopy cover—factors that strongly influence the micro-climate of crocodile nesting sites.

At Bhor Saidan Crocodile Breeding Centre, Haryana, anecdotal observations by staff suggest a progressive replacement of native emergent macrophytes (e.g., Typha, Phragmites, Cyperus) with fast-growing invasive species such as Eichhornia crassipes and Ipomoea aquatica. However, the ecological link between vegetation composition and nest micro-climate parameters (temperature, humidity, moisture) remains poorly understood.

Aim:

To investigate how changes in wetland vegetation composition affect nest micro-climate conditions—specifically temperature, humidity, and moisture—in Crocodylus palustris nesting habitats at the Bhor Saidan Crocodile Breeding Centre.

Hypothesis

We hypothesize that wetlands dominated by native emergent macrophytes maintain more stable and optimal nest micro-climates (25–33°C; 60–80% relative humidity) compared to wetlands dominated by invasive floating vegetation, which may induce fluctuations detrimental to egg incubation success.

Methods

Data were collected from six nesting sites at Bhor Saidan over two consecutive breeding seasons (Feb–May 2023 and 2024). Each site was categorized based on dominant vegetation type: Emergent-dominated (Typha angustifolia, Phragmites karka, Cyperus rotundus), Floating-dominated (Eichhornia crassipes, Ipomoea aquatica), and Mixed vegetation sites.

Study Population:

The focal population consisted of 40 wild-nesting female Marsh Muggers monitored during both seasons. A total of 48 nests were tracked: 18 in emergent-dominated sites, 15 in floating-dominated sites, and 15 in mixed vegetation sites.

Outcomes:

Nest micro-climate parameters (temperature, humidity, soil moisture), vegetation metrics (percent cover, canopy height), and egg outcomes (hatchling success rate) were measured.

Statistical Analysis:

Data were analyzed using R software (v.4.3.2) with ANOVA, Tukey’s HSD, and Pearson’s correlation to assess differences and associations between vegetation type and nest outcomes.

Results

Mean nest temperature was stable in emergent-dominated sites (30.1 ± 1.3°C) compared to higher fluctuations in floating-dominated sites (peaking at 34°C) and mixed sites (31.2 ± 1.5°C). Humidity remained highest in emergent-dominated nests (74 ± 4%) and lowest in floating-dominated nests (58%), with soil moisture retention following a similar trend. Hatchling success rates were 78%, 52%, and 66% in emergent, floating, and mixed vegetation sites, respectively.

ANOVA indicated significant differences in micro-climate and hatchling success across vegetation types ($p < 0.05$).

Discussion

Vegetation composition strongly influenced nest micro-climates, supporting the hypothesis that emergent vegetation stabilizes temperature and humidity. This study aligns with global crocodilian literature but provides the first detailed evidence from North India’s semi-arid wetlands.

Limitations:

The study was limited to one breeding centre; wild riverine nesting sites were excluded. Occasional sensor malfunctions were managed through data interpolation.

Implications:

Controlling invasive floating vegetation and conserving emergent macrophytes can enhance nest conditions and improve hatchling survival, offering a low-cost conservation approach.

Conclusion

Wetland vegetation shifts from native emergent species to invasive floating weeds disrupt critical nest micro-climates for Marsh Muggers. Conservation strategies should prioritize maintaining emergent vegetation for stable incubation conditions, thus supporting species resilience under climate change pressures.

Declarations

Author Contribution

Anjali Garg (First Author): Conceived the study concept and research questions; designed the field methodology; collected and curated ecological and social data; carried out the statistical analysis; drafted the initial manuscript and prepared figures, tables, and supplementary materials.Dr. Navpreet Kaur (Corresponding Author): Provided overall supervision of the project; guided the study design and sampling strategy; advised on analytical approaches and interpretation of results; contributed substantially to manuscript revisions and refinement of the discussion; ensured compliance with ethical and permitting requirements; handled all correspondence with the journal.

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Figures

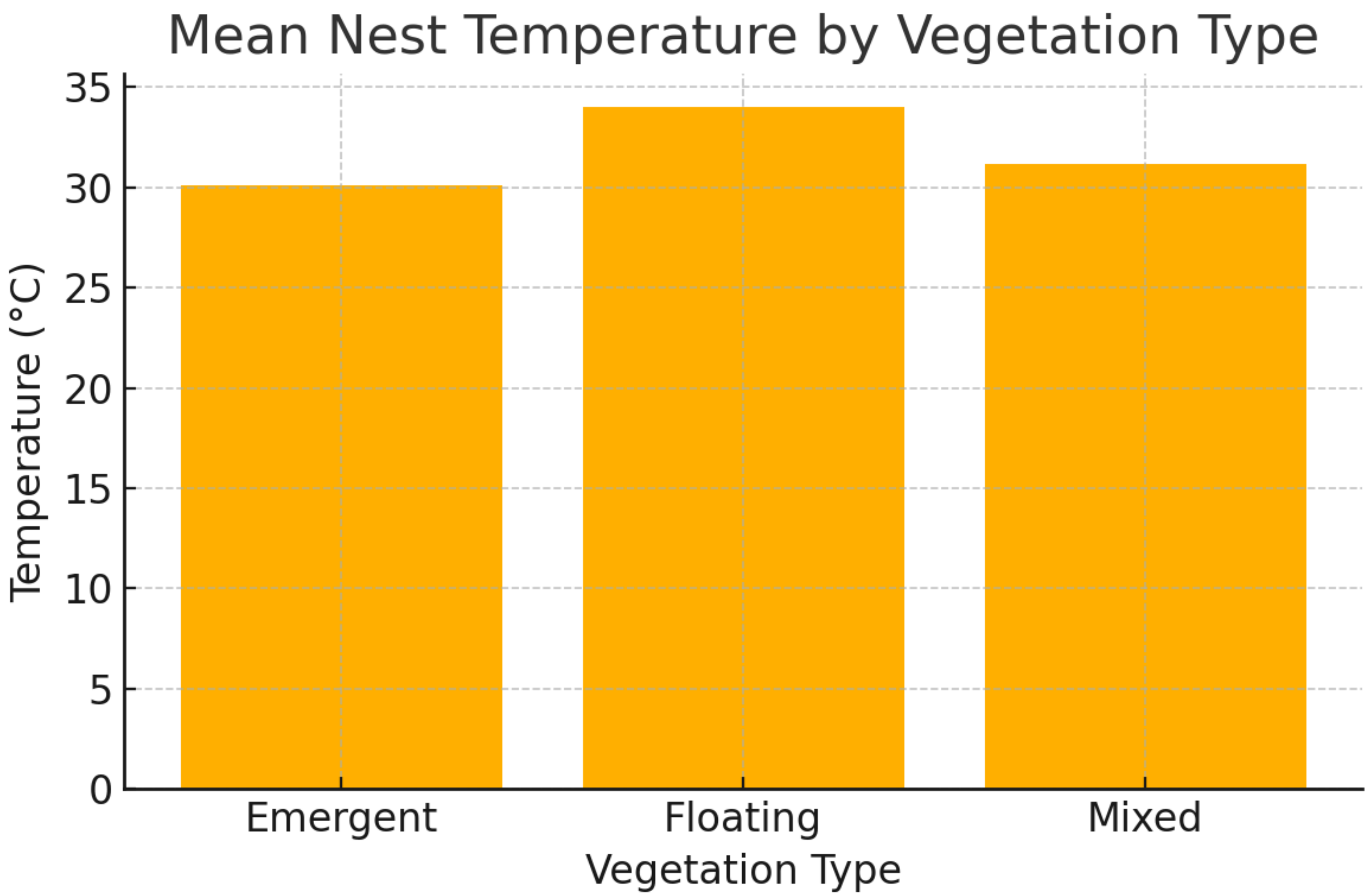

Figure 1

Mean Nest Temperature by Vegetation Type

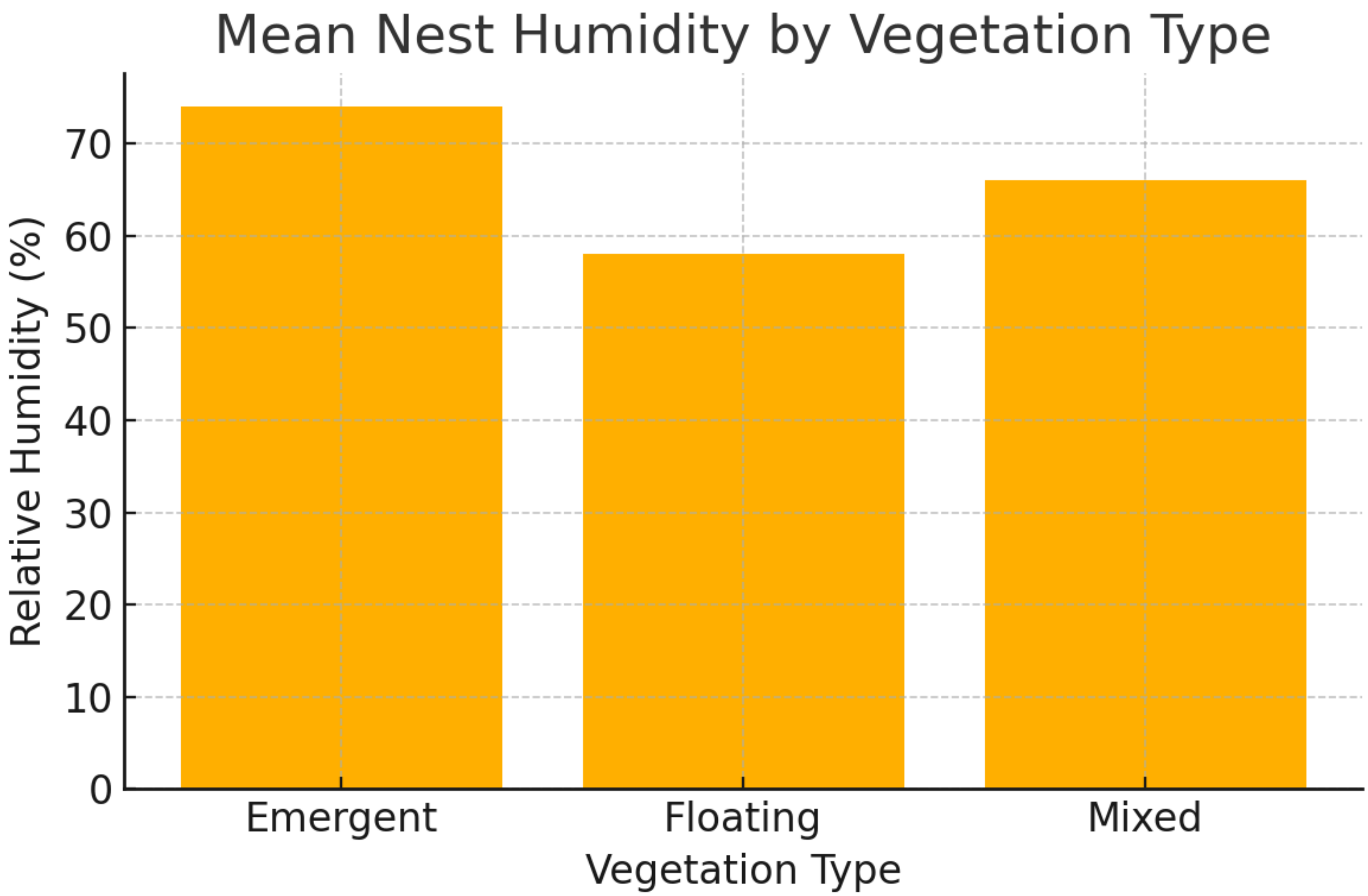

Figure 2

Mean Nest Humidity by Vegetation Type

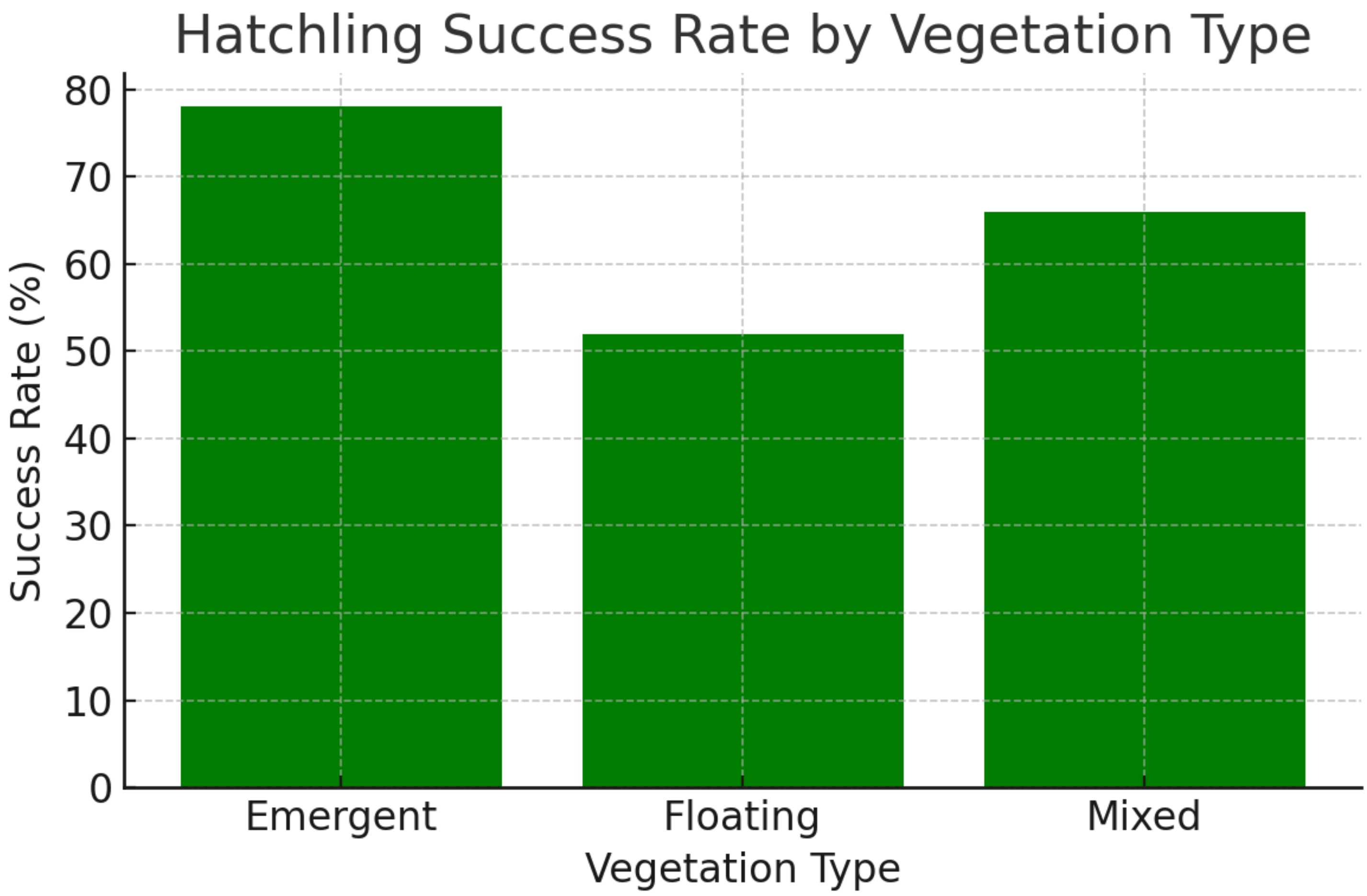

Figure 3

Hatchling Success Rate by Vegetation Type