Influence of hydrological fluctuations on vegetation and avifauna species abundance and diversity in Bahi Wetland, Tanzania

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Background

- Wetlands in Tanzania are classified into 3 categories according to their origins and land physiography (Mwanukuzi 2008):
  - *Coastal wetlands*: formed by wave action and tidal influence along the shoreline.
  - *Rift system wetlands*: rift depressions and are characterized by salt lakes with inland drainage.
  - *Wetland of the highlands drainage basins*: characterized by fertile alluvial soils of varying textures.

- Bahi wetland belongs to the internal drainage wetlands category. The wetlands in this category have internal drainage system, their annual rainfall <600 mm with high evaporation (URT 2003).

Importance of Bahi wetland in semi-arid Tanzania

Crop production

- contributes significantly to national rice production (Ngailo et al. 2002).

Production of water for human consumption

- Bahi wetland is centered between Dodom and Singida and supplies water for different domestic consumptions.

Tourism activities

- Bahi wetland is part of East African Flamingo-Habitat-Network
- Attracts tourists for bird viewing.

Fishing activities

- Famous for the production of Clarias and Tilapia which is major source of nutrients and income to local people (Bakobi 1993).

Rice production

Fishing

Tilapia

Clarias

Threats likely to face Bahi wetland

- Bahi wetland is threatened by plans for uranium mining being pushed forward by the Tanzanian Government and foreign investors.

- There is a serious risk that uranium mining would threaten the whole ecosystem by emissions of poisonous and radioactive gases, release of contaminated dust, which are dangerous to the wetland and biodiversity.

- Conflicts over water uses: villagers from Kitalo and Ngaiiti are in conflicts over water uses and cattle grazing (Ngailo et al. 2002).

Unsustainable use of wetland

- Bahi wetland is one of the wetlands which are not included in the Ramsar Convention and is a common property resource which can be used by anybody and sometimes subjected to unsustainable use.



Hydrological fluctuations of Bahi wetland

- Bahi wetland is influenced by surface and subsurface hydrological regimes due to:
    - Climatic changes
    - Daily human caused-disturbances.

- The dramatic hydrological fluctuations do not only affect wetland vegetation but also biodiversity including avifauna, fish, reptiles and invertebrates (Meryem 2005).

Hydrological fluctuations of Bahi wetland

- Given the extent of pressures on the hydrology of Bahi wetland and the need to provide relevant information for wetland management, research is necessary to develop integrated approaches for assessment of the influence of hydrological fluctuations on biodiversity to support conservation objectives.

- No study was conducted to determine the influence of hydrological fluctuations on vegetation and avifauna species composition, abundance and diversity.

- This study therefore assessed the influence of hydrological gradient on vegetation and avifauna species abundance, composition and diversity in Bahi wetland.

Site description

- Bahi wetland is situated in a Tropical East African semi-arid area btw latitudes 5^{o} 51' and to 6^{o} 16' South and longitudes 34^{o} 59' and 35^{o} 19‘ East.

- It experiences long dry season. Rainfall average <600 mm per annum.

- The total area of the wetland is 1250 km^2. The elevation of the wetland is about 800 m above sea level.

- Vegetation of Bahi wetland is a dominated by salt-tolerant grass species.

Vegetation of Bahi wetland

Leersia hexandra

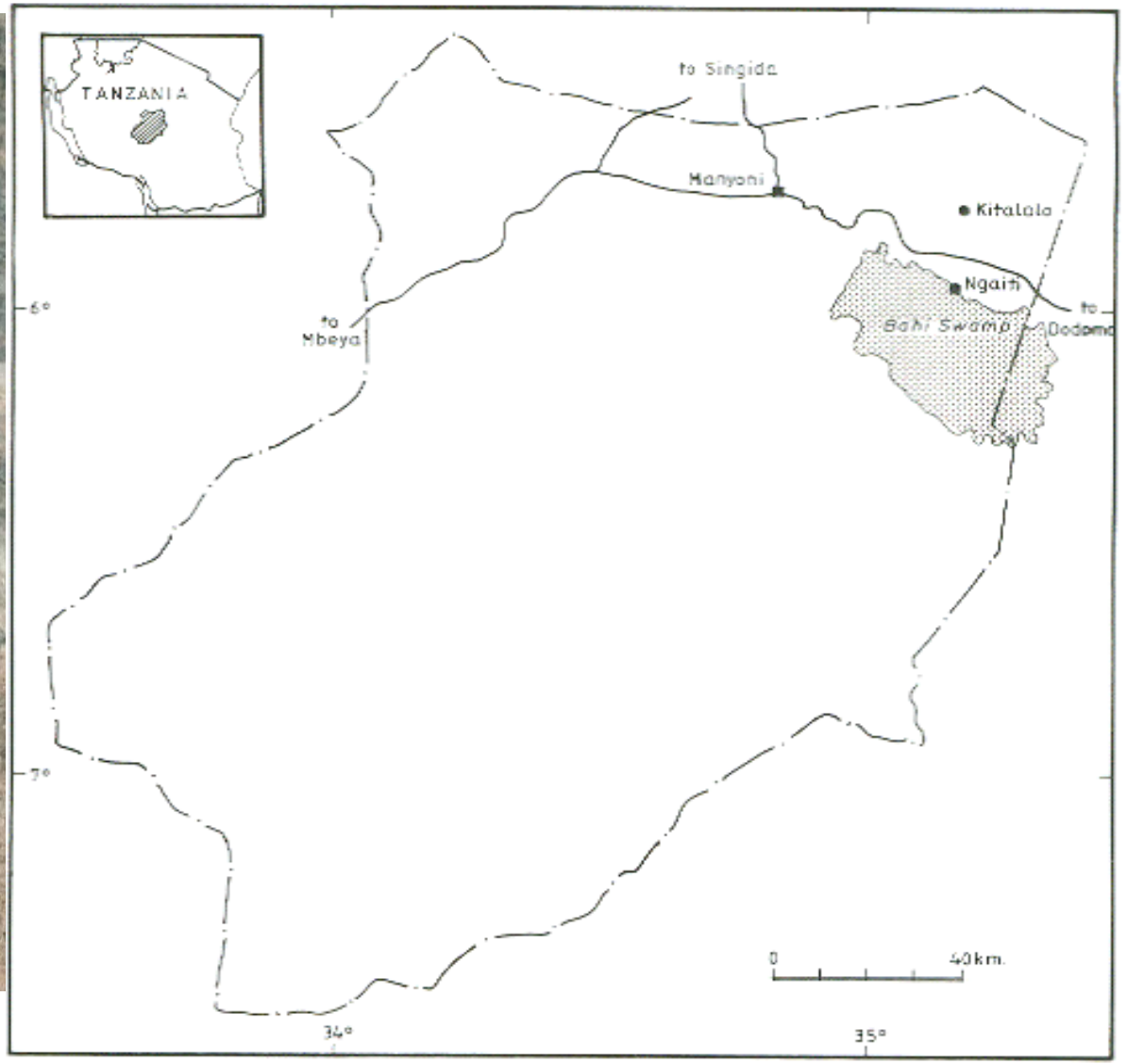
Sporobolus spicatus

Cynodon dactylon

Sedges

Reeds

Location of Bahi Wetland, Tanzania



Research Design

- Rectangular plots of 2m x 5m were established along the transect lines radiating from the wetland.

- Transects were established along 8 cardinal directions namely, North, North-East, West, North-West, East, South-East, South and South-West.

- The distance between plots was 115 m, the transect length was 1200 m to accommodate 10 plots each and making a total of 80 plots.

Sampling Technique for Vegetation

- Herbaceous plants were identified and their % cover estimated in 2m x 5m quadrants.

- Species abundance was recorded as the % cover of individual species in the plot (Bonham, 1989) using the following scales:
  - abundant 100-76%
  - common 75-51%
  - moderate 50- 26%
  - rare 25-1% cover
- The information collected on vegetation were analyzed for species composition, richness abundance and diversity.

Sampling Technique for Avifauna

- Point Count Technique: sampling points were established along transect lines with a minimum distance between points of 360 m.

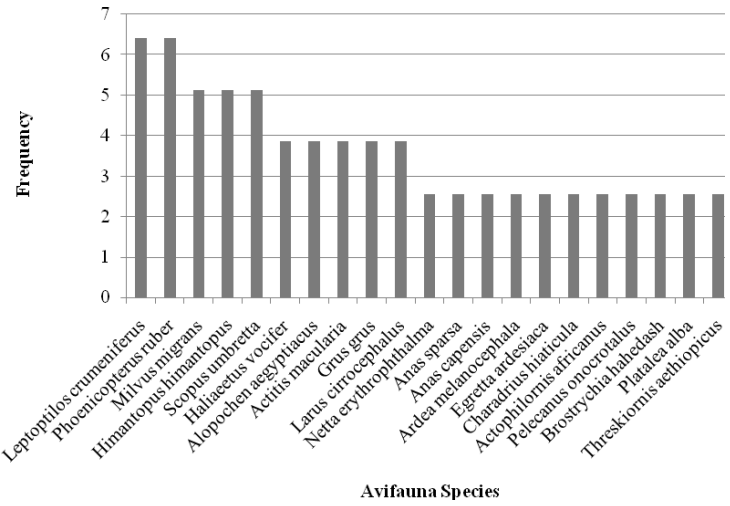
- A total of 24 points were established and birds were counted up to a fixed distance of 50 m in a concentric circle around one central position.

- All birds observed were identified and recorded. Signs of presence including nesting and vocalization were used. Local people's knowledge on the observed birds (Swarth 2003).

Key findings

Avifauna Species Composition and Richness

- A total of 42 resident and migrant avifauna species were identified.
- Greater Flamingo (*Phoenicopterus ruber*) and Marabou Stock (*Leptoptilos crumeniferus*) were the most sighted bird species.



Avifauna abundance

The most abundant resident and the distant migrant.

Egyptian Goose

Greater flamingoes

Sacred Ibis

Red Knobbed Coot

Knob Billed Duck

Spur Winged Goose

Hadada Ibis

Purple Heron

African Spoonbill

Little Grebe

Cape Teal

Long Tailed Cormorant

- Bahi wetland is of great significance for migratory birds.
- About 46% of the recorded bird species were migrant species, of which:

  - 69% were African migrants

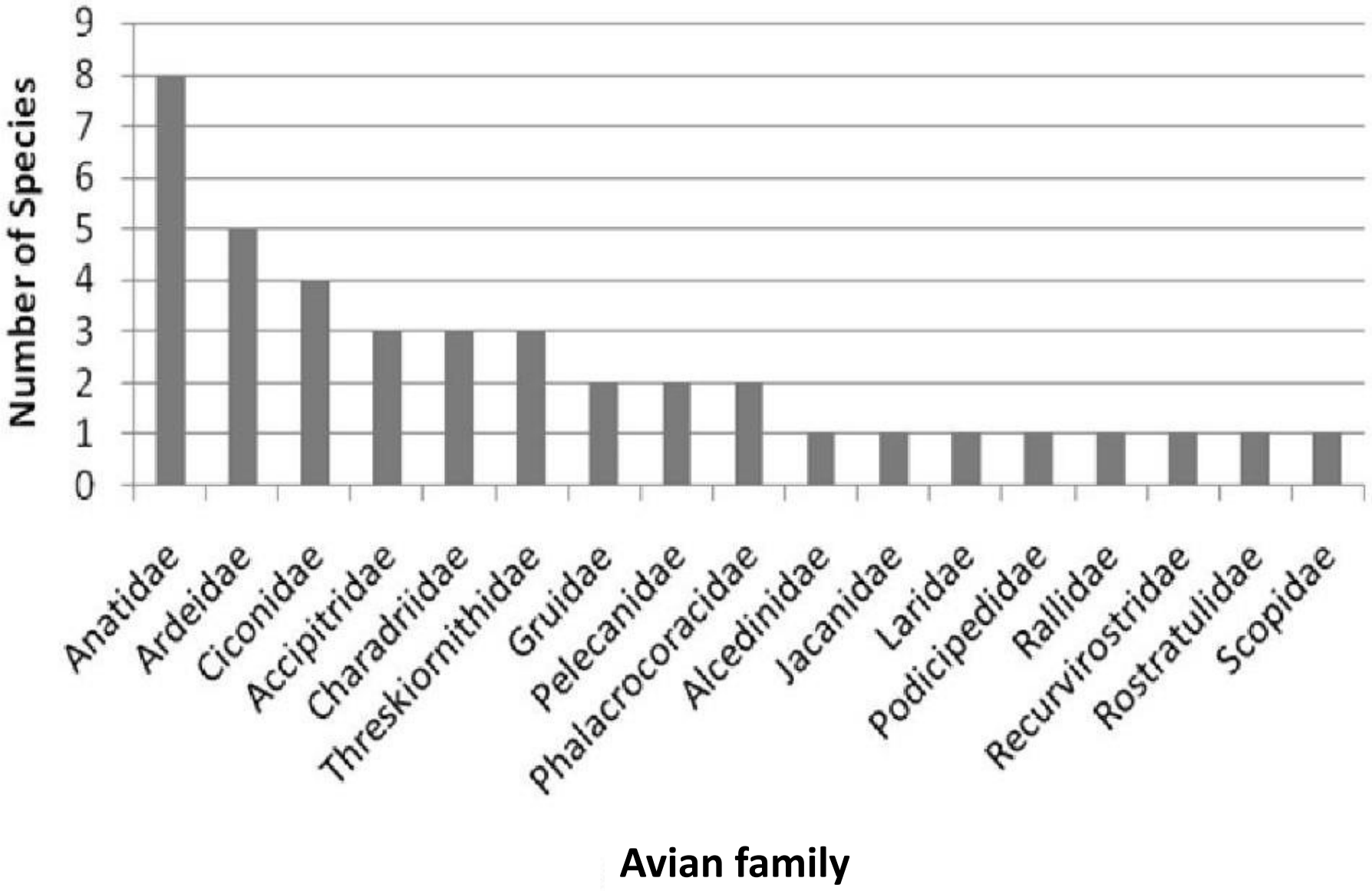
  - 31% were distant migrants from Asia and America.

European White Stork

Eurasian Marsh Harrier

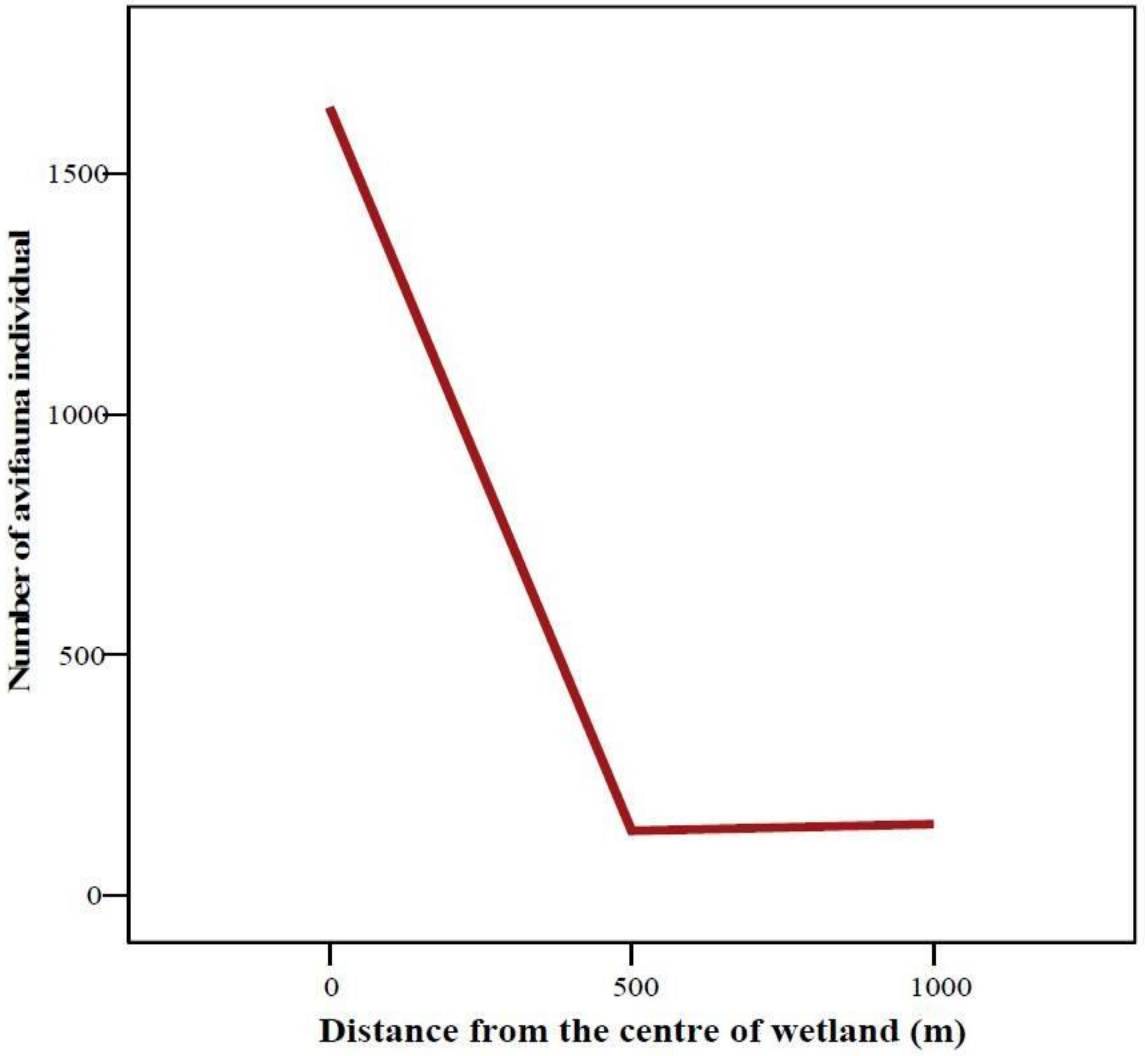
European Spoonbill

Avifauna families



Variation of birds abundance from the wetland

- Significant difference in birds abundance between distances from the centre of wetland ($p<0.05$).
- The highest number of both migrant and resident birds' abundance were recorded within 500 m from the centre of wetland.



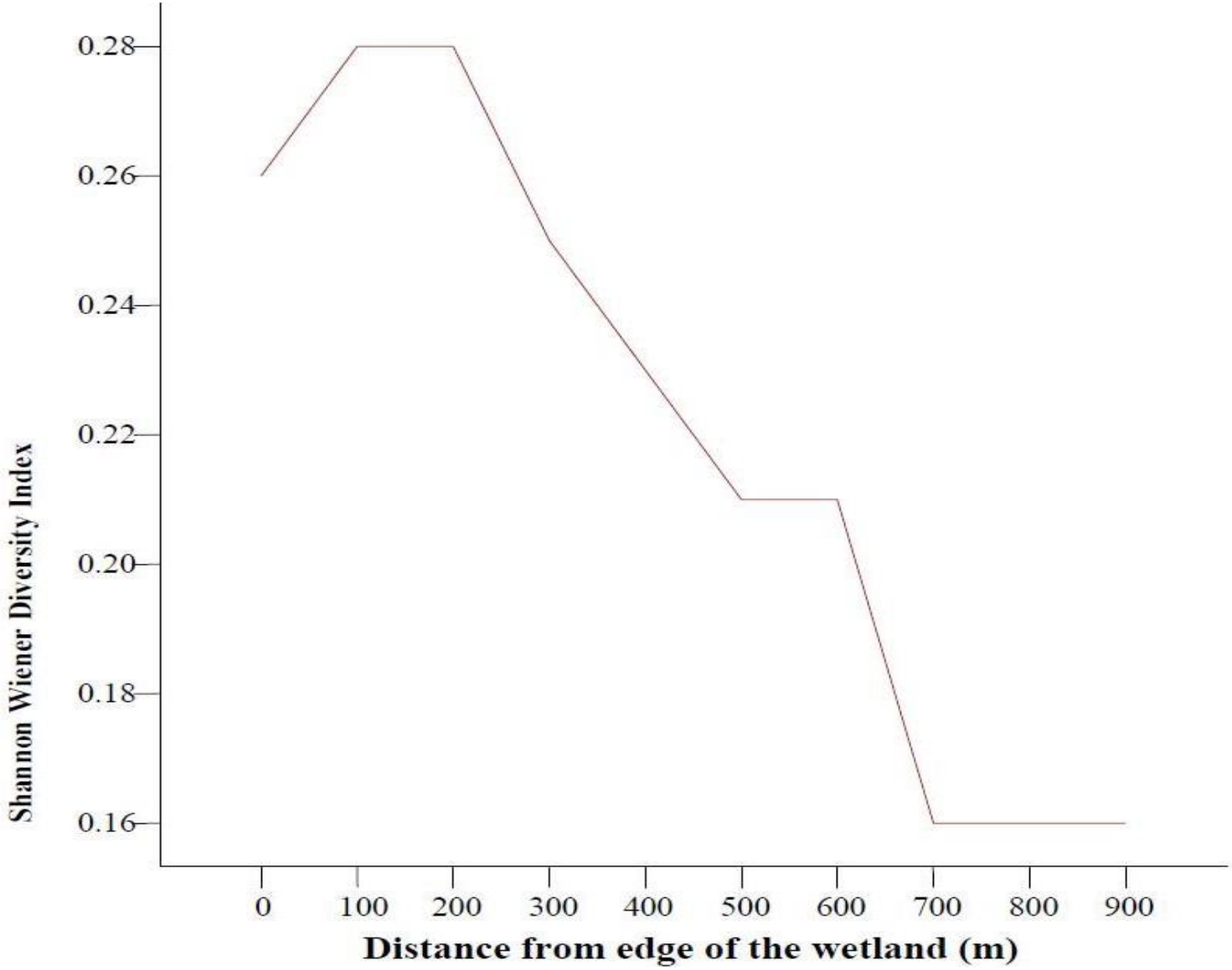
Changes in bird diversity along a hydrological gradient

- There was a significant different ($p<0.05$) in the bird species diversity along the hydrological gradient.

- Notable decrease in the numbers of both resident and migrant bird species from the centre of the wetland.

- Bird species diversity varied greatly in permanently and temporarily inundated areas, whereby the diversity was higher ($H' = 0.28$) at the centre of wetland, where inundation is permanent, and low ($H' = 0.16$) at 1000 m, where inundation is temporary.

Changes in bird species diversity along a hydrological gradient



Plant Species Composition and Abundance

- A total of 56 plant species belonging to 7 families were identified in Bahi wetland.

- Cyperaceae was the most dominant plant family with 47 species followed by family Graminae which had only 4 species Family Tamaricaceae, Cecropiaceae, Ceratophyllaceae, Nymphaeceae and Lemnaceae had only one plant species each.

Plant species composition along the hydrological gradients

- Plant species in seasonally inundated areas varied largely from those in permanent inundated areas.

- Species richness was higher closer to the edge of the wetland with more frequent inundation than in areas away from the wetland where inundation was less frequent.

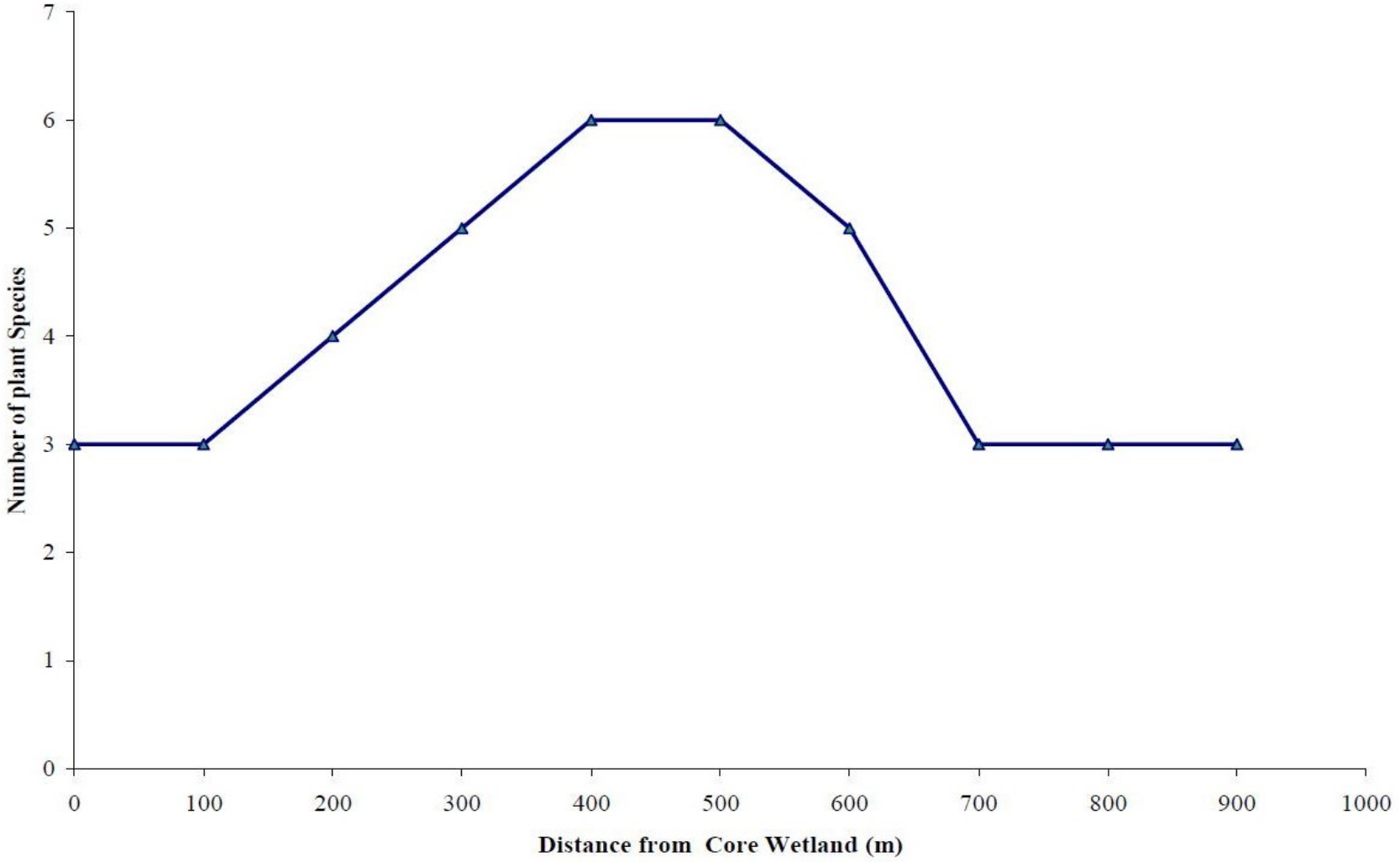
- The salinity and inundation conditions could be harsh to some plant species while favourable to others.

- However, there was a variation in the degree of resilience and tolerance of plant species against extreme salinity and inundations.

- E.g., some plant species were found in both temporary and permanently inundated areas such as *Sporobolus spicatus, Leersia hexandra*.

- Others were found only in permanently inundated areas such as *Cecropia insignis*, *Nymphaeae burtii* and *Ceratophyllum dermesum* and species of sedges belonging to the family Cyperaceae.

Change in plant species richness from the wetland

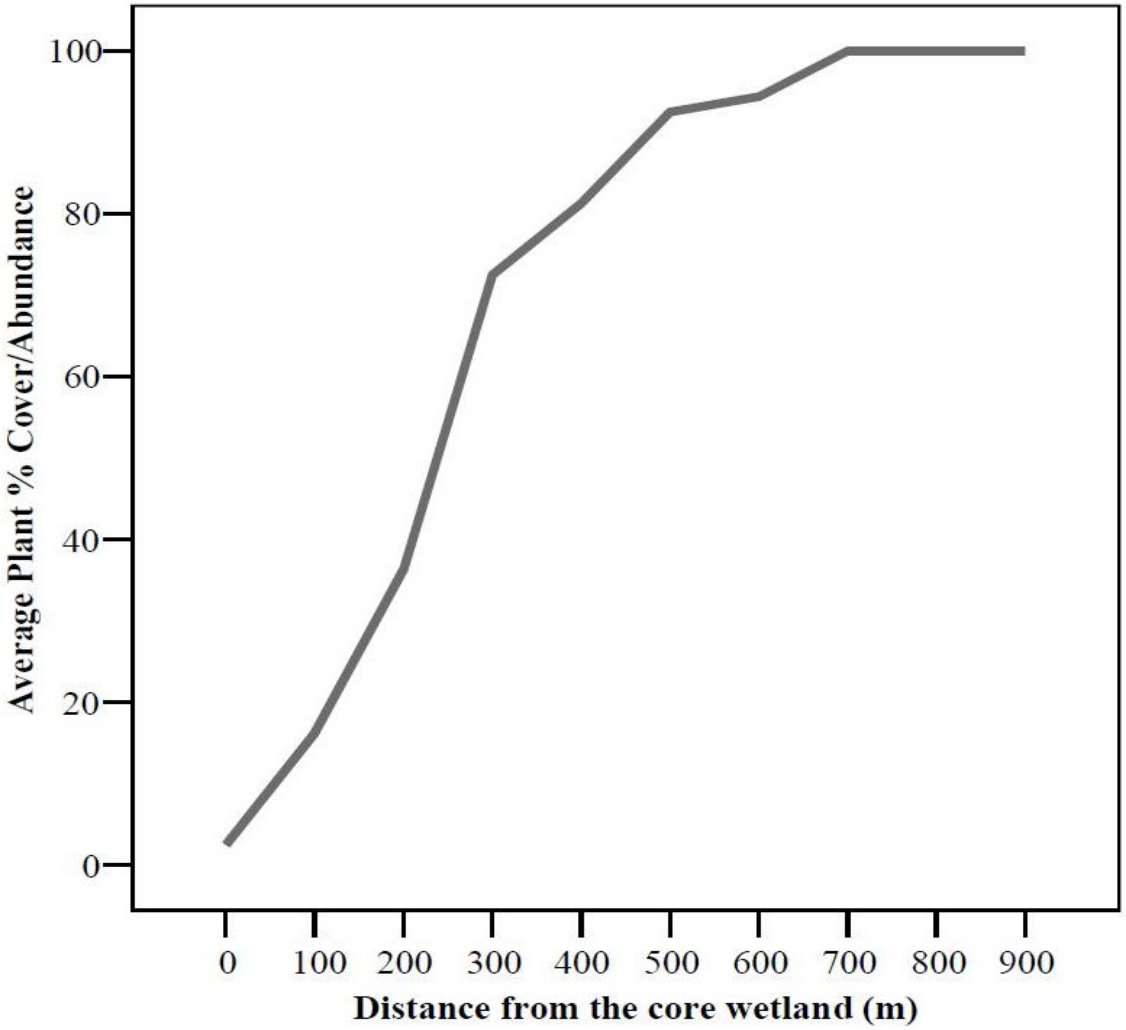


Plant species abundance along a hydrological gradient

- There was a remarkable variation in vegetation cover (abundance) in seasonally and permanently inundated areas among vegetation families depending on the type of plant species.

- Significant difference ($p<0.05$) between vegetation cover (abundance) and distance from the wetland.

Change in abundance of *Sporobolus spicatus* from the wetland

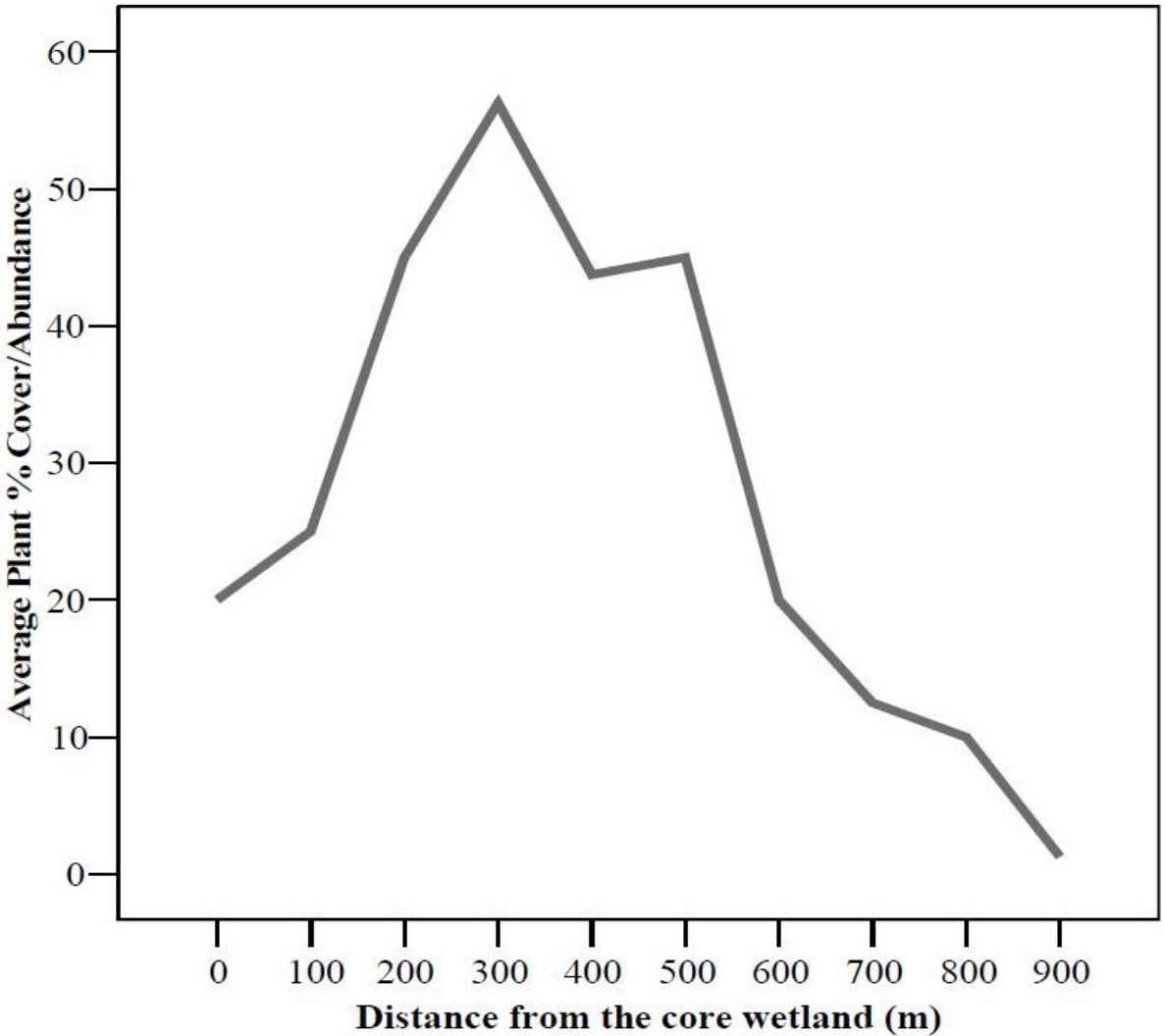


It was observed that *Sporobolus spicatus* cover/abundance increased from the core wetland towards temporary inundated areas as it is a facultative wetland species.

Sporobolus spicatus

Change in abundance of Cyperaceae from the wetland

The cover of different species of the Cyperaceae family increased from the wetland and attained its peak about 300 m.
Thereafter, the abundance decreased sharply
Considered to be obligate wetland species.

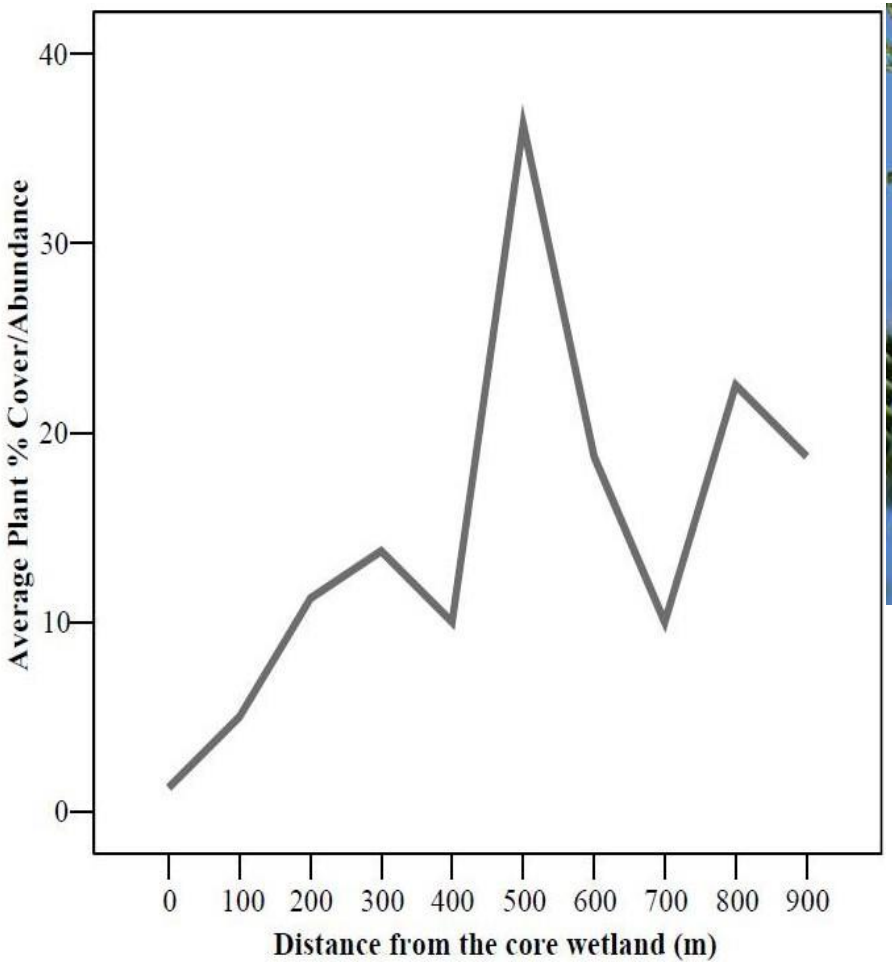


Change in abundance of *Tamarix nilotica* from centre of the wetland

Abundance of *Tamarix nilotica* increased to 500 m and declined sharply.

*C*onsidered to be a facultative perennial wetland species and occurs only in temporary inundated areas.

Its cover fluctuated due to water patches that varied irregularly with distance.



Tamarix nilotica

Change in abundance of *Cecropia insignis, Nymphaea burtii and Pistia stratiotes*

- % vegetation covers for *Cecropia insignis, Nymphaea burtii and Pistia stratiotes* declined sharply from the wetland.
- Considered obligate wetland plants or strict wetland plants and thus cannot tolerate drier conditions away from the wetland.

Cecropia insignis

Nymphaeae burtii

Pistia stratiotes

Change in abundance of *Ceratophyllum dermesum* and *Cynodon dactylon*

- *Ceratophyllum dermesum* and *Cynodon dactylon* % cover decreased constantly.

Ceratophyllum dermesum

Cynodon dactylon

Summary

- Water and zooplanktons are the main causes of high bird species abundance and diversity in permanently inundated areas of Bahi wetland.

- Migratory species highlight the importance of conserving Bahi wetland not only as a trans-boundary habitat and refuge but also as a breeding site for resident bird species.

- Human induced disturbance in temporarily inundated areas was a major contributing factor to the low diversity.

- Grazing, fishing and cultivation were observed to be the core development activities at the wetland but overgrazing had more negative impacts on vegetation.

RECOMMENDATIONS

Measures suggested for sustainable management of Bahi wetland:

(i) Preparation and implementation of a Integrated General Management Plan to conserve the wetland.

(ii) Afforestation as an important habitat improvement and conservation measure is important to avoid siltation of the wetland.

(iii) Adjacent communities need to be sensitized on the importance of conserving the wetland for its socio-ecological importance.

Thank you for your attention