GIS Digital Modeling Maps and Water Bird Conservation "Case Study Juliana Wetland Reservation, In the City of Benghazi"

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Abstract

Lake Juliana is one of the best locations in Libya for watching a variety of resident birds and migratory ones during the winter season. A number of conservation and societal issues require understanding how species are distributed on the landscape, yet ecologists are often faced with a lack of data to develop models at the resolution and extent desired. The aim of this paper was identifying and conserving critical bird habitat in urban wetlands by continuing the census of wintering water birds in Juliana digitally. Such a situation presented itself in our attempt to develop base models of water birds distribution. This statistical analysis of water birds species, using the Juliana Wetland as a halt area on their migration route between Europe and Africa, establishes its findings in accordance to the traditional international migratory water bird census of the protocol of IWC. The data was entered in Excel counts worksheet using the official IWC data submission form for national coordinators. A satellite map of the Juliana site stating the boundaries used for counting, GIS vector-based maps created using ArcInfo are layered such as the walking route covered during the counting as well as the GPS principal vantage points used for it. Then the survey presents results of three hours- observation of water birds, and a distribution of three foraging guilds in four geographical areas. All these details are kept in a file by the counter and an electronic format was submitted to the National Water birds count coordinator. The survey data will be used for advocating for the protection of enlisted endangered species in as far as the Mediterranean area is concerned.

Keywords: GIS Digital Modeling, Water birds, Juliana Wetland Reservation, Libya.

1. Introduction

Lake Juliana is one of the best locations in Libya for watching a variety of resident birds and migratory ones during the winter season. In fact more than 30% of the wintering birds in Libya have been observed specifically in the Juliana wetland [1]. Moreover, the fact that this site is in the vicinity of Benghazi city centre, gives Juliana a great potential for bird watching. In fact many of these environmental activities may attract the attention of youth and students who are interested in birds watching and wish to learn about it. Figure 1.

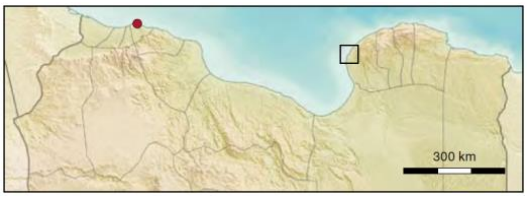

Figure 1. Study Area. 32° 05,567 N 20°03,777 E. Juliana wetland IWC boundary link: https://observation.org/user_area/info/33386

2. Applications of GIS in Bird Conservation

In recent years GIS has come to play an integral role in bird conservation, revolutionizing what we know about avian species and how we work to protect them. There are many applications of geospatial technology in bird conservation, ranging from equipment used in the field to technology used in an indoor lab setting. Satellite telemetry is a form of GIS technology that has allowed researchers to gain valuable insight into avian habitat use, migration routes, and wintering localities [2, 3].

GIS technology have reduced Transmitters that can be affixed to the bird in a number of fashions, including collar, backpack configuration, and wing tags, as well as implanted internally. In some cases the material affixing the transmitter to the exterior of the bird is designed to break down over time and eventually fall off [3].

Although innovations in technology have greatly reduced transmitter size, some Platform Transmitter Terminals PTT models may still not be suitable for certain species [4]. However, as technology advances and PTT size and weight continue to decrease, there will be more opportunities to safely track migratory birds.

Another form of GIS technology used extensively in bird conservation is digital maps. Many bird species in North America and around the world have experienced population declines throughout the past century. Loss of habitat in both wintering grounds and breeding grounds is seen by many scientists as the key culprit Hagan et al. (1992). Thus, bird conservation efforts often focus on identifying and conserving critical bird habitat. Digital maps are widely used to quantify vegetation cover and to assess habitat for wildlife use [5]. A review of the literature indicates that vector-based habitat maps created using ArcInfo or ArcView by Environmental Systems Research Institute (ESRI) Inc. are commonly used, as the maps can be layered with innumerable other datasets, creating an effective tool for analyzing spatially distributed habitat data. Typical GIS layers in a digital map may include land cover, topographic variables, human features, species distribution, nest sites, and water features. Information for dataset layers can be obtained for free from such national datasets as the National Land Cover Dataset (NLCD), National Elevation Dataset (NED), and the National Hydrography Dataset (NHD). International datasets are available for global conservation strategies as well. The Department of Defense's Digital Chart of the World provides 1:1,000,000 data on international hydrography, utilities, roads, boundaries, and land cover. [6]Weakland and Wood (2005) used digital habitat maps and statistical modeling to examine the affects of forest fragmentation on breeding Cerulean Warblers. The fragmentation, which was caused by mountaintop mining, was deemed to have a negative impact on the density of breeding birds.

The latest development in using GIS for bird conservation is the use of Pocket PCs that contain a coordinate system such as GPS, geospatial software such as ArcInfo, desktop software applications like Excel and Word, and audio equipment. [7] Stoleson et al. (2004) used Pocket PCs to conduct call-response surveys for Cerulean Warblers. While in the field, the authors were able to broadcast cerulean warbler songs through speakers attached directly to the Pocket PC, record georeferenced survey point locations and create attribute tables using the Pocket PC's ArcPad program by ESRI, and enter survey data directly into an excel spreadsheet. The authors found that Pocket PCs were relatively inexpensive, created more accurate and standardized data, were readily portable, and very efficient.

Few studies have incorporated wild birds into geographically explicit models. The aim of this paper was identifying and conserving critical bird habitat in urban wetlands by continuing the census of wintering water birds in Juliana digitally.

The objective of this paper was to develop 1 km resolution (1 km × 1 km) binary grid maps of habitat suitability for all species of water brids known to spend the winter or breed in Juliana. These base models would provide managers with data relevant to an array of conservation needs. As comprehensive nationwide water birds survey data were not available to apply newer techniques of species distribution modeling SDM, we took the initial step of mapping potential distributions (habitat suitability) by linking habitat relationships and environmental predictors in a geographic information system (GIS).

3.Method

The survey was principally focused on Juliana Wetland Reservation area (around 200 hectares located at the western entrance of Benghazi city), Visited on 27,28,31 January, 2018, 75% of the site was covered. Study area Coordinates 32° 05 North and 20°03 East. The survey was established through the traditional international migratory water birds census according to the protocol of IWC. iwc.wetlands.org. The data was entered in Excel counts worksheet using the official IWC data submission form for national coordinators.

The weather continues in the stability during the survey with a clear sky to a few clouds and the winds to moderate speed between 20 to 30 km temperature between 17 to 25 degrees.

The survey was run as follows:

- The survey was conducted in January 2018, when most birds where roosting and movement was minimal.
- In an early site visit to the Juliana lake, an on-foot-ground count was conducted on areas known for their suitable habitat based on previous recent historic records.

The ground count survey run its count on four geographical areas: a,b,c,and d of the Juliana Lake during the three named days Figure 2. It was important to divide the location into clearly visible areas from the selected GPS vantage points, without allowing any overlapping of the counted areas. Moreover, no parts of these areas were overlooked or missed [8].

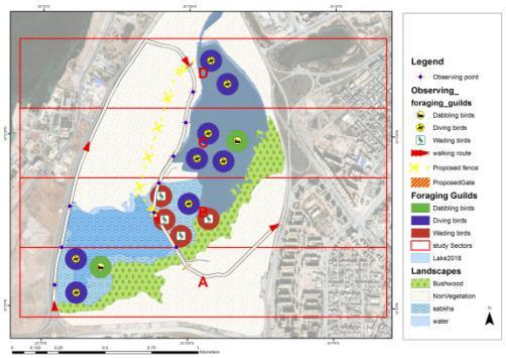

Figure 2. The ground count survey covered four geographical areas: a,b,c,d.

- One month prior to conducting the survey, the observer had completed the site inventory, instructions and record sheets.
- Counts were made within three hour periods to ensure that off-duty birds foraging , away from nest, are not missed.
- The site was systematically covered, by walking the same route as assigned in the map which was drawn for the purpose in the first instance. on each visit, there was a stopping interval every four hundred metres for scanning the area using binoculars and taking photos to count birds. Figure 3. Consideration had to be given to light conditions; birds are easier to see and observe with a light placed behind the observer. However one has to keep in mind the risk of disturbing the birds by one's presence.

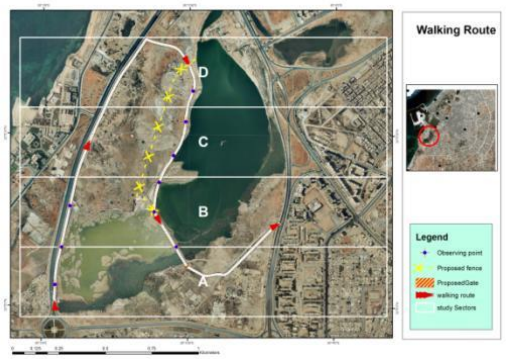

Figure 3. Walking route.

- Details of location, date, time, and observer (including contact details) are noted on a record sheet.
- Only fledged (flying) birds are counted in the total.

- Published report and updated Excel spreadsheet site list were forwarded to the national coordinators.
- Equipment: GPS, Binoculars 10x50, identification guide, camera Canon EOS 7D mark II, Canon D1100 Lens: Canon 75-300mm, notebook.

4.Discussion

This survey has been completed to date winter (2018). Around 1.236 migratory water birds were counted in the Juliana Wetland site. In This count 14 species of water birds were identified. It should be mentioned here that in the 2005 census [9], a total of 3,123 water birds of 40 species were counted in the Juliana Wetland. Table 1. gives a comparison of water birds counted in both surveys. High water level may well be the cause of disappearance of some waders and other types of birds in addition to the deterioration of the wildlife in this site.(See Figure 4).

Figure 4: Landscape in 2009 and 2018

Table 1. The table presents results of three hours- observation of water birds in the Juliana site on 27,28,31/Jan/2018. Distribution of water birds spices groups of three foraging guilds in areas A,B,C,D Juliana. 27,28,31/1/2018

OBJECTID	foraging guilds	TypeBirds	2018Number_B	ZoneArea	POINT_X	POINT_Y
1	Diving birds	LARMI Larus minutus Little Gull	1	D	111227.7399	3552682.686
2	Diving birds	Podiceps cristatus Great Crested Grebe	12	D	111316.2957	3552556.494
3	Diving birds	Phalacrocorax carbo Great Cormorant	8	C	111211.8649	3552290.572
4	Dabbling birds	Anas clypeata Northern Shoveler	33	C	111369.0277	3552250.885
5	Diving birds	Tachybaptus ruficollis Little Grebe	35	C	111151.5397	3552155.635
6	Diving birds	Podiceps nigricollis Black-necked Grebe	20	C	111294.415	3552141.347
7	Wading birds	Bubulcus ibis Cattle Egret	8	B	110959.4519	3551954.022
8	Wading birds	Ardea cinerea Grey Heron	8	B	110976.9144	3551827.021
9	Wading birds	Egretta garzetta Little Egret	27	B	111065.8146	3551739.709
10	Wading birds	EGRAL Egretta alba Great White Egret-HERON	8	B	111213.4524	3551831.784
11	Diving birds	Chlidonias hybridus Whiskered Tern	40	B	111107.0896	3551912.747
12	Dabbling birds	Aythya ferina Pochard	20	A	110632.4262	3551573.021
13	Diving birds	Larus ridibundus Black-headed Gull	1000	A	110500.6834	3551615.883
14	Diving birds	Fulica atra Common Coot	8	A	110502.2509	3551434.908

The majority of the counted water birds was of to three gull species reached 1041 birds. Avian abundance of 51 wadding species (Heron) was found in area B which is characterized by its mosaic landscape which displays varying water birds such as deep open water (diving birds), shallow open water (dabbling birds), mud flat (Wading birds) and nesting ground. Foraging guilds with

foraging techniques were used for the classification and representative species for each guild [10].

5.Results

The survey data will be used for advocacy purposes; it would particularly be useful in advocating for the protection of enlisted endangered species in as far as the Mediterranean area is concerned. Of these endangered species, we specifically name shorebirds such as summer nesting lesser crested Tern Sterna bengalensis and little tern Sterna albifrons.

Future counts should identify geographical mapping of differences in water birds population, trends and habitat field surveys. Hence, In the future there should be comparison of water birds counts in different surveys. Moreover, future work is needed for the proper management of the site and plans amendment for developing and deepening the lake. Otherwise, waders, other forms of bird species and wildlife in the site will disappear. Restoration of the reed beds at the southern bank of the lake is also a vital necessity for the feeding and nesting habitats for many bird species. Constructing gates and signs along the walking routs Figure 3 where illegal hunting shelters were taking place. See: Appendix 2 Juliana Wetland Reserve area and photos of existing conditions, Jan 2018. Fig 1. P 1.

6. Conclusion and Recommendations

The continuity of the well established methodology is particularly helpful in the next census. Results from bird counts are presented in a number of ways; the distribution maps was drawn, and the counted bird numbers were graphed and mapped within the specified areas of the Juliana lake.

The future counts should use a computerized geographic information system (GIS) to map water bird densities. (GIS) analyses will provide detailed water bird abundance and distribution information. Results can be compared to evaluate surveys and to design subsequent surveys to meet specific objectives. Density maps can be used as data layers for creating stratified survey designs and examining relationships between remotely sensed habitat data and water bird distribution.

In the future GIS can only continue to improve and enhance efforts in bird conservation. As

technology improves we will be able to safely track additional, smaller species of birds for longer periods of time using satellite telemetry. And as pixel resolution becomes finer, satellite images will be increasingly useful in creating habitat maps, as will digital orthophotos. Together these components of GIS will continue to help scientists better understand the needs of bird species throughout their ranges, and thus develop more effective management and conservation strategies for birds worldwide.

7. References

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8. Annexes - Photos

Winter waterbird survey volunteers of Jan 2018 Juliana, Benghazi.

DUCKS -AYTFE Aythya ferina Pochard, Area A

DUCKS -ANACL Anas clypeata Northern Shoveler. Area C

EGRAL Casmerodius albus Great White Egret. Area B

EGRGA Egretta garzetta Little Egret. Area B

PODNI Podiceps nigricollis Black-necked Grebe. Area C

TACRU Tachybaptus ruficollis Little Grebe. Area C

PODCR Podiceps cristatus Great Crested Grebe. Area D

Illegal hunting shelters

Proposed Signages

APPENDIX 1:

List of software and their application in this study

- observation.org: Linking and creating site boundaries.
- AutoCAD :Map production
- MS EXEL: Data exploratin
- ArcGIS: digital maps.

APPENDIX 2:

Datasets explored in this study

- Wintering waterbirds of Libya 2005-2012, format: PDF.
- Waterbirds name code 2010, format: EXEL.

APPENDIX 2:

- Winter waterbirds survey, Jan 2018, photos.
- Juliana wetland reserve area photos of existing conditions, Jan 2018.

Authors' contributions

HB conceived and designed the study. HB formatting the species distribution maps. MH developed the GIS data base, analyzed the data. HB wrote the paper. All authors read and approved the final manuscript.

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