**Journal of Researches in Agricultural Sciences**

**Journal of Researches in Agricultural Sciences Vol. 7**

**Journal of researches in Agricultural Sciences Vol. 7**



**©2019 Copyright Faculty of Agricultural Sciences Journal,**

 **Ekiti State University, Ado-Ekiti. Nigeria** Vol. 7(1), March 2019 pp 20- 29

**Comparative Assessment of the Avifauna Species Composition of the Beach Environment in Badagry-West Local Government, Lagos State.**

**Kolawole O.O.**

*Department of Leisure and Tourism, The Federal Polytechnic, Ilaro, Nigeria*

Email: olutope.kolawole@federalpolyilaro.edu.ng

**Abstract**

Anthropogenic pressures and threats to coastal ecosystems are on the increase in this 21 century and can only be halted through strategic conservation planning. This study examined the comparative assessment of the avifauna species composition of the beach environment in Badagry west local government using standard methods. Avian species diversities were calculated using the Shannon diversity index. The result indicates that the highest bird species in the study area is found in Suntan beach (51), among the 24 families recorded, the Family Ardeidae has the highest number of bird species (17) enumerated while, the following families Acrocephalidae, Alaudidae, Bucerotidae, Coliidae, Corvidae, Falconidae, Hirundinidae, Jacanidae, Muscicapidae, Nectariniidae, Phalaciocoras africanus, Ziconotide, Sternidae, and Sturnidae each has one bird species as the lowest families recorded in the study area. The status of the bird species in the study sites, resident bird species (R) are the highest (71%), followed by the Palearctic (P) (24%) and the lowest is the Intra African Migrants (M) (5%). Habitat specialization indicates that the wetland area has the highest (Forty) bird species, followed by the Understory strata layer with (Nine) while the Tall Emergent layer has the lowest (Seven) bird species. Shannon -H Diversity indices of Bird Species in both Dry and Wet seasons individual bird species were higher (281) in the Dry season than the wet season (13) and Shannon-H diversity indicates that dry season was higher (3.575) than a wet season (3.238). This is also higher in with another parameter. In conclusion bird species were higher in the dry season (56) than the wet season (39). The study provided a quantitative description of beach ecosystems in the study areas from which future ecological changes may be assessed, and it documented differences that exist between beaches in Badagry west local government, Lagos State

**Keywords:** Assessment, avifauna, Shannon diversity index, counting station, habitat, ecosystem,

Cite as: Kolawole O.O (2019). Comparative Assessment of the Avifauna Species Composition of the Beach Environment in Badagry-west Local Government, Lagos State. *Journal of Researches in Agricultural Sciences.* 7(1): 20- 29

**Introduction**

Coastal zone wetland areas are among the most threatened landscape features in the arid Middle Eastern countries. Wildlife-rich habitats such as intertidal lagoons and mangroves are spatially scarce and poorly studied. Stamatis Z. and Athanasios K. (2016). In several rapidly developing areas in this region, human-induced pressures seem to especially stress coastal zone habitats (Richer, 2009). Qatar is a good example of a country where industrial and housing development is occurring at an unprecedented rate along the coast, and biodiversity surveys are scarce and seldom systematically updated (Richer,2009, GSDP, 2009). The human population has boomed after industrial oil production, and landscape conservation awareness has only recently begun to influence protected-area policies (Richer, 2009, Sillitoe *et al.*, 2010). Anthropogenic pressures and threats to coastal ecosystems can only be rationally managed through strategic conservation planning, immediate site protection, and conservation measures. Biodiversity should be given utmost consideration, and certain indicator species groups, such as birds, may provide useful, practical guidelines for conservation planning (Bibby *et al.* 1998).

In areas lacking organized biodiversity inventories, rapid assessment procedures using birds can build biodiversity knowledge baselines (Bibby *et al.* 1998). In our case study, we conducted a rapid assessment of bird numbers and their habitat use in different habitat types during spring migration at Fuwairit, a small intertidal inlet system in Northern Qatar. To best depict bird habitat, use and preliminarily assess relevant biodiversity patterns, analyses were made at three levels of organization: habitat-based bird assemblage, food-centered ecological guild, and species residence status. It could be very essential to recognize the variety and structure of bird groups to explain the significance of local or neighborhood landscapes for avian conservation. Also, assessment of bird community has come to be an important device in biodiversity conservation for figuring out conservation actions in regions of excessive human pressure (Kremen, 1992; Safiq et al., 1997).

Most of the birds are aesthetically substantial to mankind and Bird-watching has become one of the most famous recreational sports across the world(Kronenberg, 2014; and has direct and indirect economic advantages through numerous resident programs regarding bird-watchers(Greenwood, 2007). Sekercioglu, C. (2002).

Birds recording performs massive roles in offering the baseline facts regarding the distribution of a selected species in a specific region and also provide useful information for identifying priority regions for conservation (Triviño et al. 2018). The diversity of birds is one of the most important ecological indicators to assess changes in the habitat, (Manjunath and Joshi, 2012). Birds are also the critical animal institutions of an atmosphere and numerous bird species maintain a nutrient level through their foraging ecology. Due to each herbal and anthropogenic disturbance inclusive of floods, drought, deforestation, change in land use, herbal resources, and seasonal climatic changes, the global diversity of birds is reducing continually (Chen et al., 2011). Although, habitat destruction is considered one of the main purposes of decreasing in chicken population. Most of the birds require specific habitats from season to season for nesting, foraging, roosting, and loss of such habitats may cause their extinction (Chaudharfi-Pachpande and Pejaver, 2016). Habitat alteration and indiscriminate destruction of herbal habitats by cutting off nesting trees and foraging plants are the foremost factors accountable for restriction in avian habitats. Sewell, S. R., and Catterall, C. P. (1998).

Numerous ornithological studies on diversity, and its status, have been carried out in different areas in Nigeria. .Taiwo, et al, (2011) recorded 10,180 individual birds that belong to 123 species and 51 families in Yankari Game Reserve wetlands. Out of the total number of species, 32 bird species belong to waterbirds and 91 bird species belong to terrestrial birds. Okosodo, et al, (2018) reported a total of sixteen (16) Ciconiiformes species belonging to three (4) families recorded in the Badagary creek of Lagos state. They recorded the following families *Ardeidae, Ciconiidae, Thresthiornithidae,* and *Scopidae*. Odewumi, (2017) recorded a total of 35 bird species belonging to 20 families and 10 orders were identified and recorded in Owena Multipurpose Dam, Ondo State, Southwest, Nigeria. Chapman, (2011) recorded 47 bird species belonging to 21 families and 10 orders in the fragmented deltaic formation located in the River Niger Delta and 80% of the bird species enumerated were of mangrove forest of the coastal environment

Badagry falls into the ecological zone of wetland soils and lies on the coast where inland water empties into the Atlantic Ocean. It has a geologic origin of deltaic basis and tidal flats (FADAMA, 2011). It is blessed with many Tourists attractions such as the slave trade zone, the first school in Nigeria, the first storey building and so on, The aim of this study, therefore, is to evaluate the species composition, relative abundance, and distribution of avifauna of the beach environment in Badagry west local government.

**Materials and Method**

**Study area**

Badagry is a coastal town and Local Government Area (LGA) in Lagos State, Nigeria. It is situated between the city of Lagos and the border with Benin at Seme. As of the preliminary 2006 census results, the municipality had a population of 241,093 (Federal Republic of Nigeria Official Gazette, 2007). The study areas selected in Lagos lie between 6 ̊46'' N and 2 ̊23'' E with an elevation of about 19ft at Badagry.

Badagry falls into the ecological zone of wetland soils and lies on the coast where inland water empties into the Atlantic Ocean. It has a geologic origin of deltaic basis and tidal flats (FADAMA, 2011). The natural vegetation is mangrove. The floras of the area consist of Rhizophora mangle and *Rhizophora racemosa* (otherwise referred to as red mangrove and black mangrove respectively). These two species are strongly zoned, with the former occupying areas closer to the water while the latter are in the upper reaches. Other species occurring to a lesser extent *include Avicennia Africana, Laguncularia racemosa*; plus, the palms Prodococcu water and *Ancistrophylum opacum.*



Fig. 1 Map of Badagry Greek area

**Source**: Lawson, *et al.,* (2010).

**Method**

The point count method as used by Okosodo *et al.,* (2016) was used. In this method counting stations or predefined spots were established in roosting sites, wetland and feeding sites as well as forest edges. Counting bands of 50 m radius were used for all the stations. The minimum distance between the two counting stations was 200 m. The number of counting stations was determined by the site size. On arrival at the sites, birds were allowed time to settle before recording all the birds seen or heard for a predetermined time (20 minutes). Bird calls were also recorded with a voice recorder and played back later for confirmation. Physical features of birds sighted but could not be identified immediately were taken and field guidebook of West African birds (Burrow and Demey, 2013) was used to identify the bird species within the study sites. Data on each site were collected for six months (3 months in the wet seasons and 3 months in the dry season from June 2016 to December 2017) on 8 days per month and twice a day from 07.00 – 10.00 hours and 16.00 – 18.00 hours. Bird species identified were categorized according to Burrow and Demey (2013) as follows:

**R**= resident;

**M**= intra-African migrant;

**P**= Palearctic migrant and

**V**= vagrant

These were derived from the seasonal occurrence of these birds in the study areas. Birds sighted in the wet season and not seen in the dry season as compared with a range map of West Africa birds guide as documented by (Burrow and Demey 2013).

**Data analysis**

From the data collected, avian species diversity was calculated using the Shannon diversity index,

(Usher, 1991) which is given as:

𝐻𝑖 = Σ𝑃𝑖 𝑙𝑛 𝑃𝑖

Where: Hi = diversity index

Pi = is the proportion of the *i*th species in the sample

InPi = is the natural logarithm of the species proportion**.**

**Result**

**Birds Species composition of the Study Area**

A total of fifty-six bird species belonging to 24 families and 10 orders were enumerated in the study areas with order Pelicaniformes having the highest order in the study areas. Fig. 2 below indicates the number of bird species that occurred in each study site. The highest bird species occurred in Suntan beach (51) while Asakpo beach has the lowest bird species recorded (44).

Fig 2: Number of bird species that occurred in each study site.

 Source: Field Survey 2018

**Family composition of Bird Species in the Study Areas**

A total of 24 families were recorded in the two selected sites (Fig. 3). The Family Ardeidae has the highest number of bird species (17) enumerated while the following families Acrocephalidae, Alaudidae, Bucerotidae, Coliidae, Corvidae, Falconidae, Hirundinidae, Jacanidae, Muscicapidae, Nectariniidae, *Phalaciocoras africanus*, Ziconotide, Sternidae, and Sturnidae each has one bird species as the lowest families recorded in the study area.

Fig 3 Bird Species Family composition in the Study Areas

Source: Field Survey 2018

**The status of the bird species in the study sites**

The status of the bird species in the study sites indicates that they are in different categories as

Shown in Figure 4 Resident bird species are the highest (71%), followed by the Palearctic (24%) and the lowest in the Intra African Migrants (5%).

Fig. 4: **Status of the Bird species in the study sites**

**Habitat specialization of Bird species in the Study Areas**

Habitat specialization in the study Areas indicates that the wetland area has the highest bird species of (40), this is followed by Understory strata layer with (9) bird species while the Tall Emergent layer has the lowest bird species of (7).

Fig. 5: Habitat Specialization of Bird Species in the Study area

**Source: Field survey 2018**

**Shannon –H Diversity indices of Bird Species in both Dry and Wet seasons.**

The Taxa of bird species in the Study Areas indicates that bird species were higher in the dry season (56) than the wet season (39). The result indicates that individual bird species were higher (281) in the Dry season than the wet season (13). Shannon-H diversity indicates that dry season was higher (3.575) than a wet season (3.238). This is also higher in with other parameters

Table 1: **Shannon –H Diversity indices of Bird Species in both Dry and Wet seasons.**

|  |
| --- |
| Diversity Index Dry Season Wet season |

Taxa\_S 56 39

Individuals 231 131

Dominance\_D 0.04661 0.06148

Shannon\_H 3.575 3.238

Evenness\_e^H/S 0.6376 0.6537

Menhinick 3.685 3.407

|  |
| --- |
|  |

**Discussion**

A total of fifty-six bird species belonging to 24 families and 10 Orders were enumerated in the study areas and most bird species enumerated are species that utilized mangrove and freshwater swamps in the coastal areas. Examples of such species are Common Tern (*Sterna hirundo),* Common Snipe (*Gallinago gallinago*), Common Sandpiper (*Actitis hypoleucos*), Black Headed Heron (*Ardea melanocephala*) and Black Heron (*Egretta ardesiaca* ) and others. This finding is consistent with Zakaria et al, (2009) reported that wetland bird species are adapted to a semi-aquatic life, being important components of aquatic ecosystems. He further stated that they spend their lives around water that provides food which consists of insects, worms, snails, amphibians, toads, lizards, snakes, mice, and fish (Okosodo and Kolawole, (2018) reported that wetlands are known for their abundance of birds. He further stated that the use of wetlands and their resources is widespread among many diverse bird taxa of the world, avian adaptation to utilize wetlands, and other aquatic systems are diverse and include anatomical, morphological, and behavioral changes. This finding is consistent with Taiwo, et al, (2011) who recorded 10,180 individual birds that belong to 123 species and 51 families in Yankari Game Reserve wetlands. Out of the total number of species, 32 bird species belong to waterbirds (4673 detections; 26.83%) and 91 bird species belong to terrestrial birds (5507 detections; 73.12%). Okosodo, et al, (2018) who reported a total of sixteen (16) Ciconiiformes species belonging to three (4) families recorded in the Badagary creek of Lagos state. They recorded the following families *Ardeidae, Ciconiidae, Thresthiornithidae,* and *Scopidae* which are similar to those recorded in this research study. Odewumi, (2017) recorded a total of 35 bird species belonging to 20 families and 10 orders were identified and recorded in Owena Multipurpose Dam, Ondo State, Southwest, Nigeria. The common species they encountered includes Great egret (*Ardea alba*), Spur-winged lapwing (*Vanellus spinosus*), Grey heron (*Ardea cinerea),* Great cormorant (*Phalacrocorax carbo*), Black Kite (*Milvus migrans*), Squacco heron (*Ardeola ralloides*), African jacana (*Actophilornis africanus),* Long-Tailed Cormorant *(Microcarbo africanus)* and Cattle egret *(Bubulcus ibis)* which are similarly recorded in the coastal area of Lagos state. Chapman, (2011) recorded 47 bird species belonging to 21 families and 10 orders in the fragmented deltaic formation located in the River Niger Delta and 80% of the bird species enumerated were of mangrove forest of coastal environment The result of Shannon-H diversity indicates that dry season was higher (3.575) than a wet season (3.238) these findings are supported by Okosodo, et al, (2018) who reported that the Shannon-H diversity for *Ciconiiformes* species was higher in the wet season (2.257) was higher than the dry season (2.153). The finding in this research study is also supported by these authors. MacArthur (2001) reported that diversity increases with the number of layers in the vegetation. Pearson (2001) reported that tropical wet evergreen forests support more rare bird species than other habitats. Manu (2000) reported that birds select vegetation variables according to how an individual habitat affects access to food, mates, or vulnerability to predators. The result of the habitat specialization indicates that most of the bird species were hydrophanous species. This finding is consistent with Zakaria et al. (2010) who reported that wetland bird species are adapted to a semi-aquatic life, being important components of aquatic ecosystems. He further stated that they spend their lives around water that provides food which consists of insects, worms, snails, amphibians, toads, lizards, snakes, mice, and fish. Ezealor, (2002) reported that wetlands are known for their abundance of birds. He stated further that the use of wetlands and their resources is widespread among many diverse bird taxa of the world, avian adaptation to utilize wetlands, and other aquatic systems are diverse and include anatomical, morphological, and behavioral changes. Anatomically, they include designs for diving and swimming, such as body compression to increase gravity, or adaptation for plunge-diving from great heights.

Most bird species were encountered in areas with a higher percentage of tree density increase than the ground cover. This observation indicated that some wetland birds used the trees as a roosting site. This was observed with some species such as the Egrets, Ibises, Herons, and Storks. These species were found during the survey on the bare ground feeding on the mudflats fish and another vertebrate. These findings are supported by (Huston 2011) who reported that habitat has long been used as a predictor of bird species abundance, and each variety of birds has developed different preferences for habitat. Also agrees with (Cody, 1999) who reported that birds select vegetation variables according to how an individual habitat affects access to food, mates, or its vulnerability to predators This observation also suggests that the wetland bird species may be affected by quality and quantity of food. Vegetarian birds (folivores) like white-faced whistling duck will be affected by the quality of the vegetation as it was observed during this study. Birds were found on the vegetation on the water, observed during the study, also the spur-winged lapwing found on the lakeshore scattered. The jacanas were observed in the vegetated part of the lake in the three sites and the same for the lily trotters. The bird species found in wetlands need specific areas to carry out reproductive activities especially nesting sites (Hansen et al., 2008). This also supported (Moorcroft, et al, 2006) in his research that the species composition of a specific area is inter-linked to the available resources in the area which includes physical structures of the habitat, food availability, and biotic factors.

**Conclusion**

The study provided a quantitative description of beach ecosystems in the study areas from which future ecological changes may be assessed, and it documented differences that exist between beaches in Badagry west local government, Lagos State

**Recommendation**

Human activities such as deforestation, soil excavation, industrialization, and human settlement should be logically planned so as not to affect the flora and fauna in the coastal areas where the beaches are located. These resources must be managed sustainably by always protecting ecological integrity. Coastal development and management plans should be adopted to ensure the protection of the ecosystem. There are needs for initiation of education and awareness programme targeted at children and the youth, stressing the direct and indirect values of beach tourism and the scientific basis of traditional conservation method at protecting the beaches ecosystem

**Reference**

Abegunde M. A. A. (2002). Aspect of the Physical Environment of Lagos. In History and People of Lagos state. (A. Adefuye, B. Agiri and J. Osuntokun, eds), 6-15.

Bibby,C.J., Burgess,N., Mustoe,S.H. and Hill,D.A. (2000). *Bird Census Techniques*. London Academic Press

BirdLife International (2000) Threatened birds of the world. Lynx Edicions and Birdlife International, Barcelona and Cambridge, UK

 Borrow, N. and Demey R. (2012). *“A guide to the birds of western Africa*”. Princeton University Press

Chaudhari-Pachpande, S. and Pejaver, M. K. 2016. A preliminary study on the birds of Thane Creek, Maharashtra, India. Journal of Threatened Taxa 8(5): 8797-8803 http://dx.doi.org/10.11609/jott.2397.8.5.8797-8803

Chen, I. C., Hill, J. K., Ohlemüller, R., Roy, D. B. and Thomas, C. D. 2011. Rapid range shifts of species associated with high levels of climate warming. Science 333: 1024-1026

Cody ,M.L.(1999 ) An introduction in habitat selection in birds. *In* Habitat selection in birds (Cody ed.) Academic Press Inc. London pp 191-248. doi:10.1007/s00267- 014-0317-8

Ezealor A. U. ed. (2002) *Critical sites for conservation in Nigeria*. Nigerian Conservation Foundation, Lagos, Nigeria

F. 2002. Disappearance of insectivorous birds from tropical forest fragments.

Greenwood, J. J. D. 2007. Citizens, science and bird conservation. *Journal of Ornithology*  148:S77–S124. doi:10.1007/s10336-007-0239-9

GSDP 2009. Qatar National Vision 2030: Advancing Sustainable Development, Qatar's Second Human Development Report. Doha, Qatar: General Secretariat for Development Planning.

Hansen, M.C., Stehman, S.V., Potapov, P.V., Loveland, T.R., Townshend, J.R.G., DeFries, R.S., Pittman, K.W., Arunarwati, B., Stolle, F., Steininger, M.K., Carroll, M. (2008). http://dx.doi.org/10.11609/jott.2397.8.5.8797-8803

Humid tropical forest clearing from 2000 to 2005 quantified by using multi temporal and Multi resolution remotely sensed data. Proceedings of the National Academy of Sciences of the United States of America 105: 9439-9444.

Kremen, C. 1992. Assessing the indicator properties of the species assemblages for natural areas monitoring. Ecological Applications 2: 203-217

Kronenberg, J. (2014). Environmental Impacts of the Use of Ecosystem Services: Case Study of Bird watching.Environmental management. 54:617-630 10.1007/s00267-014-0317-8.

Lagos State Handbook (1987). A Publication of the Ministry of Information and Culture,

Lawson, E.O., Akintola, S.O. and Olatunde, O.A.(2010). Aspects of the Biology of Sickle fin mullet, Liza falcipinnis (Valenciennes, 1836) from Badagry creek, Lagos, Nigeria. Nature and Science, 8(11): 168-182. ISSN: 1545-0740.

MacArthur R. H. and MacArthur J. W. (2001). On bird species diversity. Ecology 42, 594 -598.

Manu, S.A., (2000) Effects of habitat fragmentation on the distribution of forest birds in south western Nigeria with particular reference to the Ibadan Malimbes and other Malimbes, PhD thesis. University of Oxford.

Moorcroft,D ., Whittingham,M.J., Bradbury,R.B. and Wilson,J.D. 2006. The selection of stubble fields by wintering granivorous birds reflects vegetation cover and food abundance. *Journal of Applied Ecology* 39, 535-547

Odewumi OS Okosodo EF and Talabi O. (2017) Diversity and Abundance of Avian Species of Owena Multipurpose Dam, Ondo State, Southwest, Nigeria. *Journal of Biodiversity, Bioprospecting J and Development*,Vol 4 (1) 180- 186

Okosodo, E. F., O. O. Kolawole (2018). Bird Species Richness and Diversity in Armyworms Infested Maize Plots in Olabel Farms, Southwestern Nigeria. Agricultural Extension

Okosodo, E.F. O. S. Odewumi, O. O. Kolawole (2018).Diversity and Richness of *Ciconiiform* Species in Badagry Wetland Southwestern Nigeria. *Agricultural Extension Journal 2(2):*

Richer, R.A. 2009. Conservation in Qatar: Impact of increasing industrialization. Center for International and Regional Studies, Occasional Paper Series (Updated and reprinted), Georgetown University, Doha, Qatar

Sekercioglu, C. H., Ehrlich, P. R., Daily, G. C., Aygen, D., Goehring, D. and Sandi, R. F. 2002. Disappearance of insectivorous birds from tropical forest fragments. Proceedings of the National Academy of Sciences USA 99: 2 63-267

Sekercioglu, Cagan. (2002). Impacts of birdwatching on human and avian communities. Environmental Conservation. 29. 282-289. 10.1017/S0376892902000206.

Sewell, S. R. and Catterall, C. P. (1998). Bushland modification and styles of urban development: their effects on birds in south-east Queensland. Wildlife Research25: 41-63. 37 Shafiq, T., Javed, S. and Khan, J. A. 1997. Bird community structure of middle altitude oak forest in Kumaon Himalayas, India: a preliminary investigation. International *Journal of Ecology and Environmental Science* 23: 389-400

Sillitoe, P., Alshawi, A.A., Al-Amir Hassan, A. K. 2010. Challenges to conservation: Land use change and local participation in the Al Reem Biosphere Reserve, West Qatar. *Journal of Ethnobiology and Ethnomedicine* 6 (28): 1–31.

[Stamatis Z](https://journals.sagepub.com/doi/10.1177/194008291600900207?icid=int.sj-full-text.similar-articles.3) and [Athanasios K](https://journals.sagepub.com/doi/10.1177/194008291600900207?icid=int.sj-full-text.similar-articles.3) (2016) Coastal Zone Habitat-Use by Birds in Qatar: Insights from a Rapid Assessment Method during Spring Migration <https://doi.org/10.1177/194008291600900207>

[Stamatis Zogaris](https://journals.sagepub.com/doi/10.1177/194008291600900207?icid=int.sj-full-text.similar-articles.3)\*, [Athanasios Kallimanis](https://journals.sagepub.com/doi/10.1177/194008291600900207?icid=int.sj-full-text.similar-articles.3)2016 Coastal Zone Habitat-Use by Birds in Qatar: Insights from a Rapid Assessment Method During Spring Migration *journal of tropical conservation science* <https://doi.org/10.1177/194008291600900207>

Taiwo, C . O . , Joseph, D. l. O . , Talatu ,T , Shiiwua, M . and Ulf ,T..( 2011) Density and diversity of birds in the wetlands of Yankari Game Reserve, Bauchi, Nigeria. *Journal of Wetlands Ecology. Volume (5) 48-59*

Thane Creek, Maharashtra, India. Journal of Threatened Taxa 8(5): 8797-8803

Triviño, M., Kujala, H., Araújo, M., Cabeza, M. (2018). Planning for the future: identifying conservation priority areas for Iberian birds under climate change. Landscape Ecology. 33. 10.1007/s10980-018-0626-

Zakaria M, Rajpar MN, Sajap AS. 2009. Species diversity and feeding guilds of birds in paya indah wetland reserve, peninsular Malaysian International Journal of Zoological Research, 5:86-100

Zakaria M. Rajpar MN 2010. Density and diversity of water birds and terrestrial birds at PayaIndah Wetland Reserve, Selangor Penisular Malaysia. Journal of Biological Sciences 10 (7):658-666.