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Review

## PARAMOUNT ROLES OF RIPARIAN VEGETATION IN CONSERVATION OF BIRD SPECIES

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### Abstract

*Riparian vegetation can be defined as plant growing at the edge of natural water bodies such as stream, river or lake. The interface between the land and natural water bodies can be described as a riparian area or riparian zone. The over-all indicators of riparian areas: vegetation, soil and water. Some benefits of riparian ecosystem include: gathering of contaminants, sediment and mineral elements, strengthening of waterway, regulation of Water overflow, leisure and beautification of the environment and habitat for bird species. Habitat quality in avian species can be measured using parameters such as suitable habitat and marginal habitat. Bird needs habitat for food, shelter, and escape from predators, breeding and mating. All known riparian vegetation carries out functions that are the close in nature and ecological features. Some of the basic necessities of bird species are: Food, water, shelter and nesting sites. Riparian areas permit energy flow, recycling of minerals elements and water, hydrologic function, and sustenance of plant and animal population. All the aforementioned roles make riparian vegetation to be irreplaceable compared to adjoining landscape. Apart from that, it provides food, water, shelter and nesting sites for avian species. Susceptibility and the ease of riparian zones becoming degraded is very high due to its sensitive nature as a bioindicator coupled with pressure from anthropogenic activities. Hence, destruction may arise from unrestrained access to livestock, clean clearing for farming, urbanization, and road and dam construction. In order to guarantee long-standing sustainability in avian conservation, riparian health should be put into consideration, by managing livestock adequately. Fencing should be adopted to restrict livestock access to riparian areas. Restoration of indigenous floras should be promoted and afforestation and control of unwanted plants should be adopted. Diverse stratum of floras should be encouraged in any riparian vegetation for example, canopy, understory and groundcovers.*

**Keywords:** bird species; anthropogenic activities; riparian vegetation; habitat loss; agriculture; hydrology

### INTRODUCTION

Riparian vegetation can be defined as plant growing at the edge of natural water bodies such as stream, river or lake. The interface between the land and natural water bodies can be described as a riparian area or riparian zone. The vegetation has a unique ability to grow lengthwise in relation to the banks of watercourse spreading along the floodplain at both edges. This can further be described as fringing vegetation of which evolving aquatic plants developing at the

boundaries of canals of natural water bodies are inclusive. However, other components of riparian vegetation are plants covering the soil, trees and shrubs. Riparian bionetworks have a good ability to serve as a buffer in the middle of aquatic bionetworks and contributes to gathering of water. In addition, it also controls the quality of water available to wildlife species (Huh, 2017).

In a very simple language, all land occurring between water channels and natural water bodies such as river, stream and lake can be described as riparian areas for instance

streambanks and flood plains. Strong variation exists between riparian areas and the immediate environments due to exclusive soil and vegetation features which is a function of availability of water all year round (Ramey and Richardson, 2017). The presence of fertile soil and water supply influence the growth of green plant in such areas. Apart from that, the rate of soil formation is very rapid in the aforementioned areas coupled with increase in soil fertility due to continuous falling and decay of leaves. This paper aims to discuss the roles riparian vegetation play in the conservation of bird species using theoretical and empirical evidence provided in different literature and its influence on the survival and conservation of bird species.

### Indicators of Riparian Areas

Riparian indicators can be described as biotic and abiotic factors used to appraise the health condition of a riparian areas. Macfarlane *et al.* (2017), listed the following as over-all indicators of riparian areas: vegetation, soil and water.

- **Vegetation**

There is a serious difference between the types and the number of vegetation growing around the riparian areas and the immediate environment. The plants found around the riparian areas are more lustrous compared to the immediate environment due to differences in water delivery. Riparian plants usually get more water directly from the connected water channels, or the whole water body.

- **Soil**

Riparian area are associated with annual flooding or changes in water tables resulting to deposition of different class of sediments made up of erratic textures along the banks. In some cases, water tables may be extended to the top soil and how long the soil becomes wet could depend on the water volume.

- **Water**

Water has a great influence on riparian vegetation directly because they are found adjacent to natural water bodies such as river, lake, stream and constructed water bodies (dam, ditches, ponds, reservoirs and etc).

### Benefits of Riparian Vegetation

Some benefits of riparian ecosystem were listed by Warrington *et al.* (2017) which includes: gathering of contaminants, sediment and mineral elements, strengthening of waterway, regulation of Water overflow, leisure and

beautification of the environment and habitat for bird species.

### **Gathering of Contaminants, Sediment and Mineral Elements**

Environmental pollutants such as pesticides residue and heavy metals are usually associated with soil residue inform of particles of sediment of which mineral elements are inclusive.

The amount of sediment particles gathered in any riparian area can be determine by the ratio of forest cover. This is one of the paramount functions of riparian vegetation because, it promotes gathering of sediment particles. It also binds contaminants and mineral element before it comes close to the waterways through a process known as bio-filtration (Chomchalow, 2015). The active plants that are good bio-filtration are undergrowth and grasses which serve as “buffer zone” influence. In terms of effective gathering of contaminants, sediment and mineral elements, a minimum of 20 meters’ buffer zone is needed. When the flow of water is not deep and stable it makes buffer zones to be further active. Aquatic plants also contribute to effective cleansing of water through nutrients removal in a natural water body (Harvey and Gooseff, 2015).

### **Strengthening of Waterway**

The possibility of the wearing of soil particles through the action of excessive water reduces by the help of vegetation covering the bank of the stream. In terms of occurrence of erosion around the stream bank, shrubs and trees prevents such processes from taking place using the root systems to support and unity the soil, in addition to defensive apparent floor-covering. Water from the bank is utilized by trees resulting to improved soil drainage coupled with reduction in danger of the bank not succeeding due to densely flooded soils (Valladares, 2017). Riparian vegetation equally escalates waterway coarseness due to increased connected stratum of litter and debris which makes water to flow gently and reducing it erosive forces to carry soil particles laden with nutrients. The downstream part of the channels is protected through the release of sediments between the vegetation. Thereby serving as a buffer to the river pools, using large inputs of materials (Wohl *et al.*, 2017).

### **Regulation of Water overflow**

The power, elevation and capacity of water overflow can be regulated by natural vegetation in riparian areas along a fix spot in natural water bodies when water is permitted to flow out ward in straight fashion beside the course of water overflow and through the delta. Nevertheless, flora may lower and stimulate increase in water volume in riparian

vegetation. Flood can be control using floras but careful planning is very necessary due to increased volume of water platform in the soil. Base water movement is sustained through the help of alluvial aquifers in diverse natural bodies' rivers especially tropical environment. Where the climate is drier, natural water bodies lose water that promotes frequent building up of increased volume of water platform in the soil (CRLFCP, 2017).

### ***Leisure and Beautification of the Environment***

A hale and hearty riparian bionetwork has leisure value and it also beautifies the environment. The populace is usually interested in living in beautiful places and natural water bodies such as stream and river are vital riparian zone for leisure basically for fishing, boating, walking, swimming bird watching and picnicking. The aforementioned activities are associated with riparian vegetation because the natural water bodies control the indigenous landscape and it also has a very important contribution to national and global landscape, making the said areas to have vital aesthetic value (Firdaus *et al.*, 2020).

### **Habitat for Bird Species**

Any area with biological and ecological features where avian species has adjusted to due to the presence of basic necessities of life such as water, food, shelter, and mates for reproductive ventures can be described as habitat (Jedlikowski *et al.*, 2016). In avian species, can be grouped into following according to Casas *et al.* (2016), namely: forest habitats, non-forest habitats and aquatic habitats.

**Forest Habitats:** Forest habitat can be defined as an area enclosed largely with green plants such as tree species with clear demarcation of layering and understory. Even if the forest has suffered some level of disturbance such as discriminate felling of trees and wildfire it is equally defined as a forest habitat even with this forest gap because there is still some anticipation of its regeneration into a forest in the nearest future (Czerepko *et al.*, 2021).

**Non-forest Habitats:** Non- Forest habitats can be defined as areas enclosed with scrub, shrubs, grass, otherwise a mixture of numerous plant varieties. This type of habitat is famous for only one stratum. For instance, stunted undergrowth layers are common characteristics of non-forest habitats (Bobic *et al.*, 2018).

**Aquatic habitats:** Aquatic habitat can be defined as areas that are perpetually or periodically enclosed by water and there is a strong difference between areas enclosed by bare-ground, to grasslands, undergrowth and etc or a mixture of several plants categories. Any habitat that is flooded does not

fall into the categories of aquatic habitats (Lefebvre, *et al.*, 2019). Elements that are necessary for the day-to-day survival of the bird species are made available by all habitat but there is a great various in the various types of habitats with respect to their multiplicity in terms of structural essentials associated.

### **How can habitat quality be measured in avian species?**

Habitat quality can be defined as the number of acute structures that are accessible to avian species and in what way that these acute structures are of importance to the life processes of such species or a fraction of it. Habitat quality in avian species can be measured using parameters such as suitable habitat and marginal habitat (Brambilla *et al.*, 2018).

**Suitable habitat:** In a suitable habitat element that are necessary for life processes or a fraction of it are made available. This enable the species to be sighted in the habitat all the time and riparian vegetation provides such habitats for bird species.

**Marginal Habitat:** In a marginal habitat, few hard-to-get indispensable elements are made available to life processes of bird species. The species occurrence in the habitat is usually erratic and very few fractions of the population may be sighted in such habitat.

### **Why is Habitat Availability throughout the Year Cycle Important in Bird species?**

Bird needs habitat for food, shelter, and escape from predators, breeding and mating. This is the reason why habitat accessibility all year round is necessary especially for migratory birds. Habitat all year round includes: resident species habitat, breeding habitat, non-breeding habitat and habitat in migration.

**Resident Species Habitat:** This kind of habitat is during life processes such as when they are breeding and not breeding (Tarjuelo *et al.*, 2020).

**Breeding Habitat:** This type of habitat is only useful during their breeding period and it is different from the habitat birds utilized during left over life processes (Fretwell, 2020).

**Non-breeding Habitat:** This habitat is utilized when the bird species are not breeding. It is used especially off breeding window and it is different from the habitat birds utilized during breeding ventures (Ritterson *et al.*, 2021).

**Habitat in Migration:** This habitat is utilized throughout migratory period (Ritterson *et al.*, 2021). The other form of habitat is micro-habitat:

**Micro-habitat:** This kind of habitat can be defined as a home range made up of composition, structure, or substances that may varied in additional widespread home range. Diversity of species exist in micro-habitats and it is also made up of flora species or community or non-living components of the environments all are found in widespread home range (Ozdemir *et al.*, 2018).

### Values and Functions of Riparian Areas

The essential part of fluvial systems is riparian bionetwork and it is capable of carrying out some many socio-ecological purposes (Dufour *et al.*, 2019). Riparian bionetwork differs all over the nation and it carries out diverse functions in as much as they differ. All known riparian vegetation carries out functions that are the close in nature and ecological features. For example, allowing flow of energy, recycling of minerals elements, recycling of water, hydrologic function, and sustenance of plant and animal population. All the aforementioned roles make riparian vegetation to be irreplaceable compared to adjoining landscape. Datry *et al.*, (2018), highlighted few noticeable roles and values of the above-mentioned areas such as;

1. Hydrology,
2. Baseflow,
3. Recycling of mineral elements,
4. Transfer of energy,
5. Downstream flooding,
6. Water quality
7. Marine life.
8. Terrestrial Life

#### 1. Hydrology

The quality of soil form in riparian areas can be influenced by water flow, which directly influence the vegetation performance at all stages of development in a bionetwork because riparian areas are located around low areas on the earth surface and it is closer to groundwater. However, this water readily made accessible to plants. Soil particles that are fine in nature in sediments found in delta has high ability to retain huge volume of water. In every riparian area positive yield and diversity in plant communities are the ultimate goals. In order to meet these objectives, the following condition reiterated by Hill, (2019) must be met:

- i. There must be continuous deposition of sediment that contain high mineral elements embedded in organic matter and few mineral elements dissolved in water to stimulate plant growth in any riparian bionetworks (Tichá *et al.*, 2020).

- ii. The top soil must be wet and dried periodically because flood takes place seasonally, thereby resulting to movement of underground water in flood plains. The occurrence and flow of water from the top soil to the sub soil promotes continuous availability of mineral elements and additional chemical reactions to plants. It also keeps the process of nutrient recycling stable and promotes the growth of plants in riparian areas (Shuai *et al.*, 2017).

The scheduling of water overflow is quite vital to the life processes of diverse aquatic birds and roughly terrestrial species that depends on flooding to complete their life cycle. Continuous flooding that takes place naturally may stimulate the survival of living organisms that are found around the riparian vegetation, thereby resulting to increased species diversity and ecological yield (Hill, 2019).

#### 2. Baseflow

Alluvial soil can be defined as sediment substances dumped by action of moving water. Alluvial deposits are very rich in mineral elements and water. Large volume of water from precipitation and excessive runoff are kept in it because it is usually not shallow and stores large amounts of water from rainfall and runoff. Water percolation of highland excessive flow in natural water bodies' course are responsible in sustaining alluvial aquifers in most riparian vegetation both locally and globally. Baseflow can be defined as a percentage of excessive runoff channel to a natural water body such as stream, river and lakes as a result of discharge into waterway from the subsoil to keep riparian vegetation alive. However, riparian vegetation protects the watershed, maintain it temperature and reduces the rate of water loss due to evaporation. Alive (Gryczkowski, 2015). Therefore, it makes all year-round water supply available to wildlife species and provides shades to keep them cool during hot environmental conditions.

#### 3. Recycling of Mineral Elements

Mechanism that may utilized or alter mineral elements are readily available in riparian vegetation as long as mineral element gain access into the area. Most riparian plants that are not deep rooted absorbed macro-nutrients such as potassium, phosphorus, calcium, nitrogen and magnesium. Once mineral elements are dissolve in water the mobility of such mineral is very high do the excessive runoff and leaching. Therefore, deep rooted riparian plants utilize dissolved mineral elements flowing in the subsoil with groundwater. Mineral elements absorb by riparian plants may be introduce again when the plant dies and decompose

whereas some may be accessed by plants without retention (Bowman, 2020).

#### 4 Transfer of Energy

There is high level of energy transfer in riparian bionetwork and this is responsible for the exceptionality of riparian areas. Plant materials produced in the aforementioned areas if drops on the ground may be conveyed alongside and made accessible to aquatic animal populations, including those dwelling in the downstream. Aquatic animal and downstream populations equally benefit from the energy source of organic material yielded. If a comparative discussion is carried out between total aquatic and terrestrial bionetwork, organic materials from riparian zones has the prospect of creating a more diverse food chain or a more complex structure (food web) that is advance in all the home range mentioned-above (Baruch *et al.*, 2021).

#### 5. Downstream Flooding

The paramount factor that reduces overflow in downstream in any vegetated bionetwork is green plants because excessive runoff emanating from flooding could be stop by vegetation and the energy contain in the flow could be scatter, resulting to more time been offered to promote water percolation into the soil and conserved for plant usage (Croke *et al.*, 2017).

#### 6. Water Quality

Overflow water usually comes with high velocities, but as it moves across the delta the velocities decrease thereby reducing the prospect of sediments and mineral elements that are very rich in organic matter to return to the natural water bodies such as stream, lakes and rivers. Sediments and mineral elements that are very rich in organic matter convey from the nearby uplands to the lowland are interrupted by the areas covered with lustrous vegetation in the riparian bionetwork (Tomer *et al.*, 2015).

#### 7. Marine Life

The major problems associated with marine life is siltation due to excessive runoff. However, the roots of herbaceous and woody species enhance restructuring of marine home range and alleviates banks of watercourse, slowing down excessive runoff, and in some cases establishes sagging banks that could be utilized by fish as new home range. Sediment could be confined before gaining access into the watercourse, thereby promoting and maintaining a cleaner or watercourse that are free from sediment at the bottom where marine organisms' dwell. These living organisms serves as

good source of feeding items for fish and aquatic birds (Petkovšek *et al.*, 2020).

#### 8. Terrestrial Life

Different home range values are made available to wildlife species by riparian bionetworks because it is highly prolific (Bauer *et al.*, 2015) because even in a least locality with where riparian bionetwork was smaller amount of one percent with respect to the total areas yet large number of land-dwelling wildlife was encouraged. Unique access strip is made available to migratory birds due to straight line nature of riparian ecosystems. Therefore, it serves as an imperative route to birds' migration and distribution. Apart from that, also serves as a link between a forest and wildlife home range (Cubley *et al.*, 2020).

The characteristics between riparian vegetation and wetlands are similar because few riparian zones are head-to-head with the features set aside for a wetland. However, the roles of a wetland and riparian bionetwork is a function of structure, types of soils, plant life, hydrology, and countryside framework. In some cases, area that are not classify as wetland riparian areas have features that are mutual inclusive with respect to the roles and values ascribe to wetlands; for example, topsoil or subsoil water, or mutually, and wide range of diversities with respect to flora and fauna populations (Hong *et al.*, 2021).

#### Roles and Resources Provided by Riparian Vegetation to Bird Species

Riparian home range are biologically dissimilar and it can be found in a collection of common habitat types such as moist savannahs, swamplands, marshlands, forestlands, wildernesses, valleys, highlands, and with watercourse passages or waterfalls in arid regions (Richards *et al.*, 2020). In arid regions or areas notorious for drought, the riparian zones could be erratic or permanent depending on precipitation and humidity regimes, with native flooding inclusive.

Dynamic source of water and successive plants depending on the water source are the basic features of riparian bionetworks (Baniya *et al.*, 2020). Just like arid refuge, the areas described above could be an excellent home range designed to address the basic necessities of bird species due to diversity in plant and animal species. Some of the basic necessities of bird species are: Food, water, shelter and nesting sites.

**Food:** Popular feed items that blossom in riparian home range are flora (fruits, flowers, grain, berries) fauna (fish,

amphibians, molluscs, insects) and diverse extra feed items which enables avian species to have access to different varieties of food irrespective of their diet type. In case of remote water spring, such as in arid environment, it may equally entice large number of preys consume by raptors just like indigenous water hole (Scott, 2017).

**Water:** Riparian water source in any riparian home range can be defined as any indispensable water source that serves as a good source of water to avian species. The environment is usually moist, resulting to wet soil and pools which are extra beneficial water sources utilized by avian species for bathing, drinking and preening (Riley *et al.*, 2018).

**Shelter:** Riparian vegetation are associated with close canopy resulting from continuous growth which enables birds to have access to an excellent shelter made up of dense grasslands, hedge plant coppices, and big trees. The movement of water fashioning into terrestrial home range, banks, extensions, and niches generate support to survival of birds through provision of shelter (Weber, 2017).

Riparian flight path, specifically the interior which is subjected to farming is of great value and also encourages diversity of habitat structure in the environments which in turn brings an increase in the population of bird species utilizing such home range (Kontsiotis *et al.*, 2019). Subsequently, continuous supply of water is made available to bird species in terms of proximity. (Xiang *et al.*, 2017).

**Nesting Sites:** There is a strong variation in nesting types utilized by birds and from all indication riparian areas are well equipped to meet the diversity in nesting requirements. For examples cavity nesting birds uses the cavities on old and rotting tree species or already dug trees within the barriers of the streams, scrapes on coastlines or brushwood, or additional nest types. However, an excellent example of cavity nesting birds are parrots, lovebirds and woodpeckers. Plant species found in riparian habitat makes large different nest building materials available to bird species such as twigs, mosses, leaves, lichens and grasses and other materials that meets the prescription of several bird species with respect to their diversity (Cubley *et al.*, 2020).

### **How Does Human Interference Affect Riparian Vegetation?**

**Construction of roads:** Construction of roads may stimulate rapid erosion and bring in contaminants such oil, heavy metals and pesticides residues into natural water bodies. It may disconnect underground water from drifting into natural

water bodies such as lake, stream and rivers which could be a big and threat wildlife such as aquatic birds (Brunot *et al.*, 2016).

**Agriculture:** Agricultural actions are associated with rapid increase in erosion around stream barriers, once riparian vegetation is cut down for to expand farmland. Decreased farmland could be recorded in areas where erosion is highly pronounced resulting to increase in sediment deposited into the stream (Bruno *et al.*, 2016).

Once the carry capacity of a rangeland is exceeded overgrazing may set in resulting to degradation of home range utilized by bird species irrespective of the habitat types. Green plants have good ability to prevent excessive runoff using their twig, roots and leaves. The percentage of vegetation cover or fodder determines the rate of erosion, and quantities of mineral elements and bacteria (faecal coliform) eroded into natural water bodies such as stream, lakes and rivers.

**Urbanization:** Urbanization can be defined as rural areas becoming an urban center, with rapid increase in human population most rural areas are transforming into cities resulting to increase in demand for shelter. This has resulted to removal of tree species associated with riparian areas and modification of stream barriers due to building of residential houses or profitable ventures. These changes can promote high proliferation of water overflows, coupled with great rise in straight discharge of toxic substances into water, resulting to drastic fall in population of birds and other wildlife species (Fierro *et al.*, 2017).

**Deforestation:** Deforestation can be defined as indiscriminate felling of tree species. Riparian habitat serves as a bioindicator which can be used to measure the integrity of the surroundings if the functions and populations are considered. Felling of trees (Logging) reduces the ability of riparian vegetation (Fierro *et al.*, 2017) in serving as an ecological specimen that could be used to measure the health conditions of environmental. In communities where road passes through the riparian vegetation logging and road construction are the major culprits responsible for decrease plant population in the aforementioned habitat. If the vegetation around the highland is cut down excessive flow of water may set in at once into the stream resulting to erosion around the stream barriers, intense and slender waterways, contracted riparian areas and augmented deposits laden with sediments (Liu *et al.*, 2017).

**Construction of Dams:** Construction of dams shrink downstream overflow. However, dams play a vital role in

rural populace by providing basic necessities of life such as fish, all year-round water supply and leisure especially those dwelling in downstream close to the delta but degradation of riparian areas may set in. In order to measure the health conditions of riparian areas regular flooding is very essential because floods introduce necessary water deliveries, minerals and sediment. Apart from that, flood also stimulates creation hindmost that could be used for raising fingerlings (Liu *et al.*, 2017), but with increase dam construction some the benefits associated with natural flooding are cut short which may be detrimental to aquatic birds.

## CONCLUSION AND RECOMMENDATIONS

### Conclusion

Riparian areas permit energy flow, recycling of minerals elements and water, hydrologic function, and sustenance of plant and animal population. All the aforementioned roles make riparian vegetation to be irreplaceable compared to adjoining landscape. Apart from that, it provides food, water, shelter and nesting sites for avian species. Susceptibility and the ease of riparian zones becoming degraded is very high due to its sensitive nature as a bioindicator coupled with pressure from anthropogenic activities. Hence, destruction may arise from unrestrained access to livestock, clean clearing for farming, urbanization, road and dam construction.

### Recommendations

- In order to guarantee long-standing sustainability in avian conservation, riparian health should be put into consideration, by managing livestock adequately.
- Fencing should be adopted to restrict livestock access to riparian areas.
- Restoration of indigenous floras should be promoted and afforestation and control of unwanted plants should be adopted.
- Diverse stratum of floras should be encouraged in any riparian vegetation for example, canopy, understory and groundcovers.
- Control of erosion around riparian areas should be carried out with the help of highly trained personal to give guidance on control of excessive runoff and extra constrain connected to it.
- Stream barrier should be reinforced to boost bank permanency, guarantee water quality and quantity and increase in output.

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