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Review on growth of mixed Heronry as assessment parameter for Wetland management

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Abstract

Wetland management is alarming agenda in today's globalizing India. These are important for water bird breeding colonies called Mixed Heronry-the nursery ground. With consumption of wetland areas, water bird pop ulations (especially long legged wading birds) are at greater risk. The papers that are reviewed here deals with growth of mixed heronry and its dependence on wetland ecosystem. Most of the papers show direct relation between health of mixed heronry and wealth of wetland resources. Some studies have clarified that with increase in anthropogenic disturbances or interference in wetland areas there is substantial decrease in reproductive success of mixed heronry in that particular area. Therefore reproductive success of mixed heronry is bioindicator of wetland ecosystem since coexistence of large number of birds in a given area requires differential resource partitioning as adaptive strategy facilitated by abundance and variability of resources of that area. In this review paper we have summarized how different biotic factors shape up the growth and formation of mixed heronry and by what mean this phenomenon can be considered as assessment parameter for wetland management.

Key words: Aredeids, bioindicator, cormorant, resource partitioning, wetland.

Introduction

Mixed heronry is very common in water birds especially those belonging to Ciconiiformes order and Phalacrocoracidae family as it acts as nursery ground for them. This nursery grounds are found near wetland areas (swamp, marshy to mangrove places) because of dependency of water birds on water (Neinavaz et al., 2011; Kim & Koo, 2009; Volponi, 1999) for their daily requirements like food (fish, frog or any water dependent prey) and nesting materials. Thus mixed heronry is congregation of large number of birds of different species in a particular place during breeding season. But, it may result in severe inter and intra species competition

having an effect on their reproductive success. However even in the presence of high competition mixed heronry has evolved into a successful example of coexistence because of resource partitioning among different species. This shift in niche dimensions is possible only when resources are abundant i.e., on the productivity and trophic structure of wetland since it is considered as most dynamic and highly productive ecological system. This is the reason that breeding success of these long-legged wading birds (aredeids) and cormorants are considered as bio-indicator of wetland ecosystem (Durmus & Adizel, 2010; Saveljić, 2006; Dragoneti & Giovacchini, 2009). Hence mixed heronry is evolutionary stabilized strategy molded by social interactions. These social interactions are dependent on availability of resources (both food and nest site) and predatory pressure prevailing at nursery site i.e., wetland areas. Thus to conclude the necessity of wetland for development of heronry it is imperative to understand how these factors shape up the growth of heronry.

Factors affecting growth of mixed Heronry

As mentioned above heronries are breeding grounds for waterbirds like aredeids, cormorants etc. A breeding ground is selected on two basic parameters-

(A) Resources and (B) Predatory pressure

Resources

There are three types of resources (a) food (b) nest-site (c) mate, among which food and nest-site location are of importance because they act as basic pillars for the formation of mixed species heronry even in presence of severe competition.

Role of food

Congregation of different species of birds at particular site for breeding purpose create a pressure on food availability. In a limited area, it can have negative pressure on mixed heronry survival since competition for food will increase. However, differential resource partitioning reduces the severity of competition and help in cohabitation (Park, Kim, Chung, Choi & Sung, 2011; Gopi & Pandal, 2011). Besides resource partitioning it has also been proposed that mixed heronry act as Information Centre where less or unsuccessful foragers follow the successful ones by imitating the path taken by flock of early breeders or experienced ones as they have good idea of food sources (Bayer, 1982; Forbes, 1989).

The act of differential resource partitioning and information centre of mixed heronry come into play with better availability of food not only in terms of abundance but also in variation since vegetation variability reduces inter-specific competition by diversifying choice of food and foraging behaviour among individuals of different species (McCrimmon, 1977, Ayas, 2008). This concept was proved statistically (Jenny, 1969; Ogden, 1978) by clearly showing that if same quantity of food is provided then level of competition will be high in mono-specific as compared to mixed species colony. Here it can be inferred that coloniality is adaptation to reduce the searching time for food sources, which are ephemeral and scattered, thus increasing reproductive fitness (Burger, 1981).

Role of nest-site

For any breeding population nest-site selection is very important because it directly affects their breeding success. According to Gause's Competitive Exclusion Principle, no two species living in same area can coexist

until or unless they show a shift towards differentiation of niche dimension. In nesting ecology these dimensions are Vertical and Horizontal Stratification (Park et al., 2011). These dimensions are moulded by social dominance (Burger & Gochfeld, 1990) along with cumulative effect of other species like nest initiation time, abundance of nest in different areas of heronry, inter and intra specific competition (Ayas, 2008; Naugle, Johnson, Meeks & Higgins, 1996; Jha, 2012; Hillaudin et al., 2003; Parejo et al., 1999).

Between these two dimensions, vertical nest stratification (VNS) is more vital because of tendency of birds to nest at high level of tress. There are certain advantages of nesting at certain height- Clear supervision and vigilance from predators; Protection from ground predators; Easy access to nesting area. Thus one can say that there is biasness towards birds breeding at top of trees regarding their breeding success as compared to breeding pairs of lower height (Ismail & Rahman, 2012; Ashoori & Barati, 2013; Volponi, 1999). However, this is not the entire truth, instead VNS ensures proper resource partitioning by temporal and spatial segregation of resources facilitating colonization of birds (Park et al., 2011; Burger, 1981; Jha, 2012). VNS depends on vegetation structure that is either Homogeneous (similar types of plant species) or Heterogeneous (different types of plant species). Heterogeneous vegetation is assemblage of many homogeneous vegetations scattered in small sub-habitats (Burger, 1979). Initially it was considered that VNS is characteristic of homogenous vegetation only but later it was found that it also persists in heterogeneous vegetation localized at small homogeneous sub-habitats. Moreover, VNS is more profound and significant in heterogeneous vegetation because of its variability in food and nesting resources (Crimmon., 1977). This is possible due to spatial segregation in heterogeneous vegetation allowing two competing species to coexist by relaxing interspecific competitive tension (Shigesada et al., 1979; Gopi & Pandav, 2011). In stratification of birds, horizontal diversification is influenced by the vertical stratification as it promotes the neighbours to be conspecifics or similar sized species to mitigate aggressive encounters from larger species (Burger, 1979). Although accumulation of large number of individuals at a particular site should have negative effect on heronry development but it has been proved and supported that a community with high resource sharing or more niche overlapping support more species (Pianka, 1974). It completely goes with the finding that monospecific colonies have less individuals and low breeding pairs than mixed species heronry (Burger, 1981).

Even after all this discussion, one question remains how the pairs nesting at low intermediate heights are benefitted in VNS. Answer to this question related with safety of nesting pair, which depends on the space present around the nest. Space around the nest is divided into two regions, Space above and below the nest. Space below the nest is smaller than space above nest for birds nesting at the top. However, those nesting at lower or intermediate position, their space above the nest are also small and guarded by the nest present above it. Thus, decreasing their area of defense against sky predators like raptors (Burger, 1979). Hence, it can be concluded that though nest located at high level have the advantage of vigilance but the birds of lower height also have benefit of reduced defending area due to present of nests of larger birds above them.

Finally at the end one controversial topic remain i.e. central versus periphery nest site. Usually it has been found that in a mixed heronry centrally localized colonies are favoured by low predation risk and high reproductive success than periphery ones (Ashoori & Barati, 2013; Bennets et al., 2000; Kim & Koo 2009). However, it is not always true and in some cases, no difference in reproductive success has been found between periphery and central localized nest (Vessem & Draulans, 1986; Kazantzidis et al., 1997). In fact, it was proposed that if no difference were observed in reproductive performances between two sites then nesting at periphery is more beneficial in terms of low competition and less aggressive encounters from larger species (Baxter, 1994). This condition found to be true in case of night herons (Burger & Gochfeld, 1990; Ismail & Rahman, 2012) and in cattle egrets (Naugle et al., 1996).

Hence, at last it can be deduced that mixed heronry have evolved as successful example of niche partitioning where nesting pattern is a successful example of physiognomy and fine temporal and spatial segregation.

Predatory pressure

Besides food and shelter, safety is a vital point taken into consideration by birds during nest making. Company of so many individuals act as double-edge sword because at a time it can lure more predators towards the easy to catch prey i.e., eggs or nestlings and simultaneously it increases vigilance due to more number of eyes looking at their surrounding areas. These are two sides of a same coin, which seems to be contradictory from one another but they are not mutually exclusive, instead they are very much linked and this interlinking has developed through course of evolution in form of anti-predatory behavior. It was presumed that herons, cormorants, egrets show mobbing behavior in colony as anti-predatory behavior but soon it was dismissed and proved to be useless or in some cases dangerous tactics making g their young ones or eggs vulnerable to large raptors - common predators (Burger, 1981; Forbes, 1989).

Then how the two contradictory results get linked through evolutionary course? This becomes possible due to synchronization of breeding season among coexisting bird species so that there is particular peak period when availability of prey i.e. nestlings or eggs for predators will be high. As a result swamping of large predators persists only for short period reducing overall mortality rate (Burger, 1981; Baxter, 1994; Ashkenazi & Yom-Tov, 1997; Emlen & Demongs, 1971).

Besides, synchronous breeding overall vigilance is also considered to be important as anti-predatory behavior but not with the viewpoint of offspring protection, instead for the protection of adult ones, which will ensure continuity of next generation of their population. Hence, conclusion arises that future reproductive opportunity success is always facilitated at the cost of present reproductive success (Forbes, 1989). This concept was proved by the observations on grey heron colony where most of the clutches taken by corvids were already deserted by their parents (Vessem & Draulans, 1986).

Interconnection of factors (resources and predatory pressure) with wetland ecology

As far it is clear that mixed heronry is successful survival strategy for promoting growth and upbringing of new generation under the pressure of negative effects of competition and predation pressure. These negative effects are resolved by differential resource partitioning which is possible due to abundance and variability of vegetation

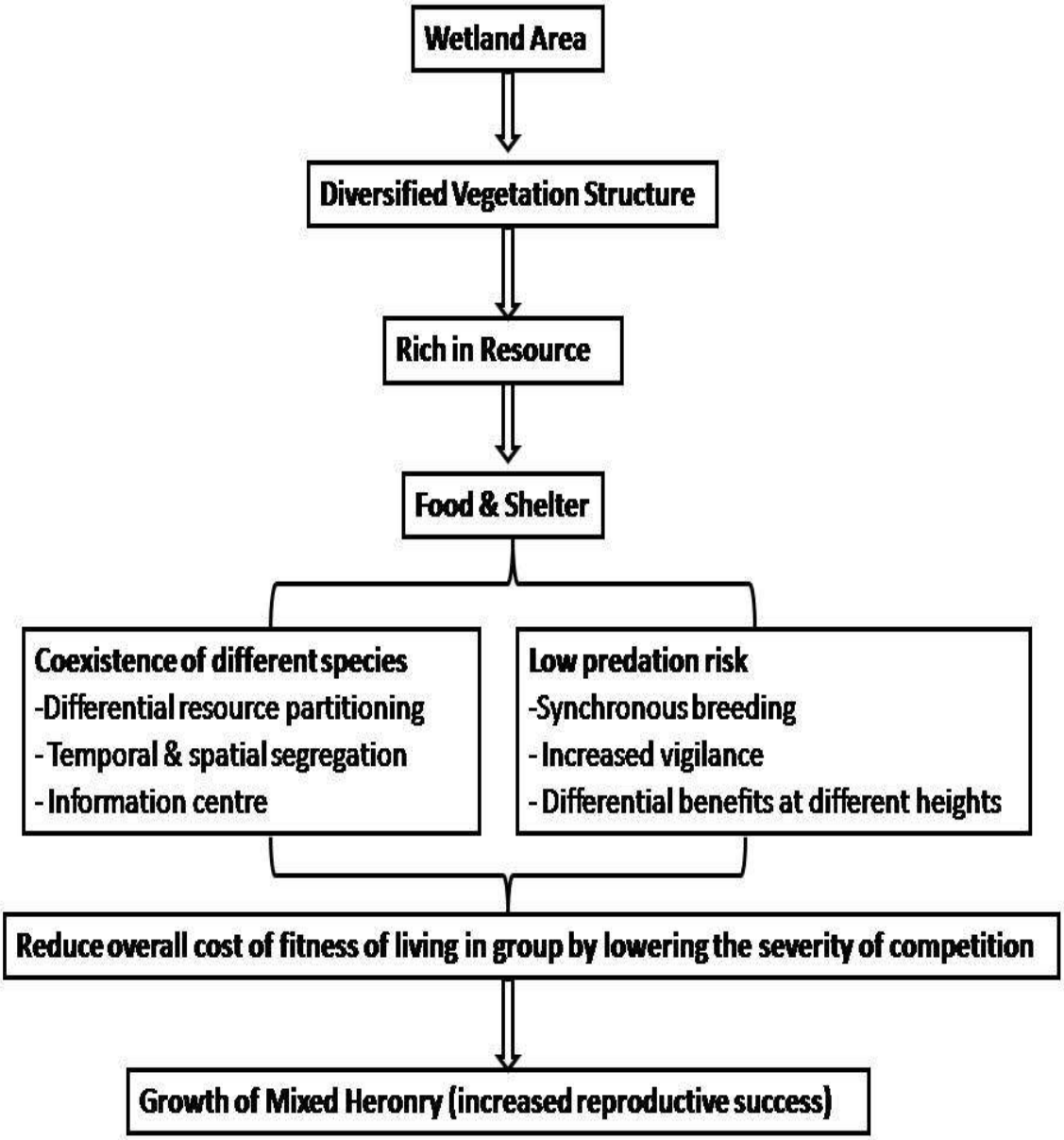

Fig. 1. Dependency of heronry development on wetland.

phenology that is rich supply of food and nesting material. This is verified by the fact that the adaptation like synchronous breeding related with seasonal peak of food, which coincides with rainfall period (McKilligan & Baxter, 1994; Bennets et al., 2000; Neinavaz et al., 2011). Further, it was found that in absence of food chick mortality increases either due to malnutrition or due to predation (Kazantzidis et al., 1997). Thus with food scarcity or low vegetation variation conspecific competition will shift mixed heronry towards solitary or monospecies colony (Forbes, 1989). Therefore, for quality and quantitative supply of foods wetland is of great importance since they are considered as

rich ecosystem consisting of various range of vegetation starting from marshy to mangrove areas. That is why it is important for conservation of wetland for continuity of water birds population (Yong et al., 2006; Joshi & Shrivastava, 2012; Monfils, 2004).

Hence, a model can be proposed as simple representation of a complex ecological interconnection between growth of mixed heronry and wetland ecosystem (Fig. 1).

Conclusion

After the entire discussion & above-mentioned model, it is clear that growth of heronry is a function of wetland ecology. Hence, the reproductive success of colonial breeding water birds (aredeids, cormorants etc) is indicator of wetland productivity, trophic structure and human interference (Kim & Koo, 2009; Neinavaz et al., 2011; Ashoori, 2010). Thus, to protect wetlands to get lost in the midst of urbanization, new conservation ideas and rehabitation techniques of heronries is immediate requirement (Narayanas & Vijayan, 2007; Carney & Sydeman, 1999; Kour & Sahi, 2013; Naher, 2014).

Future aspects

Not many studies on water bird breeding ecology are found in India. With increase in population size and less availability of land for residential purpose, wetlands are soft targets for land dwellers and promoters having a direct effect on the water birds breeding population. Therefore, for future research, integrated study of breeding ecology of water birds along with the wetland's productivity and trophic structure will provide a great step towards conservation.

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