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Behavioral Ecology of Forest Birds

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Abstract

Birds are among the most extensively studied organisms; their aspects of behavior as migration, feeding, sexual and social display, and nesting are well documented Naish. Birds are relatively easy to identify compared to other taxa because of their conspicuous nature and therefore particularly interesting to study in community ecology Bird behavior refers to the action of a bird in response to environmental situations. Testosterone (T) regulates avian behaviors such as songs and aggression during the breeding season. However, the role of T in year-round territorial birds is still unknowable, especially in tropical birds

Keywords: Avian • Ecology • Foraging • Preening • Sleeping

Introduction

Avian studies on behavior can be divided into four categories such as foraging, socialization, grooming or self-preening, and sleeping or resting but most birds spend their time on foraging which acts as the natural behavior of searching and finding foods [1-3], either to feed themselves or their young hatching or care for a brooding mate [4]. Research in the African forest has focused on several aspects of bird community ecology, particularly of the biogeography of forest birds [5]. Also, work the community composition, structure, distribution, and diversity of forest birds and the importance of forested areas to birds is far-reached [6].

Foraging Behavior

The foraging behavior is as allocation, acquisition, and assimilation of food by organisms breed [7] and often characterized by food selection, habitat preferences and prey capturing tactic [8]. Foraging behavior is the most important activity for avian species in terms of survival and reproduction [9]. Most birds spend the majority of their time in foraging related activity either to feed or care for a brooding mate or young hatchlings [4]. As Lyons [10] stated foraging behavior often reflects food availability and in habitats where food availability is high, predators move more slowly and attack prey more often than in habitats where food availability is low. Birds are forced to forage in unfavorable habitats where food may be more abundant but predation risk may be increased, to feed themselves and their offspring adequately [11]. Studies on the foraging ecology of birds have been used to explain the community structure, resource use and competition or co-existence in a particular habitat [12].

Foraging ecology of birds often is limited by foliage structure, plant height, and life forms and plant community composition influences the ecology and composition of bird communities Forests have a complex, multilayered structure where plant composition determines both the structural heterogeneity and food availability that support a diversity of bird species [13]. Some birds forage preferentially on certain plant species and also are known to forage at different heights in the same plant species Not all birds forage within the same strata because species are morphologically adapted to forage on particular substrates [14]. Also, birds are not equally distributed along the strata but the canopy has a richer diversity of birds relative to the lower strata, particularly the ground [15]. A recent study by Samantha and Craig [14]. indicated that in the wet season, the number of foraging birds in the upper strata increased, where ground-foraging birds moved into the upper strata and some bird species absent totally. The reduction of ground-foraging birds is due to the increase in forb cover on the ground [14]. Due to the risk of predation, birds will usually forage in areas near dense vegetation that provide safety and these types of habitat spend less time watching for threats [15].

Birds are often placed into guilds based on their food preference or feeding habits [16]. The foraging guilds in a bird community are the way species obtain food, the types of food taken, the foraging substrates exploited, and the heights at which different species forage [17]. These data help to compare communities within and between habitats [18] and also to assess the health of the ecosystem and management needs for the conservation of species and ecosystems [19]. According to Prajapati [16], Prey availability, abundance, distribution, and vegetation structure; interact to create unique “foraging opportunities” which vary among bird species and forest ecosystem and croplands are highly supported to different kinds of insectivore, grainivore, and frugivore, nectarivore guilds whereas, the water bodies supported to different aquatic guilds like as herbivore, carnivore, and insectivore. Different species of bird occupying a particular feeding guild and space had evolved specialized feeding structure to explore and obtained food resources efficiently and thereby reduces competition within a guild [20]. According to the principal food component in the agroecosystem, maximum bird species were found to depend on vegetable matters as their main food, followed by insects [21] also that the highest percent of bird species were granivorous followed by ground carnivorous guild [21]. According to a study by Thivyanathan [22], there are two major guilds, namely gleaners and salliers and gleaner are further consisted of three distinct guilds based on the substrates of gleaning, namely: Fruit, Flower, Ground, and Stem (trunk and twigs) and are four major groupings among the bird species based on the food eaten such as insectivores, nectarivores, frugivores and omnivores.

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Mixed flocking may reduce the risk of predation or enhance foraging efficiency [23]. According to Lars et al. increased foraging efficiency in flocking birds caused by predation risk reduction because individuals that have the benefit of group surveillance against predators may devote less time to watching for predators and, more time to searching for prey foraging rates. Visibility and cover density around foraging birds to identify differences between flocking and solitary individuals that may result, from reduced predation risk or, from foraging-efficiency enhancement mechanisms independent of predation risk [24].

As Ramesen and Robinson [25] stated there are five sequential components of foraging behavior: (1) search, (2) attack, (3) foraging site, (4) food, and (5) food handling and between foraging- site movements can be categorized as walk, hop, jump, run, climb, glide, flutter and fly. Closely related species used the same basic foraging method indicating the importance of phylogeny in determining the feeding patterns of birds wheeled and Calver. Insectivore birds exhibit different methods of exploiting resources such as gleaning, sallying, probing, pouncing and hawking [22].

Nest Site Selection and Nest Construction Behavior

Nest-site selection is crucial for survival and reproductive success in birds [26]. All bird species reproduce through the use of a cleidoic egg (shelled egg) and this egg must be placed in an appropriate environment to grow correctly and hatch into a healthy chick [27]. Even though there are many factors affecting nesting success includes: inflection, weather, the health of the female, food availability, and predation is the main cause of nest failure in several bird species [28]. Furthermore, the intensity of rain, the abundance of food resources, photoperiod and latitude are variables related to reproductive success [29]. According to Suwanrat et al. [26] breeding success in birds is affected by the selection of suitable nesting sites and directly affects population dynamics and is selected to reduce the risk of nest predation. The way, habitat variability, and its quality directly act on survival and reproductive success [30]. Most studies regarding nest building and role of nest characteristics focused on species that build a new nest for each breeding attempt, whereas little is known about nidicolous species (nest reusers), such as raptors. Pablo et al. [31]. stated current breeding birds do not typically build the nest but they repair and add material to apre- existing nest. Males take charge of carrying most of the material for repairing the nest, females also participate in the process and addition of materials continues though out the breeding period even the young have fledged [31]. Larger nests are higher breeding success than smaller ones [32].

Vegetation structure is usually considered to be important for the nest-site selection of many birds [33], and plays a role in predator avoidance [26]. Birds select nest sites concerning vegetation characteristics non-randomly Knopf and Sedgwick, and some prefer nest sites with lower predation risk [34]. Birds also select nest sites close to borders to advance early detection or prevention of disturbances by neighboring groups [35]. Based on a study by With Kimberly A and DR Webb. Birds select nest sites located in positions associated with: a higher degree of slope to facilitate flying out of the nest when predators attack; and higher nest concealment to make the nest less exposed to predators. Ground-nesting birds place their nests close to objects or clumps of vegetation to keep from environmental conditions and nest predators [36]. Effective nests are determined by the presence of large eggshell fragments in a nest whereas ineffective nests are indicated by a deserted clutch, missing clutch or small eggshells distributed around the nest during the incubation period Further more bird remains or large feathers at the nest site are indicated the incubating birds injured by predators However, nest site selection can be influenced by several factors, including nest predation, physiological tolerance, abiotic factors and interspecific competition [37].

Migration Behavior

Migration in birds can be defined as a regular return movement between geographically separated breeding and wintering ranges [38]. Migration is often annual and is closely related to the cyclical pattern of the seasons and is most evident among birds, which have a highly efficient means for traveling over long distances [39]. Two types of have been documented namely: Obligate migration, birds pre-programmed to leave its breeding area at a certain time each year and to return at another time. In contrast, facultative migration is considered optional, occurring in response to conditions at the time. Individuals migrate in some years but not in others, depending on prevailing food supplies or weather conditions [38].

Adaptation of Migration

Birds use different migratory tactics such as: changing of behavioral, ecological, and life-history traits [40]. A study by Wiltschko and Wiltschko [41] indicated that migrant birds require orientation methods to reach their final destination, including innate changes of the direct route to fit the best journey in terms of time or energy. Morphological adaptations may also evolve to reduce the cost of migratory flight, includes body mass, bones, feathered wings, wing-powering muscles, streamlined shape and physiological and visceral organic such as respiration, cardiovascular system, metabolic rate [42]. Also, birds adjust their life cycles to complete their breeding season, molt, and other activities between migration times Gwinner. Migratory birds can build fat stores as an energy source for long flights [39]. For example, a small passerine bird consists of between 85% and 95% of fat and 5%-15% of protein for migratory flight as fuel This fuel used during flight is accumulated before migration and restored at stopover sites. During migration, diurnal birds change their activity rhythm and fly at night [43]. However, daily rhythm changes when fuel stores become low and land to refuel and return to diurnal [43].

Migration Route

The total geographic area used by a population, species or group of species throughout its annual cycle is termed as rout (flyway) Kirby [44]. Even if migration is progressively studied, many factors that influence migratory flows and routes still remain poorly understood [45]. Many flyways are oriented longitudinally (from south to north, and from north to south), include the Atlantic oceanic route, the Atlantic Flyway, the Mississippi Flyway, the Central Flyway, the Pacific Flyway, and the Pacific oceanic route and some routes are more latitudinally (Convention on Migratory Species (CMS, 2014). According to Shackelford [39] migrating birds believed to use three major compasses to orientate their route, namely sun (at day) stars (at night) and the magnetic field of the Earth and evidence also indicates that the glare of the moon can interfere with this orientation. There is also variation in the routes chosen by different species and this is because the difference in distance traveled, time of starting, speed of flight, the latitude of breeding and wintering grounds contributes variation of migration routes among species [46]. In flocking migrants, there is a clear seasonal variation in the migration route great climate is a There is a major factor in determining seasonal variation [47].

Causes for Migration of Birds

The selective advantages leading to the evolution of the migratory movement of birds have long been documented Francisco According to Berthold [43] migration is an adaptive response to seasonal environments, allows birds to take advantage of spatial variation in the seasonal fluctuation of resources and successfully colonizes areas offering favorable conditions only during a short period. Birds migrate to areas where food resources are at their peak abundance and food of birds varies and different not only in

different birds but also in different seasons [48]. However, according to the main environmental trigger for bird migration the changing ratio of daylight and darkness, hence with the onset of winter, days get shorter reducing activity hours. Additionally, many bird species have been able to successfully colonize areas offering favorable conditions only during a short period and can take advantage of the extraordinary abundance of food during a few weeks in early summer Francisco. Other ultimate factors such as escape from inter and intraspecific competition in saturated habitats and avoidance of predators and parasites favoring the evolution of migration [48]. Also, according to Berthold [43] there is a sex difference in migratory behavior, females, which in most species of birds are smaller than males, often tend to be more migratory than males. However, Survival challenges faced on a majority of annual adult mortality in terrestrial birds Sillett and Holmes.

Singing and Calling Behavior

Vocal communication is an important part of social and reproductive behavior in many songbird species [49]. Vocal signals play a significant role in the life of birds in a variety of aspects like pair maintenance; parent-offspring interactions, cohesiveness among flock or family members, and threat situations and in birds are usually divided into calls and songs [50]. The syrinx is the organ that produces vocal signals in birds and varies markedly among bird species [51]. Biologists differentiate about 9000 species of birds and list about 4000 of them as 'songbirds' [52]. Singing behavior in birds is greatly varied and song characteristics in bird species also vary temporally and spatially [51].

There is a fundamental difference between calls and songs of birds [53]. Male birds use Song for two main functions, defend territories and attract mates during the breeding season [54]. But sometimes occurs outside the breeding season. In some cases, birds use songs to inform females, there is no immediate threat of predation and distract potential predators and organize nest exchanges between mates. In some bird species, females also sing [55]. Long and more elaborated songs indicate better male quality and affect females' choices by their preference [55]. In birds six types of calls are identified namely: territorial calls, emergence, and roosting calls, threat calls, submissive calls, begging calls and distress calls [51]. Birds use calls in all seasons and play important roles in the sociobiology of birds: namely social contact, parent-offspring interactions, cohesiveness among flock or family members, threat and danger Geoff. In contrast to calls, songs are learned and generated by a vocal imitation of individually experienced signals [56].

Territorial Behavior

Territory defense in birds has been extensively studied, but primarily in temperate zone species where breeding territories are defended for a short period in spring and summer [57]. During the period of reproduction, many birds occupy territories which they defend aggressively against conspecifics [58]. In temperate birds, reproduction and territoriality usually co-occur, and outside the reproductive period, territorial aggression and song are uncommon [59].

Many species only defend territories for part of the year, such as the breeding season [60]. The reason for this is that the relevant resources (nesting or mating sites) are only required during that particular period [61]. However, tropical passerines are unique in territorial behavior because in many species both sexes sing and defend the territory and territory defense takes place all year round [62]. Hence, females are less conspicuous and much harder to observe, their role in territory defense is limited [63]. However, both males and females consistently responded more aggressively to territorial disturbances during the dry season than during the wet season, likely because food abundance is low in the dry season and territory value is high. In a male, nectar-feeding birds defend territories for two main reasons that are to attract mates and secure access to food and in most male mid-latitude birds, territorial behavior, such as song and aggressive displays, are regulated by the hormone testosterone

Preening Behavior

Preening is an arrangement, cleaning, and general maintenance of the feathers using the bill and holds nine percent in the daily budget of birds Dominguez and Vidal Birds use preening for signaling the quality of mates Katarzyna, Birds use preen wax over the surface of feathers to maintain feather quality and keeping properly positioned [64] and reducing the number of ectoparasites [65]. Preening of the inside the wing, tail, pinions and head rubbing have high value and in a certain order of birds after bathing [66].

There are two types of preening such as self-preening (grooming of own feathers) and allopreening (grooming of feathers of other individuals) may promote the horizontal transfer of bacteria [67] and viruses [68]. Moreover, preening behavior can increase in frequency when flock size increases due to social facilitation [69]. During preening, birds decreased vision caused by feathers covering their eyes and increase predation risk because individuals with visual barriers are less to detect a predator A recent study by Palestis et al. [69] on White Stork *Ciconia ciconia* indicated that most preening behavior occurs in the nest and found that being on the nest males (30%) spent more time on preening than females (16%).

Flocking Behavior

Flocking behavior is the behavior exhibited when a group of birds, are foraging or in flight [70]. Many birds form flocks with their kind, but some join other species to form mixed-species flocks [71]. A flock is also an effective first warning system; some birds can act as safeguards and warn if a predator is on its way, while others are busy feeding and such benefits are most rewarding when species similar to each other flock together [72].

Flocking behavior differs among species [73]. Many flocking species are insectivorous because the diet is most cooperative to the constant movement of a flock. Flocks can lead to intraspecific competition and increase detectability by predators [74]. However, there are two main hypotheses to the benefits of flocks: improved foraging efficiency and increased predator avoidance [75]. The first suggests that birds can get feeding benefits from assembly flocks by obtaining food more efficiently than when solitary [76]. In the other case, the second hypothesis considers predator avoidance through several behavioral mechanisms [75]. Additionally, Species with a high tendency to flock either have a foraging technique or a microhabitat that makes them more exposed to predators [77]. Nevertheless, mixed bird flocks can also generate costs for their members includes an increase in competition and aggressiveness, changes in foraging patterns, and increases in predation risk because these groups are more noisy and conspicuous than the lonely foragers Several flock features in mixed-species flocks of diurnal passerines birds are thoroughly investigated while the flocking behavior of nocturnal birds remains poorly documented [75].

Bird flocking has received considerable attention in the scientific and engineering literature, beginning with the classic Boids framework of Reynolds [78]. As reviewed by Petit and Bon models of self-organizing systems suggest that repeated interactions among individuals and following simple rules can generate complex patterns and coordinated group movements and following simple rules: Separation (not get too close to any boid near it) Alignment (matches the velocities of boids near it), Cohesion (move towards the average position of its neighboring) and targeting (to move toward a target location).

Alarm Calling Behavior

In many species of birds and mammals, predators produce vocal responses from potential prey labeled alarm calls, which can alert other

animals to impending danger The alarm call is a widespread antipredator behavior [79]. Alarm call, the giving of particular vocalizations in the face of impending danger, is a key antipredator strategy that has evolved in a wide range of species [80]. Alarm call behavior, as with all vocal communication, consists of three aspects: the delivery of calls with a specific set of acoustic features (call production); the use of calls in particular contexts (call usage); and the response to calls produced by others (call responses) [79]. Although there is often an obvious selfish selection pressure on receivers to respond to alarm calls, their production can appear altruistic: in giving a signal that enhances the likelihood of others escaping, callers may attract the attention of the predator themselves. Studies of alarm call behavior have therefore proved invaluable for our understanding of such issues a skin selection, nepotism, reciprocal altruism and cooperation Wheeler. The exact response to alarm calls need not, however, remain fixed throughout life: in many species, changes in behavior become apparent over days, weeks or even months [81].

Bathing Behavior

Bathing is an essential element of avian maintenance behavior. Birds of the majority of species frequently bathing and follow bathing with sessions of preening and oiling behavior [82]. Although some forms of feather maintenance behavior have been studied in detail (Preening) other (bathing) are rarely stated in bird literature [83]. Because most feather maintenance activities occur frequently and unpredictably and are often short duration, they are difficult to study systematically [84]. According to Brilot [82] bathing helps to wet the feathers in a controlled manner that aids the distribution of preen oil and thus improves preening feathers, ensuring skin and feather roots are rinsed. Most members of the order Galliformes and some passerine species bathe in the dust as a supplementary substrate to water and have comparable to play a role in feather maintenance, especially in reducing ectoparasite loads and controlling the lipid content of feathers [85]. Furthermore, birds' customs to sunbathing (basking) as a thermoregulatory behavior, in which birds absorb heat from the sun and decrease the metabolic expenditure needed to maintain its optimum body temperature, mainly in cold circumstances [83]. It is mostly occurred in the winter season in the early morning from 8:00 to 9:00 AM and late morning 9:00 to 12:00 AM and noon 12:00 to 2:00 PM.

Flying Behavior

The flight is a highly energetically expensive form of locomotion. However, concerning its cost per unit distance covered, powered flight is a very efficient mode of transport [86]. In the Animal Kingdom, powered flight has evolved only in two phyla, namely the chordates and the arthropods. Birds and bats are the only extant vertebrate taxa that have achieved flight [87]. There are more than 50 kinds of flightless birds. Birds that don't fly often live on small, far-away islands where they don't need to worry about being hurried by other animals.

Bats are the only mammals capable of sustained flight but have distinct traits than birds that likely reflect key differences in ecological adaptations and distinct evolutionary histories [88]. Bats have elongated fingers instead of elongated forearms as seen in birds and have bones with high levels of mineral density that increase the stiffness of the skeleton [89]. On the other hand, as with birds, bats have relatively small bodies, fused bones and lightweight skeletons [90].

There are only a few species of birds in which flight speeds have been reliably determined [91]. The ability to fly is the key adaptation that has made birds so successful. They can travel long distances in a short time and can, therefore, exploit the best seasons for reproduction and survival [91]. Among vertebrates, the avian respiratory system, the lung/air sac system, is unusually morphologically complex and remarkably efficient [92,93]. There are two competing theories for the evolution of flight: the arboreal (trees-down) scenario and the cursorial (ground-up) scenario [93]. The primary flight muscles of birds, the pectoralis and supracoracoideus, are designed for work and power output, with large stress (force per unit cross-sectional area) and strain (relative length change) per contraction [93]. The longest documented non-stop flight of any terrestrial bird has been a crossing of the western Pacific Ocean by far eastern curlews *(Numenius madagascariensis)* flying for 3-5 days between eastern Australia and China, a distance of approximately 6500 km with an overwater leg of approximately 4500 km. Long-distance flights require extra energy to transport the heavy fuel loads, and a series of shorter flights with smaller fuel loads is advantageous to reducing energy used during transport [48].

According to Tobalske [94] birds fly in organized groups commonly do in one of two techniques: Line formations and Cluster formations. The former groups are typically revealed by large birds like waterfowl, where birds fly arranged in single lines, often joined together. The scientific questions about these groups usually involve potential adaptive functions, such as why do geese fly in a V? The latter, Cluster formations, are typically made up of large numbers of smaller birds like pigeons or blackbirds flying in more irregular arrangements that have a strong three-dimensional character. The groups are defined by synchronized and 8 simultaneous rapid changes in direction.

Conclusion

Birds are essential components of forest ecosystems. Birds are among the best studied animals in forested ecosystems, because the majority of birds are conspicuous and relatively easy to study. This review provides kinds of behavior in forest birds by describing different behavior of birds in their ecology. Each bird species may be characterized by a general habitat type, however many species use different features of a forest during different life stages, requiring a various set of behavior even for an individual species. Knowing their behavior can increase their aesthetic value. Foraging behavior is the most frequent behavior and spent most their time searching of food. Most of avian species prefer to migrate at night. For 10 of thousands of years the only light sources during the dark period of the night were the polarized sunlight, the moon and stars. However, in the recent decades, due to extensive industrial and urban development, many migrating birds encounter during their nocturnal flights vast areas of bright artificial lights, often including tall structures. Numerous evidences at present indicate that anthropogenic lights may attract and disorient birds, sometimes causing their mass death.

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