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Review Article

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Evolutionary Concepts in Pigeons (Aves: Columbidae)

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ABSTRACT

In order to survive, it is important to know the state of evolution. In avian kingdom, pigeons either domestic or wild have raw materials of all sorts of evolutionary elements. Available scientific data were used to compile this set-up. Since fancy pigeons have focused uncountable variations, they show sometimes their ancestral characteristics. Pigeons or fancy pigeons are an outstanding example for divergence evolution. Due to geographical barriers, and for the same plumage and characteristics they exhibit sympatric and allopatric speciation. Pigeons' wings were noticed as their homologous and analogous organs at the time of comparing with other critters in nature.

Keywords: Pigeons, Doves, Divergence, Convergence, Homologous, Analogous, Sympatry, Allopatry, Barrier.

INTRODUCTION

Columbiformes diverged from their ancestor between 83 and 107 Mya [1]. Behavior is necessary to take advantage of new ecological opportunities [2,3], and has long been suggested to be a major driver of evolution in animals [4]. Behavioral change brings the population close to an adaptive peak with demand, hence favor evolutionary stasis and niche conservation [5]. Larger brains have generally more extensive evolutionary diversifications [6], subspecies richness [7], and species richness [8]. Evolutionary change supports to reduce extinction of animals [9]. Columbiformes experienced a worldwide radiation from the early breeds presumably facilitated by their high dispersal ability [1], which allowed them to diversify into a large number of species (greater than 310) and colonize an extremely diverge range of habitats except Antarctica [10]. The factors that have triggered changes in foraging behavior in Columbiformes are colonization [11] and dispersal ability [12]. High dispersal ability and competition, behavior may thus be a powerful force in the evolutionary diversification of animals [5]. During their geographical expansion, pigeons and doves probably encountered a myriad of different environment [10]. Foraging behavior should be primarily reflected in the shorter hindlimbs and longer tail [13,14]. The

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objective of this review is to focus how the evolutionary ingredients act in nature for speciation in pigeons or doves.

EVOLUTIONARY ELEMENTS TO UNDERSTAND SPECIATION

Barriers in nature for speciation: There are lots of natural and artificial barriers are found in nature. For instance, mountain, waterbodies, railway, boundary, dense forest, glaciation, desert, landscape, genetic, physical, physiological barriers are available which are directly or indirectly related to the sympatric and allopatric speciation.

Concept of domestication: There are three pathways described for domestication—commensal, prey, and direct. When wild animals (dogs, cats, chickens) attracted to humans for human food or small prey. Humans started hunting some animals (pigs, cattle) for their meat. In direct pathway, humans captured wild animals (horses, donkeys, camelids) to obtain their physiological activities like movement, nutrition, and reproduction, which lead to the dramatic bottleneck [15].

Natural force: Pigeons exhibit more variations than any other bird species [12]. Pigeons as a striking example of continual selection can lead to significant, rapid, morphological and behavioral variations from a single ancestral type [16]. Pigeons are among the earliest domestic birds [17], relatively little known about its initial domestication. Due to crosses between wild and domestic pigeons, truly, wild rock-pigeons might be on the verge of genotypic extinction. Feral and racing pigeons being only minimally genetically differentiated [18]. Racing birds sometimes do not successfully return to their lofts, and survive as a feral pigeon population. Speciation is only mysterious under certain definitions of species [19].

Divergent and parallel evolution: Breeders have selected their pigeons to develop feathers and color variants are convergent evolution in pigeons is the process by which different pigeon breeds have independently evolved similar traits such as head crests, feathered feet, and color variants. Like owls, pigeons have toed feather and an example of parallel evolution (Table 1).

Homologous and analogous organ: For comparing the origin of wings and their functions, pigeons could be an ideal example.

Table 1. Evolutionary definitions

Features	Definition	Example
Divergent evolution	When two different individuals are evolved from the same ancestor	Darwin finches; modern elephant and mammoth, human and ape; all pigeons from the rock-pigeons
Convergent evolution	When two different individuals are evolved from the different ancestor	Birds and bats; some pigeons are look different but they are genetically related (old Dutch capuchine and Komorner tumbler; English pouter and brunner pouter)
Adaptive radiation	Different form in a rapid way	Many fancy pigeons of the world
Parallel evolution	When divergent and convergent evolution merges which are not evolutionary similar	Leg feather of pigeon, chicken, and owl
Homologous organs	When origin is the same but functions are different. These organs are found in the divergent animals	Human hands and bats patagium
Analogous organs	When origin is different but functions are the same. These organs are found in the convergent animals	Wings of insects, birds, and bats
Sympatric species	When different species are live together in the same habitat	Laurel pigeons, ruddy pigeon, short-billed pigeon
Allopatric species	When different species are live in the different habitat	African olive pigeon, pink pigeon, mountain imperial pigeon

Adaptive radiation: In the case of adaptive radiation, pigeons often triggered by factors like new environments or available food source, feather, and color (Table 1).

Mega evolution: The origin of birds has been discussed with the discovery and description of *Archaeopteryx* in Bavaria in 1861 [20]. The current cladistics analysis of bird origin postdates the earliest up to 80 million years. All cretaceous fossils are the origin of birds [21,22]. The size of the *Archaeopteryx* was similar to a pigeon.

Sympatric and allopatric association of pigeons: Rock-

pigeons are cosmopolitan species and can share all of their biological activities especially breeding with feral and tumbler pigeons [23]. Most of the large railway platforms of Bangladesh can be an ideal place for showing this type of sympatric association of pigeons [24]. In nature, there are recognized sympatric pigeons are Bolle's laurel pigeon, white-tailed laurel pigeon, ruddy pigeon, and short-billed pigeon. In contrast, allopatric species are African olive pigeon, pink pigeon, and mountain imperial pigeon as well (Table 2; Plates 1-6).

Table 2. Wild pigeons with their features and status

Pigeons	Salient features	Global status
Sympatric species		
Bolle's laurel pigeon, *Columba bollii,* Godman 1872	It looks as dark wood pigeon; endemic to the Canary Islands; it lacks any white markings; produce mournful cooing	LC
White-tailed laurel pigeon, *C. junoniae,* Hartert 1916	Probable ancestor of common wood pigeon; endemic to the Canary Islands; the call is hoarse hiccup cooing; it looks as dark wood pigeon with white-banded tail	NT
Ruddy pigeon, *Patagioinus subvinacea* (Lawrence, 1868)	Its voice is differed on the basis of habitats; sometimes it seeks roadside grits	LC
Short-billed pigeon, *P. nigrirostris,* Sclater 1860	Complex, loud, and high-pitched call	LC
Allopatric species		
African olive pigeon, *Columba arquatrix,* Temminck 1808	These pigeons are earth eater (geophagy) for fulfilling their sodium content	LC
Pink pigeon, *Nesoenas mayeri* (Prevost, 1843)	Endemic in Mauritius	VU
Mountain imperial pigeon, *Ducula badia,* Raffles 1822	Solitary species; very difficult to find, favorite habitat is canopy forest	LC

Sympatric pigeons

Plate 1. Bolle's laurel pigeon [25].

Plate 2. Ruddy pigeon [26].

Plate 3. Short-billed pigeon [27].

Allopatric pigeons

Plate 4. African olive pigeon [28].

Plate 5. Pink pigeon [29].

Plate 6. Mountain imperial pigeon [30].

Table 3. Examples and sources on evolutionary studies

Features	Examples	Sources
Historical background	History of evolutionary concepts is mandatory to know the diversification of pigeons	[1]
Domestication	Due to domestication, many fancy pigeons have been evolved in the world	[15]
Natural force	Natural force was the precursor on the evolution	[12,16-19]
Geographical diversification	Columbiformes has great diversification ability to survive	[1,5-14]
Behavior of pigeons	Behavior needs to be changed for the different environment	[2-5,11]
Mega evolution	Connection from reptilia to aves was the first connecting record in the animal kingdom	[20-22]
Sympatric and allopatric speciation	For ecological barriers, birds show sympatric and allopatric parameters	[23,24]

CONCLUSIONS

As a common and cosmopolitan bird, pigeons can be a great tool for studying many connecting links of evolution from Reptilia to Aves. In the present context, now fancy pigeons are available all over the world with their distinguished behaviors and characteristics. With available molecular studies, their physiques forecast many ancestral points of connecting links. Due to natural or artificial barriers, all animals are bound to show their sympatric and allopatric speciation, and in this case, wild pigeons or doves can be a suitable example.

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CONFLICT OF INTEREST

None declared.

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