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Modern Evolutionary Biology: Some Concepts, Questions and Comments in Relation to Birds

Peiro IG*

Department of Ecology and Hydrology, University of Murcia, Spain

***Corresponding author:** Ignacio García Peiro, Department of Ecology and Hydrology, University of Murcia, C/ El Salvador, Elche (Alicante), Spain, Tel: (00) 34 965 451 777; Email: ignacio.peiro@yahoo.es

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Abstract

There are four principles in evolution: variation, inheritance, selection and time. These principles summarizes natural selection. In the same way, sexual selection can be defined as the evolution of certain conspicuous physical traits, such as pronounced coloration, increased size, or striking adornments that may grant the possessors of these traits greater success in obtaining mates. Both concepts join on time in the branch termed evolutionary biology (EB). Current EB since Darwin had a primer at the end of the past century in the Trivers-Wilard's hypothesis based on the relationships of parents' effort with the condition of offspring. This hypothesis has required new brands termed "Sex-allocation", "Parental Investment", "Delayed Maturation" and "Sexy-sons" to conform the framework of the current EB. Here, I try to summarize the key concepts of these theories trying to bring the theme towards birds.

Keywords: Trivers-Willard Hipothesis; Sex-Allocation; Parental Investment; Delayed Plumage Maturation; Sexy-Sons; Birds

Abbreviations: EB: Evolutionary Biology; THP: Triver-Wilard's Hypothesis; SA: Sex-Allocation Theory; PIT: Parental Investment Theory; DM: Delayed Maturation; SS: Sexy-Sons Theory.

Introduction

The primary force of EB is to self-ask why, but not how or for what [1-4]. Sexual selection described by Darwin CR, et al. [5] is one of the main process in EB and involves two basic arguments: intra-sexual competition and mate choice. Both are crucial to understand the posterior advances in EB. The current EB is based four theories: Triver-Wilard's hypothesis (THP), the sex-allocation theory (SA), the parental investment theory (PIT), the delayed matuation (DM) and the sexy-sons theory (SS). Here, I draw up a slight update of the major theories since Charles Darwin's theories on natural [6] and sexual selection [7]. These are significantly settled up within the processes of the modern EB.

The Triver-Willard's Hypothesis (THP)

One of the first paradigms of the EB was born in 1972 with Triver-Willard's hypothesis [6]. Perhaps this idea keept the contemporary notions of EB from the ends of the early century from the works of natural and sexual selection written at the eighteen century described by Charles, et al. [5,7]. THP relates parental effort with the son's condition, in the form that mothers in good condition should invest in more sons than daughters. This implicates that sex-ratios in animal populations are generally biased towards males. This theory was not adopted in the Fisher's Equal allocation Theory becouse is based in the fact that sex-ratios meet parity in the offspring [8,9].

The Sex-Allocation Theory (SA)

THP is relative to the each sex number of offspring namely sex-ratio is variable and evolves towards the "Sex Allocation Theory" [10,11] that is explained as the cost of reproduction, in terms of growth and survival and maintenance for future reproduction balanced against one sex. SA has been well explored in insects [12-14], fishes [15], reptilians [16,17] , birds [18] and mammals [19,20], but the main problem of SA is that there are biases in every one of the sex-ratios, this is, in primary (at embryo), secondary (at birth) and tertiary (at adult) sex-ratios that are not completely studied in the animal kingdom. In birds, for example, this has been partially treated as sex ratios in eggs (primary sex-ratios: [21-23]); sex ratios at nestlings (secondary sex-ratios: [24-27]) at the population level (tertiary sex-ratios: [28]). However, experimental examples [29-32] show that some birds may alter sex-ratios in response to parental quality in the described "Facultative sex ratios adjustment" [33].

The Parental Investment Theory (PIT)

THP evolves in to the "Parental Investment Theory" [34-36] when the amounts of energy devoted to offspring reveals that the less investing sex benefits more from seeking sexual parents while the more investing sex benefits more from strengthening its capability to support offspring [36]. In PIT females benefit from mating with an attractive male because attractiveness signals male genetic quality by sexual selection or by natural selection at higher age in individuals with maturation at longer age [8,37,38]. PIT has some experimental problems to alter fitness with condition in birds. Some empirical works identify a link between fitness and condition [39-43] but others not [44-47]. Fitness is understood as the maturation of one sex that is more unfavorable for the other one (e.g. fitness as term applied to gonads, ornaments, etc: [8,48,49]). How animals make decisions with less costs on reproduction which are not involved in benefits that are not related with past reproductive effort implicates the need for future trade-offs between present and future reproduction. In adaptation and natural selection, George C. Williams linked the distinction between group and individual adaptation with the distinction between group and individual selection in the term "Williams' Principle" [50] that says that adaptation at a level requires selection at that level. The contrary of these assumptions falls in the "Concorde Fallacy" [50].

The Delayed Maturation (DM) and the Delayed Plumage Maturation (DPM)

SA has direct effects in DM [51,52] and similarly to PI. PI [51] explains that if for a given investment the probability of survival is lower for one sex, selection favours greater investment in that sex. If one sex has a frequency-dependent component of fitness, such that individuals receiving a greater-than-average investment are fitter, selection favours greater investment in that sex. DM specifically in birds [53] it refers to DPM known as the delayed acquisition of a definitive color and pattern of plumage until after the first potential breeding period. DM has profound implications in fecundity of birds [54] and in the age dependent offspring linked to condition since larger sexes mature less than smaller, and are less promiscuous and less abundant sexes and less mature smaller sexes have more probability to gain older age, more lifespan, and hence more probabilities to rear more pairs and to give more discordancy [37-38]. DPM has multiple effects on the birds life outcomes as plumage and song acquisition [55-56], fitness [57], survival [58] foraging [59] and offspring [52]. DPM is very researched in short-sized Passerines [56, 60,61] and in long-size bird species as raptors [62-64], seabirds: [65], shorebirds: [66], waterfowl [67].

The Sexy-Sons Theory (SS)

In polygynous birds, females of polygynous males may compensate the multiple copulations of parents by increasing their own work load and don't care for lower-quality offspring than monogynous mated females. Then what benefits for females are to be promiscuous?. The explanation is SS postulated in 1978 [68]. It affirms that females get indirect genetic benefits by mating with polygynous males passing its qualities to their sons allowing them to attract more females, producing fewer offspring and with more grandchildren sired by sexy sons. A beautiful work of SS in birds is given in starlings [69]. There are other works about this theory in birds using great tits [70], Zebra finches [71] and peafowl [72].

Conclusion

Modern EB has developed mainly by the works of Robert Trivers and Robert Fisher. Posteriorly, a group of theories rose on his paradigms. These theories conform to the framework of the modern EB.

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