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Short Communication

Is the behaviour a feature that implies evolutionary consequences in the speciation?

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Abstract

In birds, similar behaviour decreases in dramatic form the distances among sister lineages.

The current classification of the Chilean representatives of the passerine family Rhinocryptidae includes eight species. Moreover, differences between the two lineages of Chilean species of Scytalopus genera, and two subspecies of Scelorchilus. *Scelorchilus albicollis albicollis vs. S. a. atacamae*; *S. rubecula rubecula vs. S.r. mochae*, two species of Pteroptochos: *P. castaneus* and *P. tarnii,* and two subspecies: *P.megapodius megapodius* and *P.m. atacamae* are very scarce. We propose a new methodology based on ecological and behavioural patterns in order to understand the concept of speciation in this group of birds. Our results show how when integrating behaviour and ecological terms as biological traits next to morphological characters of the plumage, allows us to conclude that there is a decrease in the distances among sister lineages in the cluster tree.

Here we discuss the speciation of the large Chilean Rhinocryptidae, based on their behavior [1] and their specific Umwelten [2]. We observed the behavioural patterns of birds in their daily environment (Table 1) such as feeding, courtship, aggressiveness, flight poorly, nest construction, great vision, highly territorial, intraspecific and interspecific sympatry and other field behaviour *in situ* of this group of birds. We propose a new methodology based on ecological and behavioural patterns in order to understand the concept of speciation in this family. Previous studies suggest that species of the genera of Chilean Scytalopus are closely related based on phenotypic traits of plumage, behaviour, and geographical dispersion [3] but different vocalization [4].

The current classification of the lineages of Chilean Rhinocryptidae has separated them in order to their morphological characters, plumage variations, geographical dispersion, and differences in vocalization patterns [5]. The brain of the Rhinocriptyds [6] has strong structural and functional similarities with those of mammals, especially with regard to the structures that enable multimodal integration capacity in the telencephalon [7]. Such anatomical characteristics of the Rhinocryptidae family may be associated with the behavioural abilities to exploit diverse environments in Chile. In turn, this behavioural plasticity might facilitate the use of diverse habitats and broad geographical distribution, as shown by the Chilean species.

We use field review data in order to evaluate the current classification of Chilean Rhinocryptids species, we first review data on ecological aspects, morphological characters of feathers, and behavioural traits (Table 1) of these lineages reported by a variety of authors [3] and field observation variables of these birds, such as their behaviour, plumage phenotype, feeding, breeding, habitat use, and dispersal movements. We use the Similarities indexes Russel & Rao [8]. Using these data, we constructed cluster trees with the following traits: morphological characters of the feathers in different parts of the body and ecological aspects (Figure 1). On the other hand, we add the behavioural variable to the other

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variables we dealt with previously (Figure 2). Furthermore, we make an integrated analysis of all characters including; ecology, morphological characters of plumage and behaviour by means of an analysis of conglomerates (distance metric is normalized percent disagreement, Boostrap software Systat 8.0) (Figures 3,4). The comparison between sister lineages of the Chilean Rhinocryptidae, in relation to the common ancestor of Furnariidae, would clearly explain how the behavioural similarity between Rhinocryptids decreases the distances (Figures 3,4) (*C. oustaleti* fall far outside out of the group, Figure 4). On the other hand, the analysis performed by the Systat 8.0 program does not make any discrimination when including data related to behavioural patterns attached to the plumage coloration phenotype and ecology [1] (Figures 3,4). In the Figures 1,2 (applying the Russel & Rao index) show that is consistent that when applying the behavioural variable, the distances between Chilean rhinocryptid species decrease. Is probably than the program is likely to show inconsistencies when integrating certain types of data due to heterogeneity in biological evolution [9].

We discuss the differences and similarities among the lineages of the Chilean Rhinocryptids and compare them with the species outgroup *Cinclodes oustaleti* (Furnariidae). According to our results, we postulate that there are no cut criteria to establish differences among three sister lineages of the

Table 1: Data base. Behaviour traits, habitat use, and diet of the eight species of Rhinocryptidae in Chile.

General traits*/**sp	A	B	C	D	E	F	G	H	I	J	K
Habitat use	1	1	2***	2	1	1	2***	2	1***	1	2***
Use of water courses	3	3	3***	3	3	3	3***	3	3***	3	3
Use of holes for shelter	4	4	4***	4	4	4	4***	4	4***	4	5***
Breeding period	6	6	6***	6	6	6	6***	6	6***	6	6***
Diet	7	7	7	7	7	7	7	7	7	7	7
Curiosity	8	8	8***	8	8	8	8***	8	8***	8	8
Aggressiveness	9	9	9***	9	9	9	9	9	9	9	9
Nest construction	10	10	10***	10	10	10	10***	10	10***	10	10***
Climbing behaviour	11	11	11***	11	11	11	11***	11	11	11	11
Vocalisation behaviour	12	12	12***	12	12	12	12***	12	12***	12	12***
Type of flight	13	13	13***	13	13	13	13***	13	13***	13	13
Escape movement	14	14	14***	14	14	14	14***	14	14***	14	14
Family interaction	15	15	15***	15	15	15	15***	15	15	15	15
Use of foot paths	16	16	16***	16	16	16	16***	16	16***	16	16
Ritual Movements	17	17	17	17	17	17	17	17	17	17	17
Visual sensitivity	18	18	18	18	18	18	18	18	18	18	18
Acoustic sensitivity	19	19	19	19	19	19	19	19	19	19	19
Corporal movements	20	20	20***	20	20	20	20***	20	20***	20	20***
Territoriality	21	21	21***	21	21	21	21***	21	21***	21	21***
Coop. in the nest	22	22	22***	22	22	22	22***	22	22***	22	22
Chick feeding	23	23	23***	23	23	23	23***	23	23***	23	23
Habit schedule	24	24	24***	24	24	24	24***	24	24***	24	24

*

1 = shrubs, meadow, mountains	11= in rocks, branches, trees.	21= dur. br. sea.
2= trees, shrubs, mountains	12 = conspicuous in males	22 = both adults
3= near streams	13 = short and intense bursts	23 = both adults
4 = nests, burrows, trees, cliffs	14 = fast response	24 = along of his life
5= in shrubs	15 = during the breeding season	
6 = same season	16= during the breeding season	
7= omnivorous	17= during the breeding season	
8 = to reply vocalis. of ind.	18= high	
9= during the breeding season	19= high	
10= similar structure	20= very fast	

A= P.m.megapodius	*F= S.a. atacamae*	*J=S. fuscus*
B= P.m.atacamae	*G= P.tarnii*	*K= E. paradoxa*
C= P.tamii	*G= S.r.rubecula*	
D=P.castaneus	*H= S.r. mochae*	
E= S.a. albicollis	*I=S. magellanicus*	

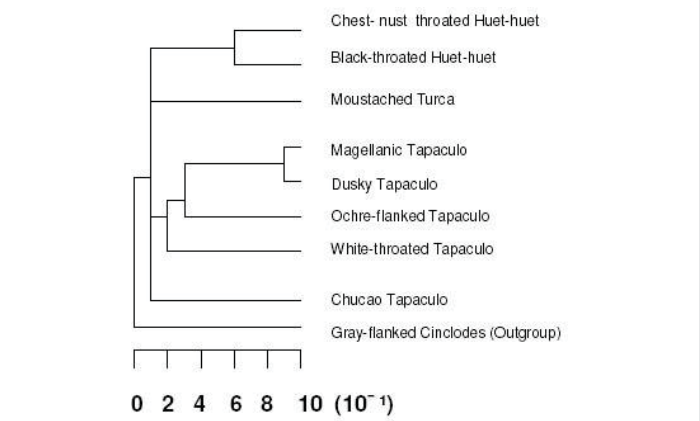

Figure 1: Cluster tree (with Russel & Rao index) of Chilean Rhinocryptidae based on ecological traits and phenotype of plumage.

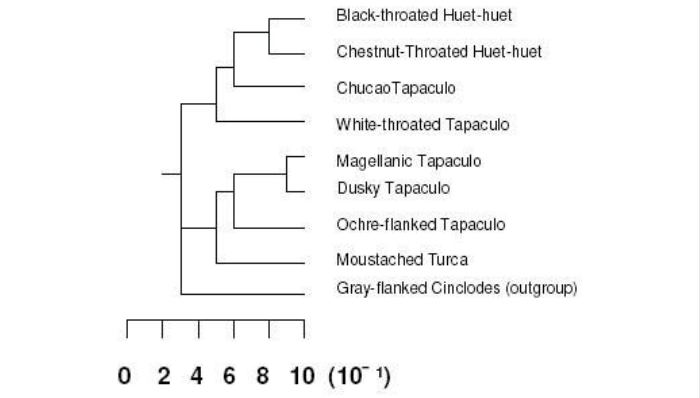

Figure 2: Cluster tree (with Russel & Rao index) of Chilean Rhinocryptidae based on ecological traits, the phenotype of plumage, and behaviour.

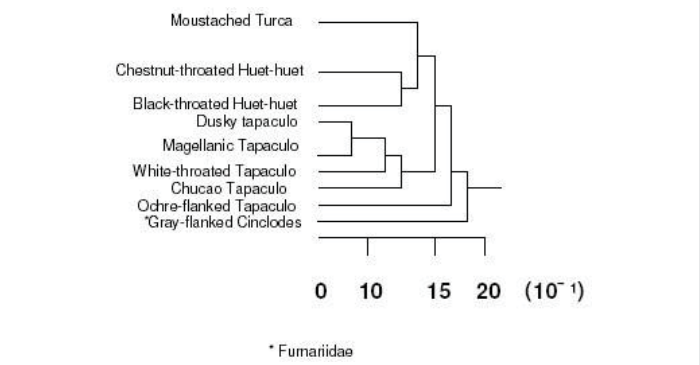

Figure 3: Cluster tree (Bootstrapping support, Systat 8.0). of Chilean Rhinocryptidae based on ecological traits and phenotype of plumage.

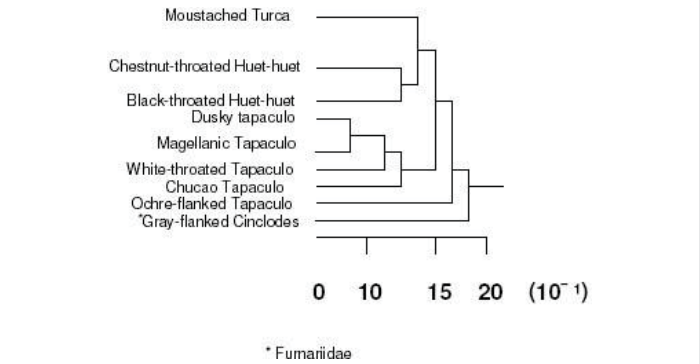

Figure 4: Cluster tree (Bootstrapping support, Systat 8.0) of Chilean Rhinocryptidae based on ecological traits, the phenotype of plumage, and behaviour.

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current classification conformed to; White-throated Tapaculo (*Scelorchilus albicollis albicollis vs. S.a. atacamae*), Moustached Turca (*Pteroptochos megapodius megapodius* vs., *P.m. atacamae*) and Chucao Tapaculo (*S. rubecula rubecula vs. S.r.mochae*), since the differences are scarce. It is possible that between sister taxa they have a tendency to be subspecific. Even the differences between Chilean Scytalopus species are minor and sympatric populations may occur between them [3,10-12]. Only differing in vocalizations [4] and some phenotypic traits, the same is for Pteroptochos species [13]: *P. tarnii* with *P castaneus*.

However, it is important to note that *Eugralla paradoxa* is the only species that fall outside the tree node that is consistent (Figures 1-4) and remains a Rhinocryptid species independent of the other species of Scytalopus. The Eugralla genus is a monotypic species that clearly falls outside the group of species of Scytalopus [14] and the way of life is different and very poor flier, live in small areas in bushes with dense shrubs with thick foliage. Probably the species of the Chilean genus of Eugralla is the ancestor of all Scytalopus genus of South America. However, we suggest that they should be reevaluated with more precision, using different criteria to elucidate a more accurate taxonomic separation than the current one. In addition, we argue that the current notion of the classification of Chilean Rhinocryptids can be modified. The disadvantages of this methodology are that at no time did we carry out a genetic study of the subspecies mentioned. Is probable that there may be some variation, as has been shown by molecular genetic studies by other researchers [3,13,14], but there may be an urgent need to integrate the behavioural variable into future research.

Conclusion

In conclusion, we propose that the integration of behaviour in terms of ecology and morphological characters of the plumage allows us to conclude the decreased distances among sister lineages in the family of Chilean Rhinocryptids. Additionally, the great similarity in the behaviour among these species is due to the lifemode. In this way, we are convinced that the behaviour is an evolutionary clue that determines the speciation in this taxonomic group of birds, further supporting the notion that the current classification of the Chilean Rhinocryptidae should be revised and modified. This group of birds is strongly adapted to the floor and poor flyers in restricted habitats, therefore its conservation should be a priority.

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