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Alloparenting behavior in Quails *Coturnix coturnix* (Linnaeus, 1758) and *Coturnix coturnix japonica* (Temminck & Schlegel, 1849) from Pakistan

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Abstract
In the present study, alloparenting behavior in Quails *Coturnix coturnix* (Linnaeus, 1758) and *Coturnix coturnix japonica* (Temminck & Schlegel, 1849) was studied from Pakistan from January 2014 to December 2015). 10 adult female quails were kept in 10 compartments of a large cage (6 ft hight, 30 ft length). A total of 85 eggs were incubated including 83 of pheasants (*Phasianus colchicus*) and (*Phasianus vericolor*) and 3 of (*Alectoris chukar*), out of which 63 hatched successfully. Chicks were divided in 10 broods (B) and were introduced to quails (P). Results showed that out of total n=63, 45(71.4%) chicks were adopted and 18(28.5%) were rejected. The present study concluded that alloparental behavior does exist in quails and further research on quail's behavior is required.

Keywords: Quails (*Coturnix coturnix*), alloparental care, behavior observation, foreign chick adoptions

1. Introduction

Quails (*Coturnix coturnix*) are beautiful small game birds, belonging to Phasianidae family and have a characteristic call of "wet my lips' [1]. "*Coturnix*" attains rapid sexual maturity and have shorter incubation period. The two species, "common quail or Japanese quail (*Coturnix coturnix japonica*) and the American quail (*Coturnix coturnix*) are vastly studied; these are migratory birds which migrate between Asia and Europe [2]. Quail (*Coturnix coturnix japonica*) is the smallest farmed avian species [3] and fetching fame in profitable poultry sector for meat and egg production. Raising quail delivers a resource for poor families with meat and eggs [4]. The females begin laying eggs on normal at 6 weeks and can lay 250 to 300 eggs a year [5]. Additionally, the quail is an effective converter of feed with each egg a female deposits a comestible package of 8% of her own body weight as compared to 3% in case of chicken [6].

Animal rather than the genetic parent when cares for other's young is called alloparent and this behavior is called alloparenting [7]. The carefulness of young by unrelated adult non-parental conspecifics is broadly described in some groups of birds such as Gray-crowned Babblers, Florida Scrub Jays, Acorn Woodpeckers and White-fronted Bee-eaters [8-11]. This care is unpredictable with life history theory: it is likely to experience fitness charges such as a reduction in adult survival or that of their offspring [12]. Parental care behavior evolves in reaction to the interchange of mating system, sexual selection, reproductive ecology and biology Young are expected to kindle alloparental care while adults tend to restrain this behavior [13].

Biparental care has been documented in many species and some pairs specially select arboreal hollows so to nest in them. In both cases, the males were believed to be mining for nest sites with their mates when the alloparental care behaviour happened. Protective behaviour by non-parental males in response to violent behavior by females and perceived threats to chicks by human observers are also described [14].

Alloparental care for nondescendant young by extra-pair matings and/or brood mixing is a uncommon, but taxonomically extensive, because this is a phenomenon that is found in a number of groups of animals including mammals, birds, social insects and also fishes [15-17].

The collaboration among organisms occurs at all stages of biological organisation [18] and by understanding the factors that select for collaboration is a major goal of evolutionary biology. One concentrated form of cooperation is alloparental care [19], in which individuals help raise the offspring of others individuals while often foregoing their personal reproduction [20]

Occasional cooperative breeding occurs rarely, and is therefore difficult to examine and remains poorly understood. This behavior may occur normally in some species, but be ignored in species that are poorly studied. However, most species are not well studied till now [21]. Behavior is observed in model species such as mute swans (*Cygnus olor*), blue tit (*Parus caeruleus*), white stork (*Ciconia ciconia*), common guillemot (*Uria aalge*), common tern (*Sterna hirundo*) and house sparrow (*Passer domesticus*). In these species, alloparents are most likely dissimilar to the breeders, as the offspring do not keep on with their parents into the next breeding season and scatter earlier [22]. It has been put forward that the focal reason behind interspecific feeding is the loss of the creature's own brood which lead to those individuals to initiate feeding at a nearby nest or home of another species [23]. It is said that the primary evolution of this behaviour may be a non-adaptive reaction to the begging of nestlings and may have lead a first step towards alloparental care [24]. The present study was designed to find out the existence of alloparental behaviour in quails *Coturnix coturnix* and *Coturnix coturnix japonica* from Pakistan.

2. Materials and methods

2.1. Study area

Mansehra City is headquarter of Mansehra district and is second largest city in province Khyber Pakhtunkhwa of Pakistan. The present study was conducted from January 2014 to December 2015 in Mansehra (34°15'6.62 N'': 73°6'38.39 E'') KPK, Pakistan.

2.2. Setting of cages

Ten adult female American/New world quail (*Coturnix coturnix*) were kept separately in 10 compartments of large cage measuring (6 ft height, 30 ft length) hence each *coturnix coturnix* got a separate space of (6 ft height, 3 ft length). They were fed normally on finger millet (*Eleusine coracana*), oat (*Avena sativa*), wheat (*Triticum aestivum*), sunflower (*Helianthus annuus*) seeds, and left overs of fruits and vegetables. Birds were given natural environment by placing twigs, wooden logs and shelter covered with vegetation for living.

2.3. Incubation of eggs

We incubated a total of 85 eggs. Out of which 82 eggs were of Ringneck (*Phasianus colchicus*) and Japanese green pheasant (*Phasianus vericolor*) and 3 of Chukar bird (*Alectoris chukar*). Pheasant's eggs took 23 days for hatching and chukar eggs took 26 days. A whole of 63 eggs (6.3±1.06) hatched successfully, including 60 of pheasants and 3 of chukars. While 22 eggs (2.2±1.0328) did not hatch. Chicks were randomly divided in to 10 broods naming B1, B2, B3 up to B10 respectively (Table: 1 and 2).

2.4. Introduction of chicks to quail cages

Ten quail parents were named P1, P2, P3 up to P10 respectively. Ten chick broods were introduced to 10 parental compartments; each brood consisted of different number of baby chicks (Table: 4). Data was written and collected to check that does alloparental care exists in quails or not.

2.5. Data analysis

Data was analyzed by software (SPSS) version 16.0. Obtained data from experimental groups was subjected to t-test and one-way analysis of variance (ANOVA).

3. Results

3.1. Alloparenting welcomed

Results were quiet amazing. It was seen that that 4 female quails (P1, P2, P7, P10) were not bothered by introduction of foreign chicks in their cages, they soon adopted them and spent time normally with them. They made chicks learn to peck and at night, they used to take them under their feathers to keep them warm.

3.1. Do we know you?

Three females (P3, P4, P9) took time as they were frightened because of new entry to their cages, so at first they showed no response but soon after a day they started behaving normally too and adopted the foreigners. A total of 45 chicks, p^{Val} (0.066) were adopted (Table: 5).

3.2. You are not welcomed

Three (P5, P6, P8) out of 10 quails however did not accept the introduced broods. From 18 chicks given to them 16 were killed and we removed the last 2 our self's.

3.3: Percentage of alloparental care among parent quails

A total of 45 (71%) chicks were adopted by parental quails and 18 (29%) were rejected (Fig: 3).

Table 1: Hatching percentage (%) of broods

Brood number	Number of eggs incubated	Successful hatching (%)	Unsuccessful hatching (%)	Total number of young in brood
B 1	9	7 (77.7%)	2 (22.2%)	7
B 2	10	7 (70%)	3 (30%)	7
B 3	10	7 (70%)	3 (30%)	7
B 4	8	5 (62.5)	3 (37.5%)	5
B 5	8	5 (62.5)	3 (37.5%)	5
B 6	8	7 (77.7%)	1 (12.5%)	7
B 7	8	8 (100%)	0 (0%)	8
B 8	8	6 (75%)	2 (25%)	6
B 9	8	6 (75%)	2 (25%)	6
B 10	8	5 (62.5%)	3 (37.5%)	5

Table 2: Showing descriptive statistics as Mean ±SD of hatching rate

Hatching	Mean	N	Std. Deviation	Variance
Successful hatching	6.3	10	1.06	1.01
Unsuccessful hatching	2.2	10	1.0328	0.96

Table 3: Showing paired Samples Test between successful and unsuccessful hatchings

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Success hatching-Unsuccessful hatching	4.10000	0.468	0.33	3.1170692	5.0829308	8.7634	18	0.0001

Table 4: Alloparenting among parent (P) *Coturnix coturnix*

Parent	Brood number	Number of young	Successful alloparenting	Unsuccessful alloparenting
P 1	B 1	7	++	-
P 2	B 2	7	++	-
P 3	B 3	7	++	-
P 4	B 4	5	++	-
P 5	B 5	5	-	++
P 6	B 6	7	-	++
P 7	B 7	8	++	-
P 8	B 8	6	-	++
P 9	B 9	6	++	-
P 10	B 10	5	++	-

Table 5: Showing Paired Samples Test between alloparental care

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Success Alloparenting Unsuccessful Alloparenting	-2.70	3.24	1.383	-0.21	-5.61	1.9525	18	0.0666

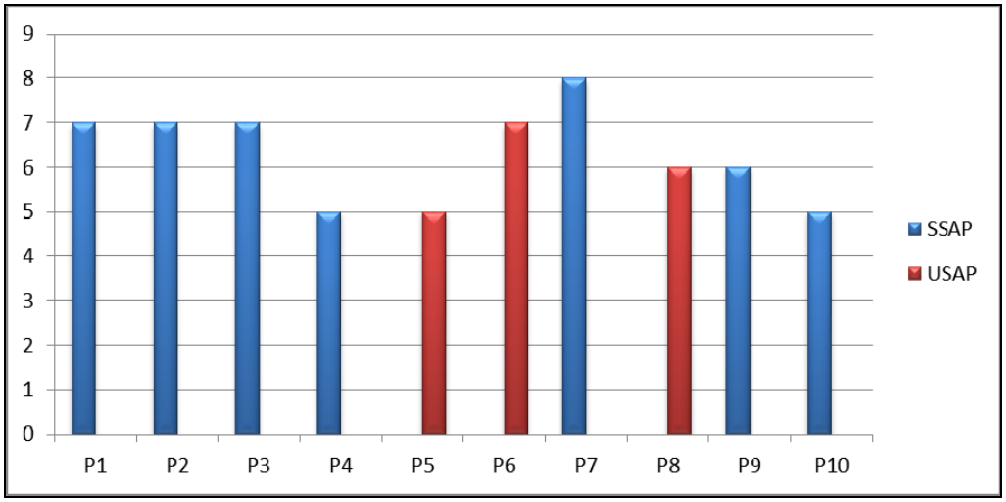

Fig 1: Successful Alloparenting (SSAP) and Unsuccessful alloparenting (USAP)

Table 6: Analysis of variance between successful and unsuccessful alloparenting among parent *Coturnix coturnix*

ANOVA					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	15.413	9	1.713	0.079	1.000
Within Groups	1,142.000	53	21.547		
Total	1,157.413	62			

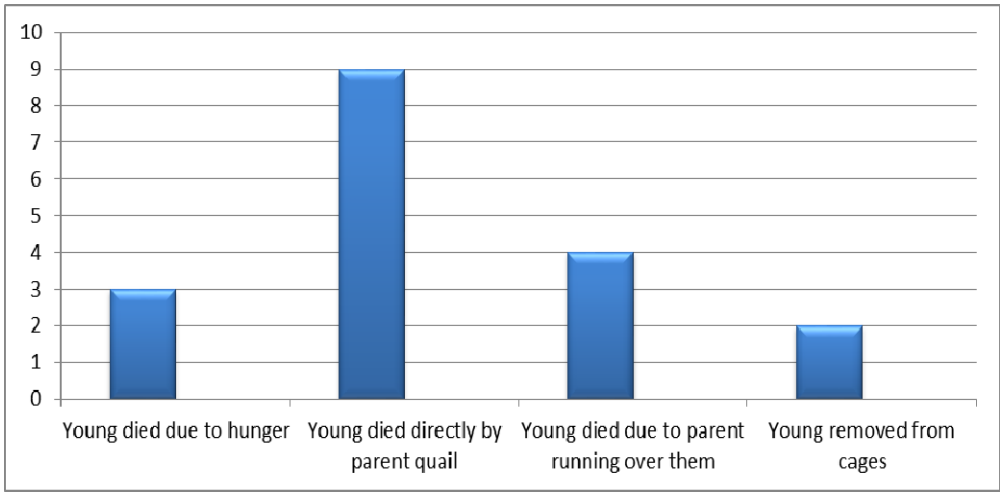

Fig 2: Unsuccessful alloparenting conditions occurred to young

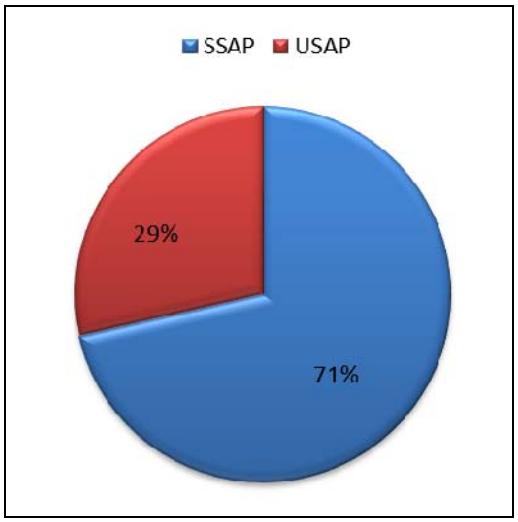

Fig 3: Showing percentage of successful and unsuccessful parenting among parents

4. Discussion

Study on alloparental interactions and conditions which could enable or prevent the appearance of alloparental behaviour in Ade lie penguins (*Pygoscelis adeliae*), seabird which nests in high colonies around Antarctica was done. Observation sessions were carried out on 48 identified pairs and 50 identified chicks in a 217-nest subcolony. As the season progressed, it was seen that young were fed less often by their own parents because they are often absent from the breeding sites and are less responsive towards their offspring. Only 4.1% (3 out of 73) of alloparental solicitations resulted in feeding, which is negligible compared to parental feeding. In present study 3 out of 10 females did not show the alloparental care which is quiet higher [25].

The behaviour of alloparenting is predominantly well studied in birds, using both long-term and proportional studies. However, many species are poorly studied, and in 152 species, this behaviour only has been observed infrequently (i.e., occasional cooperative breeding). In most cooperatively breeding species, helpers deliver alloparental care at the nests of their parents or nearby relatives; though, only in one rarely cooperatively breeding species do offspring continue into the next breeding season with their parents. Therefore, different factors are likely to be with regular and occasional cooperative breeding. The latter behaviour bear a resemblance to interspecific feeding, which occurs when birds lose their brood and initiate feeding at a nearby nest, or when birds misguidedly feed at another nest [26].

A ferruginous hawk adopted four nestlings as male parent died. Implementation of parental duties by the replacement male conjointly with the female parent was done. The carcass was fresh and we determined that cause of death was vehicular collision. The nest contained four nestlings (estimated ages were 21 to 24 days). Previously, both parents actively defended the nest when approached, but after finding the dead male, only the nesting adult female ferruginous hawk defended the nest. Nest monitoring was done after this observation up to next 13 days; only the adult female ferruginous hawk fed nestlings and defended the nest. After few days male ferruginous hawk defending the nest and delivering food to nestlings was observed. This study suggested that it could be adoption by a male of an unrelated brood or might be cooperative in nature. Ferruginous hawks have been so-called as cooperative breeders and it is quite possible that the adoption behavior observed was performed by a related male. In diurnal raptors that are hypothetical cooperative breeders 14% presence of an extra male during the breeding season has been confirmed in 60% of species [27]. However like these birds data on the alloparenting behavior in quails is lacking and research on this is required.

5. Conclusion

From the present study it was concluded that alloparenting do exist in quail (*Coturnix coturnix*), as from results 71.4% foreign chicks were adopted by the quails and the under researched broods spent 2 years of their life with them. It is further recommended to check quails with different offspring's as study on the alloparenting behaviour in quails is still wanting.

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