

Neighbours vs. strangers discrimination in Water Rail (*Rallus aquaticus*)

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SUMMARY. Water Rail (*Rallus aquaticus*) manifest strongly intra- and interspecific aggressivity. In our study we test the Water Rail's reaction to the calls of conspecifics neighbours and strangers, to conclude if they express the “neighbour-stranger discrimination” (NSD) and / or “the dear enemy effect” (DEE) behaviour as evolutionary attributes that would reduce the energy consumption. Ten points located 100 m apart inside the Sic Reedbeds wetland were selected. In each point the acoustic reactions to spontaneous and playback of territorial Water Rail's call were counted for three days (18, 19 and 20 April 2011), between 6:00 – 8:00 p.m.. A statistically significant difference was found between the number of songs recorded after spontaneous activity and the number of calls recorded after playback. The results argues the hypothesis that individuals of this species recognize their neighbours and react less aggressively towards them. Moreover, our findings indicated that response to neighbours' calls follows a constant trajectory during the first or second half of the minute while the reaction towards foreigners is significantly losing intensity during the second half of the minute. The results suggest that the NSD and DEE are expressed in the Water Rail behaviour.

Keywords: dear enemy effect, intraspecific, neighbour-stranger discrimination.

Introduction

Most individuals of territorial species interact repeatedly with their conspecific neighbours, particularly during breeding season but also during their movements and migrations. They are competing for space, food and fertilization resources (Yezerinac *et al.*, 1995; Webster *et al.*, 2001; Segelbacher *et al.*, 2005; Akçay *et al.*, 2009). In

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many species, individuals manifest less aggressively towards their neighbours, a phenomenon called “Dear Enemy Effect” (DEE) or Fisher Phenomenon - Dear Enemy (Temeles, 1994).

Birds occupying closed habitats communicate primarily through calls. In these individuals, the capacity to differentiate the acoustic signals emitted by conspecifics has major implications for the recognition and discrimination of foreigners and neighbours, a phenomenon called “neighbour-stranger discrimination” (NSD). The phenomenon was described in birds species (Stoddard, 1996) as well as other taxonomic groups such as insects (Gordon 1989, Thomas *et al.*, 1999), amphibians (Bee and Gerhardt, 2001), fish (McGregor and Westby, 1992), reptiles (Whiting, 1999), and mammals (Rosell and Bjørkøyli, 2002).

NSD and DEE manifestation are greatly beneficial for the individuals in the sense that by reducing aggressiveness, individuals can afford more time to other activities (feeding, courtship) while minimizing the risk of injuries resulting from direct confrontations (Akçay *et al.*, 2009).

Meanwhile, there are some costs of reduced aggressiveness, which may lead to giving up the opportunity to enlarge the territory or even losing territory to a neighbour who manifests aggressiveness (Akçay *et al.*, 2009). In this regard it would be more effective for the DEE to be conditioned by the level of aggression manifested by neighbours. Thus, an individual may manifest aggressiveness towards the aggressive neighbour or not (Akçay *et al.*, 2009).

Therefore, recognising neighbours and reducing aggressiveness towards them decreases energy consumption in the individual and improves its chances of survival. Generally, neighbours defend their own territory, which they already occupied, and are not a danger to others, whereas an intruder will try to gain new territory, at the expense of those who already occupy it (Stoddard, 1996).

Referring to NSD, studies have been conducted on 27 species of Passeriformes, with a single case showing that individuals react more aggressively to the song of intruders than that of neighbours (Falls, 1982; Lambrechts and Dhondt, 1995; Stoddard, 1996; Lovell and Lein, 2004).

Meanwhile, studies on a species of Ralid (*Gallirallus philippensis*) (Lachish and Goldizen, 2004) argue that the lack NSD and DEE is due to territorial instability that characterizes this species, a phenomenon which is also common in Strawberry poison Frog (*Dendrobates pumilio*) (Bee, 2003) and is explained from the same perspective.

On the other hand, recent studies conducted on a species of the family Tyrannidae (*Empidonax alnorum*), demonstrates that they recognize and react less aggressively to the song of neighbours (Lovell and Lein, 2004)

The Water Rail (*Rallus aquaticus*) is a species that expresses strong aggressiveness, both interspecific and conspecific, not only during establishing territory, courtship and egg incubation but also during rearing, thus including the entire

breeding season, of over five calendar months (Ripley, 1977; Taylor, 1998; Ciach, 2007). Because it is a species that strongly expresses that behaviour, its energy consumption is high. In this case, neighbour recognition (NSD) and lowering aggression towards them (DEE) would be an evolutionary attribute that would reduce consumption of energy, increasing the individual's chances of survival.

In this context our study aims are (i) to highlight if there is a difference in the Water Rail's reaction to the calls of neighbours or strangers, to conclude if they express the NSD and (ii) to analyse the intensity of these reactions to determine the degree of aggressiveness manifested towards neighbours and intruders in term to emphasize if they exhibit or not the DEE behaviour.

Materials and methods

The experiments were carried out at the Sic Reedbed, a 252.68 ha wetland which is 98% covered by the reed *Phragmites australis* (David, 2008). Located in the Fizeş Basin, in the central part of the Transylvanian Plain in Romania (24°10' E; 46°50' N) the Sic Reedbed is the largest reedbed in Transylvania (Stermin *et al.*, 2012). The density of the vegetation is around 400 plant stems per square meter and the water level does not exceed 1.5 m, generally ranging between 20 and 50 cm (Stermin *et al.*, 2012), with a high Water Rail population density (1 pair/ha) (Stermin *et al.*, 2013).

Ten points, located 100 m apart, were chosen inside the Sic Reedbeds, in a transect that crosses the marsh area. This distance was considered large enough since sounds emitted in one point would not be audible in the neighbouring points. From our observations, the sounds used (playback) in this experiment were not audible over a distance of 30-40 m due to the noise barrier created by dry vegetation. A sound intensity similar to that of a natural song was used throughout the experiment. Because the width of the reeds in the area is approximately 450 m, it was more efficient to choose observation points inside the reeds, covering a radius of 360 degrees.

The experiments lasted for three days: 18, 19 and 20 April, in the first part of the breeding season, when the territories were established and neighbours had already time for social interaction (Ripley, 1977; Taylor, 1998; Stermin *et al.*, 2012), between 6:00 – 8:00 p.m. the day time when the birds express a high call activity (Stermin *et al.*, 2013). The following study methodology was applied: in each point, we waited for a Water Rail's spontaneous reaction from inside a radius of 20 m from the point. From one minute after the moment the spontaneous reaction began, all acoustic reactions of its conspecifics were recorded, taking note of the number and time lapse between calls. After another minute, a playback of territorial calls of the species was played. Mean playback intensity and duration (20 seconds) coincided

with the intensity and duration of a natural song by individuals. From one minute after playback began, reactions by surrounding Water Rails as well as their duration were noted.

The principle behind the methodology was based on the fact that the number of reactions by surrounding birds after spontaneous activity of an individual is characteristic aggressiveness towards neighbours who are already known, and the number of reactions after playback would characterize aggression shown to outsiders. The data were interpreted by applying ANOVA.

Results and discussion

A statistically significant difference was found between the number of songs recorded after spontaneous activity and the number of songs recorded after playback ($F(1,62) = 14.400, p = 0.00034$) (Fig. 1).

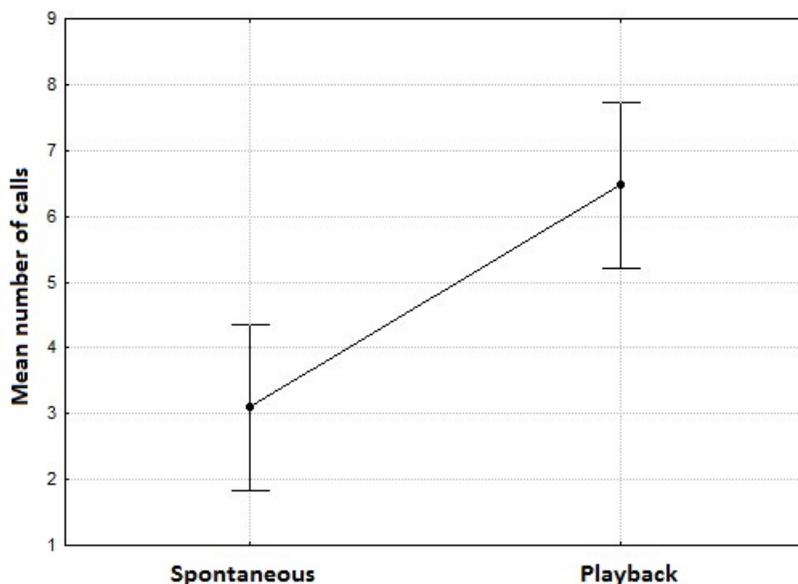


Figure 1. Mean calls numbers after spontaneous and playback activity.

Regarding time distribution, for the spontaneous activity during the one minute experiment, songs were grouped for the first half (the first 30 seconds) and second half (last 30 seconds). In this respect no statistically significant difference was found ($F(1,62) = 0.176, p = 0.676$) (Fig. 2).

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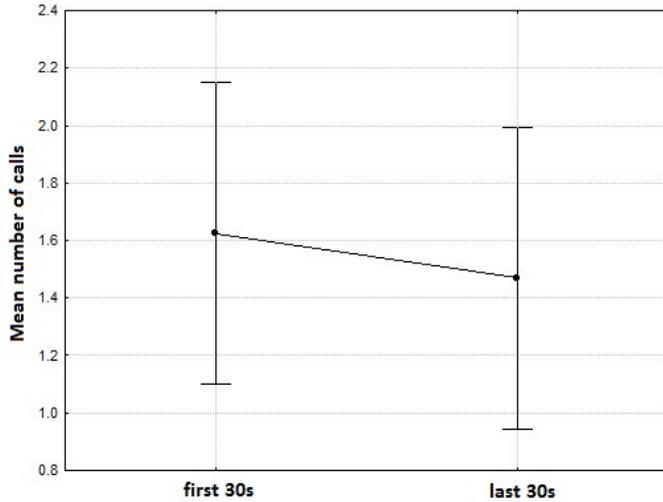


Figure 2. Mean calls distribution after spontaneous and playback reaction, by time of emission (first and second 30 s intervals)

Regarding the reactions recorded after playback, a statistically significant difference was noted between the mean number of songs issued during the first and the last half minute which followed the playback ($F(1,62) = 4.089, p = 0.0474$) (Fig. 3).

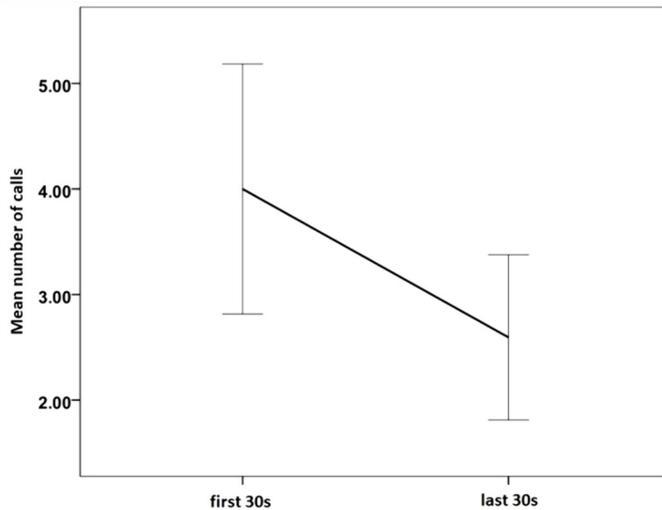


Figure 3. Distribution of mean calls number emitted after playback, by time of emission (first or last 30 s intervals)

As far as the difference between the average number of songs issued during the two time periods (first and last 30 seconds) in either approach (spontaneous reaction and playback), a statistically significant difference has been found ($F(3,124) = 8.437$; $p = 0.00004$). Analyzing the differences between mean number of songs issued during each period within each method (spontaneous and playback), it became clear that the mean number of reactions to playback during each period is significantly higher than the mean number of reactions to spontaneous activity (Table 1, Fig. 4).

Table 1. Fisher LSD test results regarding the differences between mean calls number emitted after spontaneous reaction and playback during each time period (I – first 30 s, II – last 30 s) (Significant results ($p < 0.05$) are in bold).

	Spontaneous I	Playback I	Spontaneous II	Playback II
Spontaneous I		0.000056	0.781290	0.068694
Playback I	0.000056		0.000019	0.021030
Spontaneous II	0.781290	0.000019		0.036463
Playback II	0.068694	0.021030	0.036463	

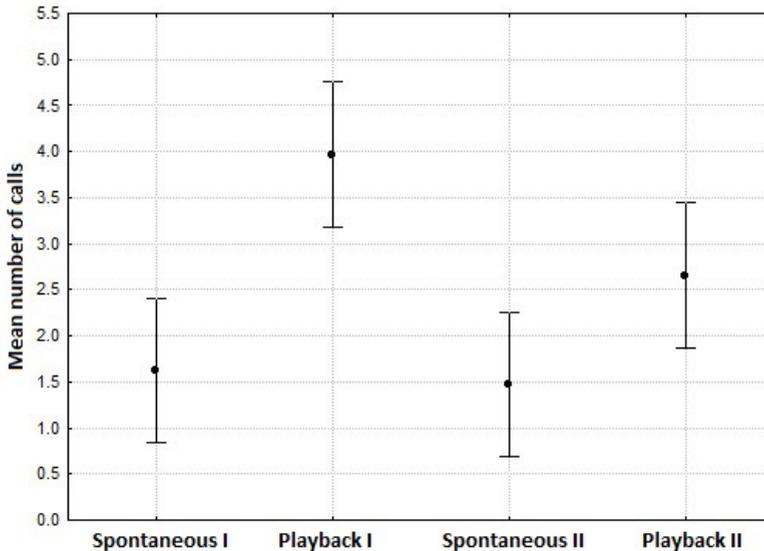


Figure 4. Distribution of mean calls number emitted after spontaneous reaction and playback, during each time period (I – first 30 s, II – last 30 s)

According to the results, the bird's reactions to playback were almost double in intensity at compared to the reaction to spontaneous calls of indigenous bird. This case argues the hypothesis that individuals of this species recognize their neighbours and react less aggressively towards them.

Also, the response to neighbours' songs follows a constant trajectory, with no differences between the numbers of responses issued during the first or second half of the minute. Instead, the reaction towards foreigners is very strong at the beginning, significantly losing intensity during the second half of the minute, towards the point of matching the intensity manifested towards neighbours.

This behaviour leads to minimizing the energy consumed by acts of aggression. By tolerating neighbours, individuals spend more time and energy with courting or caring for offspring (Ydenberg *et al.*, 1988; Temeles, 1994). One hypothesis argued by Temeles (1994) postulates that some species are more aggressive towards strangers because they may lose both their territory and partner, while with neighbours, only the partner can be lost since the neighbours already have well established territories.

However, the tolerance shown towards neighbours in other species (*Thryothorus ludovicianus*) (Hyman, 2002, 2005) is explained by pair monogamy and the lack of "extra-pair copulations" EPCs (phenomenon in which one partner mates with other individuals within a breeding season) (Haggerty *et al.*, 2001), while in cases where EPC is present, DEE is not manifested, individuals reacting very aggressively towards neighbours in order to prevent them mating with their partners (Akçay *et al.*, 2009).

No genetic studies have been conducted on the Water Rail to support or refute this species' monogamy, but the lack of aggression towards neighbours may support the hypothesis of genetic monogamy.

Conclusions

Water Rail can differentiate between neighbours and strangers expressing NSD behaviour and also DEE reacting less aggressively towards calls that are familiar than to new calls. The main reason may be energy saving in the context that this species frequently manifests aggressive territorial behaviour and often with high intensity.

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