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BREEDING BIOLOGY OF *Vanellus chilensis* (AVES: CHARADRIIDAE) IN A PERI-URBAN AREA OF SOUTHERN BRAZIL

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ABSTRACT

The neotropical species *Vanellus chilensis*, known as Southern Lapwing, is found in grassland environments, in rural and urban open areas. The species is considered a social Bird, which aggregates in pairs or small groups during the breeding period, in austral spring and summer. During the reproductive period, the cooperative breeding behavior is common among individuals of the species, when a non-breeding individual, called "helper", assists the breeding pair in parental care activities. We monitored a total of 11 social breeding unities of *V. chilensis* between august 2014 and january 2015 in the Universidade do Vale do Rio dos Sinos campus, in São Leopoldo, Rio Grande do Sul. We conducted nest observations, by evaluating the breeding success of individuals regarding eggs and chick's loss, with and without helpers' presence, as well as behavioral aspects. We recorded the laying of 65 eggs, of which 10.7% achieved breeding success, regarding the number of viable chicks. In this study, helpers' presence in the nests did not influence the breeding success of individuals, thus, dismissing the hypothesis that helpers' assistance improves breeding success of the species. Our findings contribute to the knowledge on the breeding biology of *V. chilensis* in peri-urban areas.

Keywords: Behavior; Breeding Success; Social Birds; Social Unities.

RESUMO

Biologia reprodutiva de *Vanellus chilensis* (Aves: Charadriidae) em uma área periurbana no sul do Brasil. A espécie neotropical *Vanellus chilensis*, conhecida como quero-quero, é encontrada em ambientes campestres, áreas abertas, rurais e urbanas. É considerada uma ave social e agrega-se em pares ou pequenos grupos, durante o período reprodutivo, na primavera e verão. O comportamento de reprodução cooperativa é comum entre os indivíduos desta espécie, quando um indivíduo não reprodutor, chamado "ajudante", auxilia o casal reprodutor na atividade de cuidado parental. No presente trabalho, monitoramos entre agosto de 2014 a janeiro de 2015, um total de 11 unidades sociais reprodutivas de *V. chilensis*, no campus da Universidade do Vale do Rio dos Sinos - Unisinos, perímetro periurbano em São Leopoldo, Rio Grande do Sul. Foram realizadas observações dos ninhos, avaliado o sucesso reprodutivo da espécie, contabilizada a perdas de ovos e ou filhotes, presença ou ausência de ajudantes, bem como aspectos comportamentais. Foram registradas a postura de 65 ovos, dos quais 10,7% tiveram sucesso reprodutivo relacionado ao número de filhotes viáveis. A presença ou ausência de ajudantes não interferiu no sucesso reprodutivo da espécie, não confirmando a hipótese de que os casais com ajudantes obtêm mais sucesso na

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criação dos filhotes. O estudo contribuiu com informações sobre a biologia reprodutiva de *V. chilensis* em área periurbana.

Palavras-chave: Aves Sociais; Unidades Sociais; Comportamento; Sucesso Reprodutivo.

INTRODUCTION

The species *Vanellus chilensis* (Southern-Lapwing) belongs to the Family Charadriidae, Order Charadriiformes, represented by sandpipers and plovers. *Vanellus chilensis* occurs in the neotropical region, in open grassland environments, near lakes and lagoons, and in urban areas (Belton, 1994; Narosky et al., 2010). The species nests during Spring and Summer, between August and January (Belton, 1994; Sick, 1997). Individuals are about 30 cm of total length, and present a characteristic coloration, constituted by a black strip from the neck to the chest, reddish iris and tarsus, greyish plumage on the dorsal region, from the head to the rump. The ventral plumage is partially white (Sick, 1997; Narosky et al., 2010). The presence of a nape crest is remarkable, as well as spurs in the wings, which are used for defense (Sick, 1997; Oliveira, 2003). Individuals of this species do not present apparent sexual dimorphism (Costa, 2002).

Southern Lapwings are considered social birds, which aggregates during the breeding period in pairs or groups, constituting social breeding unities (SBU) (Saracura et al., 2008; Santos and Macedo, 2011). The species is considered well adapted to changes in natural environments, especially those resulting from urbanization and agriculture activities, and may be considered a generalist species (Belton, 1994; Sick, 1997).

As widely reported in the scientific literature, changes in natural environments may harm specialist native species, although it may also provide niches for generalist species, thus favoring breeding success of those (Pereira et al., 2009). Open urban areas, such as parks and squares, in which the vegetation is constantly managed, may represent an adequate environment for generalist species to live and/or breed in (Friedrich, 2013). Understanding the processes which involves biology and breeding success of wild birds in their natural environments are important premises for the comprehension of evolution and behavioral aspects, feeding and population dynamics, especially regarding chicks' survival rates (Marini et al., 2010).

Birds may present social behavior, often aggregating in big or small groups, and in most cases, the intraspecific cooperation among individuals is observed. Regarding nest helpers' behavior, non-breeding individuals assists breeding pairs in both feeding and protecting the chicks (Alcock, 2011). The advantage in such association by birds often related to the greater capacity of surveillance against predators (Roberts, 1996). In the case of *V. chilensis*, it is noticeable that the alert state of individuals which quickly respond to people, domestic animals and birds of prey approach (Maruyama et al., 2010). The behavior of aggregating in breeding unities improves the surveillance on potential predators, which may influence the breeding success of the species. However, studies regarding the breeding behavior of *V. chilensis* focused on the efficiency of helpers' assistance during the breeding period are still scarce in the scientific literature.

In this sense, we aimed to describe relevant aspects regarding the breeding biology of *V. chilensis* in a peri-urban area, as well as to identify and verify the efficiency of helpers' influence on the breeding success.

MATERIAL AND METHODS

This study was conducted in the campus of the Universidade do Vale do Rio dos Sinos – Unisinos (29°09'12.46"S, 51°09'12.46"W), which is located in a peri-urban area in the city of São Leopoldo, Rio Grande do Sul. It is an area of 90 hectares, occupied by buildings, car parking, aquatic environments, grassland and tree environments, presenting native and exotic vegetation.

Surveys were conducted between August 2014 and January 2015, period in which 11 social breeding unities (SBU) of *V. chilensis* were sampled (Figure 1). One observer, three times a week during daylight, evaluated the following aspects: number of days of egg incubation, brood size, potential disturbances, causes of brood losses and influence of the chosen environment for egg laying. Nests were monitored at 10-20m of distance by the observer using binoculars, in order to prevent the stress of breeding adults, following methods described by Marini et al. (2010).

Information such as the number of eggs in each nest, number of chicks and adult individuals around the nests, as well as the presence of potential predators, were recorded in field worksheets for further analysis. SBUs were classified according to structure, in the following categories: with helpers' presence (HP), which comprises one or two helpers, and the absence of helpers (HA) in the nest. The categories were used to investigate if helpers influence on brood survival. All methods and techniques used in this study are in accordance with the rules of the Ethics Committee on the Use of Animals (CEUA) and Biodiversity Information and Authorization System (SISBIO) (Protocol: 47126-1).

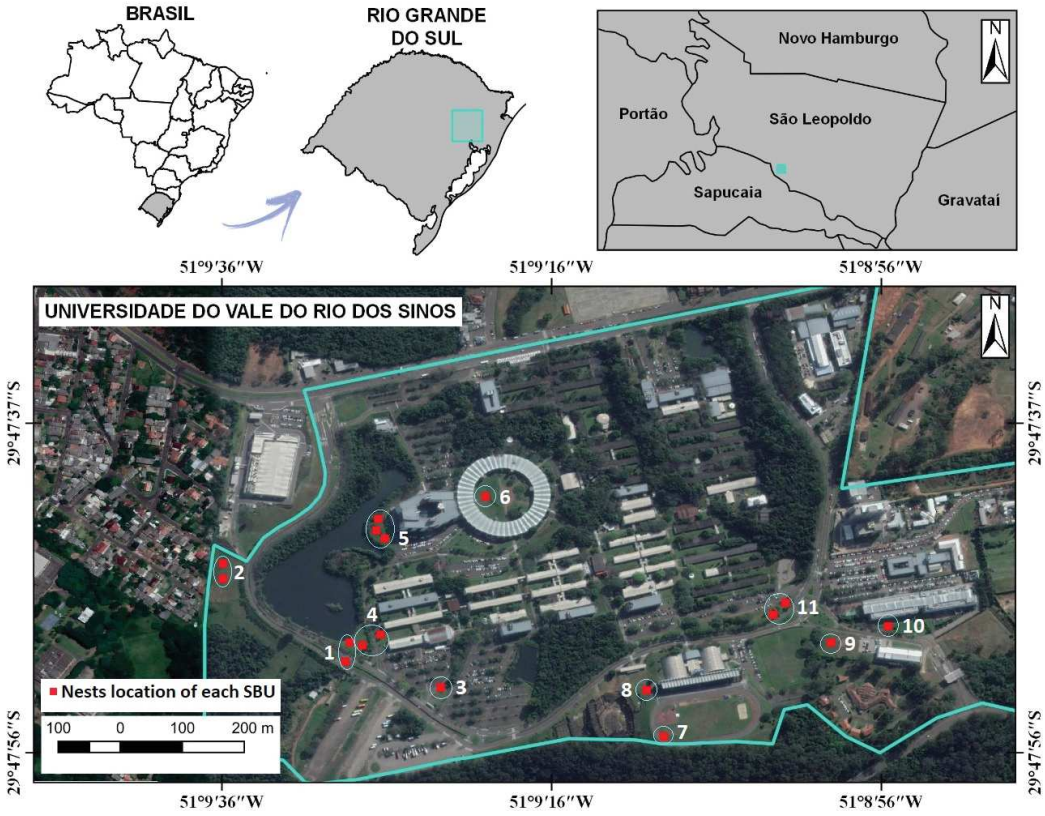

Figure 1. Study area with red squares representing nests of SBUs of *Vanellus chilensis* at Unisinos campus, Rio Grande do Sul, Brazil.

For each SBU, we registered the total number of hatched and lost eggs. Furthermore, we evaluated the average time (days) of incubation until egg hatching, the average number of eggs per breeding pair, the number of chick losses after hatching, and the number of viable chicks. All values were expressed for total population and for each SBU. Data regarding eggs were evaluated trough average numbers of the total population and for each SBU. Since data correspond to the average incubation time, we only considered unities which were monitored from laying to hatching. We expressed the breeding chronology of *V. chilensis* trough graphics, presenting the number of eggs and chicks per month, in order to determine the breeding chronology and to identify the period in which the breeding activities of the species are more intense in the study area.

RESULTS

Overall, we monitored 11 SBUs along the breeding period of 2014-2015. From all unities which helpers were present (HP), five were composed by three adult individuals and one by four adult individuals, totaling 19 individuals (Figure 2), thus representing 54.54% of the total sampled population (29 individuals). Two adults, totaling ten individuals, composed all unities in which helpers were absent (HA).

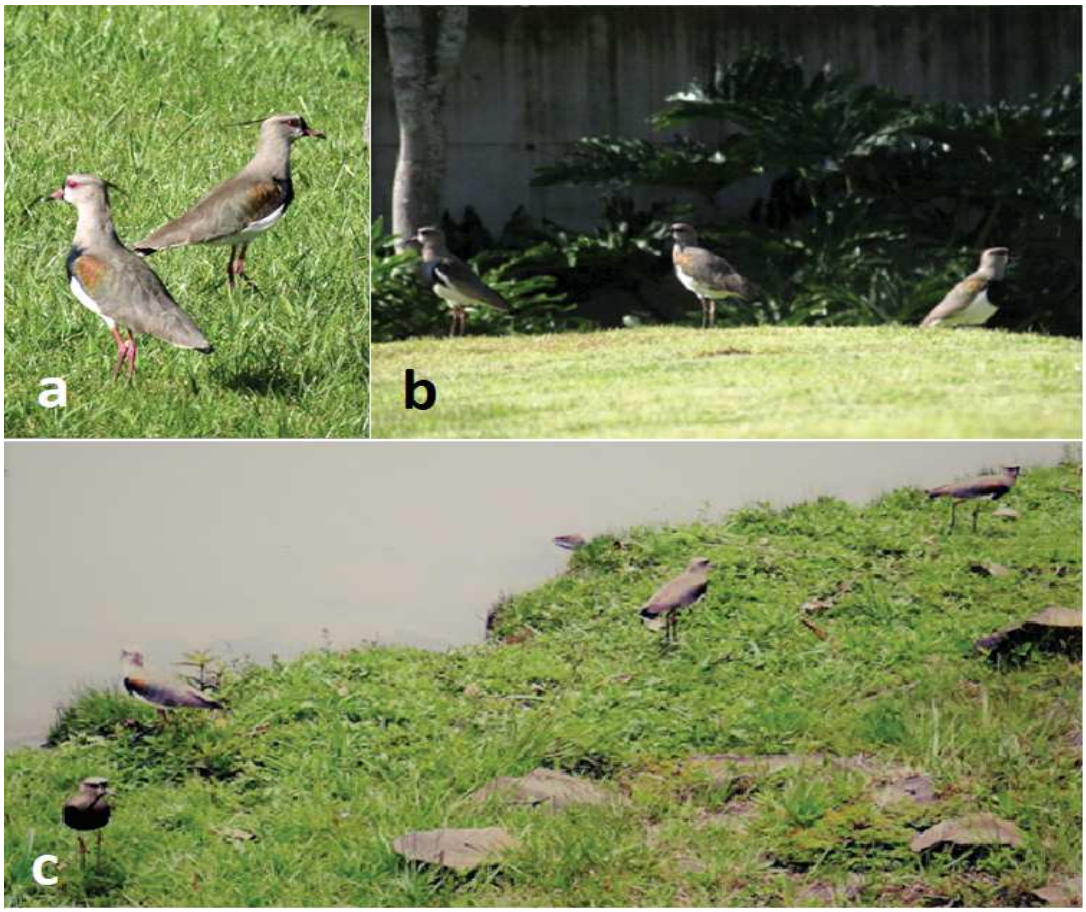

Figure 2. UBSs of *Vanellus chilensis*: (a) SBU with no helper (b) with one helper and (c) with two helpers.

The sampled SBUs performed egg laying three times along the breeding period, in which we recorded three to four eggs each, except for one nest, in which five eggs were laid (Figure 3). In the nests in which two

eggs were laid, the same were abandoned. We found a total of 65 eggs during the breeding season, and of those, 37 hatched. In total, 28 eggs and 30 chicks bird were lost during the season. Only seven eggs resulted in viable chicks birds, when considering as viable the individuals that have reached juvenile status. These represented a 10.7% breeding success of the total monitored population. From the nests that we monitored from laying to hatching, we found and average number of eggs of 3.5 per unit (Table 1). The average time of eggs' incubation was 26.3 days, varying from 19 to 35 days. In unities in which chicks hatched out, the average number of chicks was 3.5. Among all unities, in two of them eggs did not hatch, in one unity only two eggs hatched, and in another we observed a total of seven hatchings, considering all laid eggs. In one SBU the eggs were inviable in two occasions, being one nest abandoned after eggs' loss, and in the other, birds changed the nesting area. In two SBUs, after nests' loss, birds did not lay any more eggs, although they remained in the area until the end of the breeding season defending the territory.

Figure 3. Nests of *Vanellus chilensis*: (A) with three (B) four and (C) five eggs.

Table 1. Description of breeding sucesso of each Social Breading Unit (SBU) – helper absent (HA) and with helper present (HP) – representing total of laid eggs laid (EL), hatched eggs (HE) and viable chicks (VC) for each social Breedeng Unit (SBU).

	SBUs HA					SBUs HP					
	1	2	3	4	5	6	7	8	9	10	11
EL	10	7	4	2	7	8	3	6	9	3	6
HE	5	7	3	2	5	3	0	0	3	3	6
VC	0	1	1	1	0	0	0	0	0	1	3

The period with the highest number of egg laying was October, with 22 eggs. The highest numbers of chicks were recorded in September and December, with 15 chicks each (Figure 4). Regarding the total number of egg laying, the unities HP presented a total of 35 eggs and the unities HA a total of 30 eggs. The unities with helpers presented hatchings of 22 eggs, and the unities without helpers of 15 eggs. From the total laid and hatched eggs, four resulted in viable chicks in HP unities.

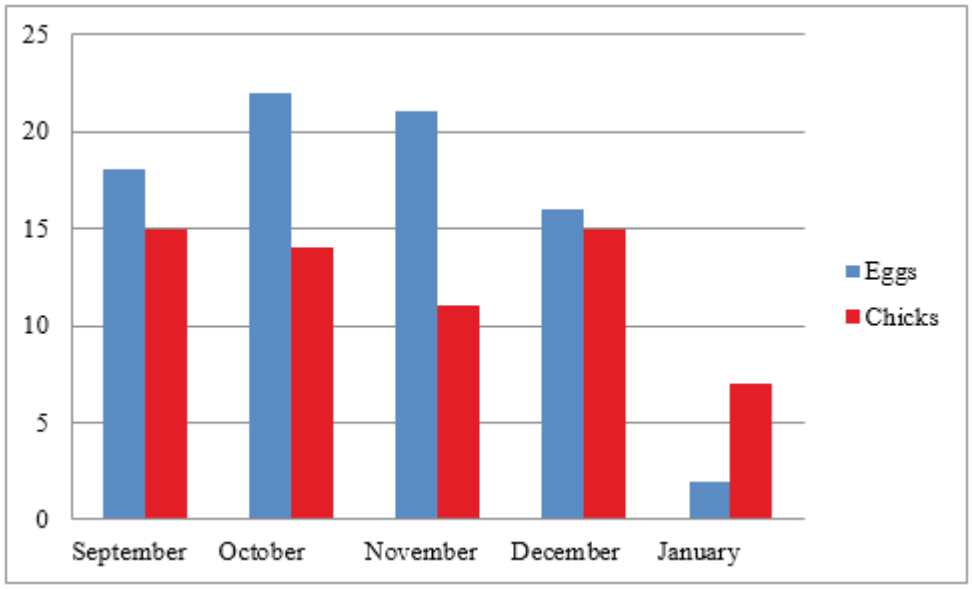

Figure 4. Breading cronology showing the total of eggs and chicks of all Social Breeding Units' between September of 2014 and January of 2015.

From the total laid and hatched eggs, four resulted in viable chicks in the HP unities and three in the HA unities, with average number of laid eggs of 3.44 in HP unities and 3.71 in HA unities. Regarding brood losses during the breeding season, in HP unities we observed a total of 20 eggs and 11 chicks, and in the HA unities, eight eggs and 19 chicks (Table 2). During behavioral observations, we reported two cases of adults expelling three nestlings, already in the flight stage, after the hatch of the second egg laying.

Table 2. Breading sucess of *Vanellus chilensis* in social breedeng unit (SBU) for helper absent (HA) and with helper present (HP) in total of eggs (TE), number of hatched eggs (HE), lost eggs (LE), lost chick (LC), viable chicks (VC), mean time of incubation (MI) in days and mean of eggs (ME) during the breading season of 2014/2015.

	SBU	TE	HE	LE	LC	VC	MI	ME
HA	5	30	22	8	19	3	27,8	3,7
HP	6	35	15	20	11	4	24,7	3,4
Total	11	65	37	28	30	7	-	-

DISCUSSION

Urban areas may be suitable environments as breeding areas for generalist species (Pereira et al., 2009), such as *V. chilensis,* since this species has been observed in extensively urbanized and anthropized areas, which contrast with those previously described by Belton (1994) and Sick (1997) for this species' breeding habitats. The study area where this research was conducted is a suitable environment for this species' breeding activities, considering the presence of lakes, wooded and open areas, which are constantly managed, thus providing an adequate habitat for *V. chilensis*. According to the literature, anthropogenic actions related to spaces' management, such as grass cut, may benefit *V. chilensis*, since the species may

move away from sites due to the lack of vegetation management (Friedrich, 2013). Still, some populations may benefit from habitat alteration caused by men (Pereira et al., 2009).

Regarding the number of eggs laying in each SBU along the breeding season, which may reach up to three, are in accordance with previous data described by Santos (2009). The number of eggs by each egg laying was 1-4 in Santos (2009) and 3-4 in Moretti and Evangelista (2008). However, none of them reports 5 eggs laid as reported in this study. The high rate of egg and chick losses (28 eggs and 38 chicks) may be related to predation, caused by human actions, *e.g.* trampling by vehicles and breeding sites' management, by wild and domesticated animals or by natural events, such as rain and storms. According to Moretti and Evangelista (2008), predation of eggs and chicks by raptors and mammals are among the most frequent interferences in the breeding process. The wild species *Salvator merianae* (Black-and-White Tegu), *Didelphis albiventris* (White-eared Opossum), *Caracara plancus* (Southern Caracara), *Athene cunicularia* (Burrowing Owl), and the domesticated species *Felis silvestres catus* (Cat) and *Canis lupus familiaris* (Dog) were frequently sighted close to breeding areas during monitoring and *Cerdocyon thous* (Crab-eating fox) is also reported in campus area (Procksch et al., 2018), being considered as potential predators, as suggested by Walters (1990), and may be influencing egg and chick losses.

During field work, we observed that the vegetation management and the most severe weather were the factors that directly influenced on the breeding success of *V. chilensis.* Besides that, during the monitoring period, a case of a nest with three eggs destroyed due to grass cut, and other two with apparent signs of the same damage. Trampling cases were not confirmed in this study, although it may be related to chick losses in two SBU which nest near busy parking lots. Regarding breeding success, only 10.7% of all eggs resulted in viable chicks. Studies reporting data on the breeding success of the species, in terms of viable chicks by the end of the breeding season, are not available in the literature. However, Hogan et al. (2010) reported a survival rate of 6%, considering chicks which were alive until the end of the breeding season, for other Charadriiform species, the South American Tern (*Sterna hirundinacea*).

There was not a considerable relation between the presence/absence of helpers and the breeding success of the SBUs. Our data showed a slightly higher proportion of eggs that have reached hatching in SBU without helpers, indicating a greater success until this stage. Regarding viable chicks, we recorded a higher number in SBUs with helpers (n = 4), however, three of these were bred in the same SBU in two distinct egg laying, and in the WH unities, three unities had one viable chick each. Therefore, from all six HP unities, only two presented viable chicks, where in HA unities, three of five eggs resulted in viable chicks, thus representing a higher proportion of viable chicks per adult. In two unities, eggs did not reach hatching, which may be related to parents' inexperience (Linz et al., 2014) or to local environmental factors.

According to Alcock (2011), for many species the presence of helpers may contribute to the offspring's success, by helping to feed the chicks and protecting against predators, as occurs for *V. chilensis* (Saracura et al., 2008). The brood benefits with the presence of helpers by feeding themselves more freely (Legge, 2000). Yet, accorging to Manica (2008), helpers improve the protection against predators, although the movements of these individuals in the breeding areas may indicate to predators the presence of chicks (Skutch, 1949). For cooperatively breeding bird species, helpers may represent potential competitors for food to the brood, during extreme situations (Covas et al., 2011). Such kind of competition may occur in *V.*

chilensis SBUs, once the chicks leave the nest right after eggs hatching, and remain foraging in the vicinity of the breeding area, along with their parents and helpers.

However, data on the relation of food resources between chicks, parents and helpers are poorly known for the species, and studies about helpers' roles on breeding bird activities have suggested that it causes direct and indirect benefits, even providing an evolutionary advantage for species that perform such strategy (Brouwer et al., 2012; Liker et al., 2013; Hatchwell et al., 2014). Helpers may be chicks from previous offspring, which remain in the breeding area to inherit their parents' territories, but may also be unrelated, or unrelated to previous offspring (Alcock, 2011). In this sense, Green (2016) stated that the helpers' kin relation has been fundamental for the efficiency of helpers in benefiting the species. One of the reasons that may explain the lack of difference in breeding success between SBUs with and without helpers in this study may be related to the number of individuals in the studied breeding areas, as suggested by Roberts (1996), noting that where there are more individuals, the tendency is a reduced individual surveillance.

In this sense, the presence of helpers may favor the choice of better reproductive territories, disfavoring groups without helpers (Santos, 2009). In this study, we did not find relevant results regarding the effects of the presence/absence of helpers in the nests, thus highlighting the need of long-term monitoring for this species. However, we have provided some information for the literature on reproductive biology in *V. chilensis* in an urbanized area.

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