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## Gastropod species found in birds' nests from Argentina

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**Abstract:** Bird's nests are specialized habitats that are inhabited by a diverse suite of invertebrates, such as insects, spiders, pseudoscorpions, and ticks. This study presents a list of gastropods found in birds' nests from Argentina for the first time. A total of 138 specimens of gastropods, belonging to 11 species, 10 genera and 8 families of snails were present in the nests of 42 birds from 6 families in 6 provinces in Argentina. Fifty eight specimens of the snail *Pupisoma latens* of different sizes were found alive in a nest, representing a new habitat for this species, which has been previously described from the aerial parts of trees. The remaining species were represented by dead specimens (fragments or empty shells), which can be tentatively attributed to bird diets. Among these, the most abundant species were *Bulimulus bonariensis bonariensis* and *Succinea meridionalis*, both as pre-adults. The nests *Anumbius annumbi* and *Furnarius rufus* from the province of Buenos Aires had the highest number of specimens. Freshwater snails (*Heleobia parchappii*, *Biomphalaria* sp., and *Drepanotrema* sp.) comprised 13% of the snail species found.

**Key words:** Mollusks, aquatic gastropods, landsnails, *Pupisoma*, birds, nest inhabitants, diet.

**Resumen:** Los nidos de aves son ejemplos de hábitats ocupados por un conjunto de invertebrados, como insectos, arañas, pseudoescorpiones, etc. Por primera vez se presenta una lista de gasterópodos encontrados en nidos aviares de la Argentina. Un total de 138 especímenes pertenecientes a 11 especies, 10 géneros y 8 familias fueron hallados en 42 nidos de 6 familias de aves en 6 provincias. Sólo *Pupisoma latens*, representado por 58 especímenes de diferentes tamaños, fue encontrado vivo en un nido, siendo un nuevo hábitat de la especie, previamente encontrada en partes aéreas de árboles. El resto de las especies estaban representadas por animales muertos (fragmentos o conchillas vacías), que podrían estar relacionados a la dieta de las aves. Entre estas, las especies con mayor número de representantes (mayoritariamente pre-adultos) fueron *Bulimulus bonariensis bonariensis* y *Succinea meridionalis*. Los nidos de *Anumbius annumbi* y *Furnarius rufus* de la provincia de Buenos Aires tuvieron el número más elevado de ejemplares de gasterópodos. Especímenes de gasterópodos de agua dulce (*Heleobia parchappii*, *Biomphalaria* sp. y *Drepanotrema* sp.) constituyeron 13 % del total.

**Palabras clave:** Moluscos, gasterópodos acuáticos, gasterópodos terrestres, *Pupisoma*, aves, habitantes de nidos, dieta.

### INTRODUCTION

The nests of birds constitute a microenvironment that provides organic material and shelter for a diverse suite of invertebrates (insects, spiders, pseudoscorpions, and ticks), which inhabit these nests in varying abundance (Di Iorio & Turienzo, 2009, 2011; Turienzo & Di Iorio, 2008, 2010, 2011, 2014a). Nevertheless, data about the occurrence of American gastropods in birds' nests are scarcely found in literature (Appendix 1).

The probable causes of the presence of snails in bird's nests were in part suggested by Judd

(1963) and Nolan (1959). Judd (1963) reported, "most of the snails were in nests constructed in flood debris or in trees and shrubs at the river's edge." One species found in the nests is "among the commonest snail in flood debris, another is found among damp under leaves in densely shaded places, a third is found on low ground near streams, and a fourth, "the snail found most commonly in the nests, as well as being in nests along the river, is also found climbing trees". Thus, in these cases, birds' nests also serve as an extension of the natural habitat of the species already present on the branches and foliage.

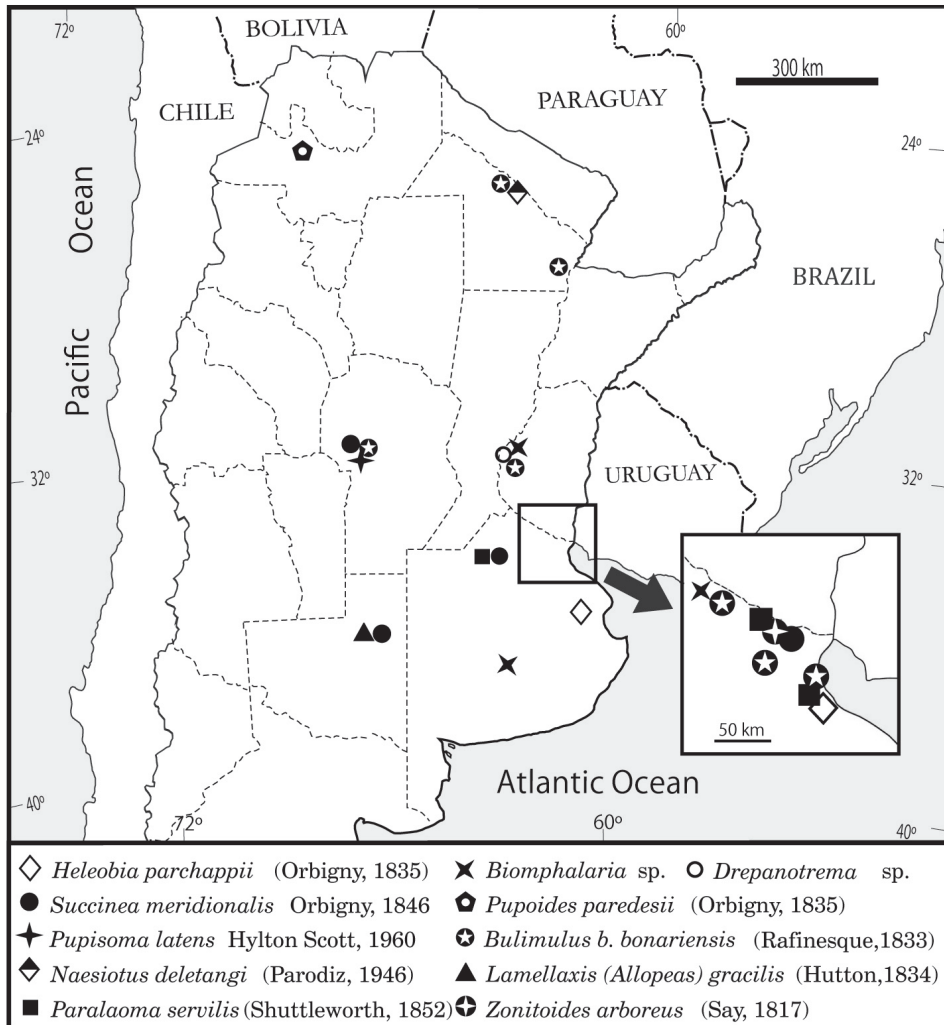


Fig. 1. Distribution of gastropods in birds' nests from Argentina.

According to Nolan (1959), Roscoe (1955) tells of the discovery of aquatic snails on birds' plumage. Ramsden (1914), McAtee (1914), and Paton & Williamson (1943) refer to similar episodes involving terrestrial snails, i.e. that the snails are involuntarily transported by the birds. Vagvolgyi (1975) postulated that a species of petrel could be responsible for the introduction of the micromollusk *Nesopupa galapagensis* Vagvolgyi, 1974 to the Galápagos Islands (Miquel & Herrera, 2014). The physiological and/or behavioral features of each species must be considered, e.g., the characteristics of the pedal mucus of species of *Succinea*, which is particularly adhesive, could help the passive transport of this gastropod (Vagvolgyi, 1975). In recent years, it was observed that operculate gastropods can survive

the passage through the digestive tract of birds (Kawakami *et al.*, 2008; van Leeuwen *et al.*, 2012; Wada *et al.*, 2012; Rusiecki & Rusiecka, 2013).

There are several historical records of freshwater snails (Ampullariidae, Cochliopidae, Planorbidae) as food items of some birds from Argentina (Aravena, 1928, Zotta, 1932, 1934, 1936, 1940), as well as records of some unidentified fragments of a mollusk in the digestive tract of *Coryphistera alaudina* Burmeister, 1866 [Furnariidae] (Olrog, 1956). In the case of Furnariidae birds, it was observed that prey remains can be disregarded inside the nests, in form of fragments (Turienzo & Di Iorio, 2008, 2010, 2014a), or in regurgitated pellets (Turienzo & Di Iorio, 2014b).

This study presents the first records of ter-

restrial gastropods found in avian nests from Argentina, alive or dead, in Argentina. The purpose of this work is to present new information about the existence of a relationship between birds and continental mollusks, which could provide information about the spreading of gastropods by avian species.

## MATERIALS AND METHODS

Extensive research on invertebrate communities in birds' nests from Argentina was undertaken between 2005 and 2010, encompassing a total of 695 nests belonging to 13 bird families from 14 provinces (Turienzo & Di Iorio, 2014b). Nest identifications were made following the nest descriptions of De la Peña (1987, 2005) and Narosky et al. (1983), and by the observation of the birds following Narosky & Yzurieta (2003). Each nest was entirely removed from the tree branches, placed in a bag, and taken to the laboratory where it was dissected. All invertebrates were manually collected and preserved by P. Turienzo and O. Di Iorio. The diet items of 11 species of Furnariidae (included in the present work) were summarized by Turienzo & Di Iorio (2014b).

Snails were identified by the senior author and housed in the Invertebrate Division of the Museo Argentino de Ciencias Naturales "Bernardino Rivadavia". Abbreviations used: D: diameter; H: height; MACN-In: Invertebrate Collection, Museo Argentino de Ciencias Naturales "Bernardino Rivadavia", Buenos Aires, Argentina.

## RESULTS

The following birds' nests from Argentina were positive for mollusk findings inside them: *Milvago chimango* Viellot, 1816 [Falconidae]; *Anumbius annumbi* (Viellot, 1817); *Asthenes dorbignyi* (Reichenbach, 1853); *Furnarius rufus* (Gmelin, 1788); *Phacellodomus striaticollis* Orbigny & Lafresnaye, 1838; *Schoeniophylax phryganophila* (Viellot, 1817); *Coryphistera alaudina* Burmeister, 1860; *Pseudoseisura lophotes* (Reichenbach, 1853) [Furnariidae], the nests of this last species remodeled and occupied by *Myiopsitta monachus catita* (Olrog, 1976) [Psittacidae]; *Passer domesticus* (L., 1758) [Passeridae], outside and inside the nests of *F. rufus*; *Myiopsitta monachus catita* Olrog, 1976 [Psittacidae]; *Sicalis flaveola pelzelni* Sclater, 1872 [Aves: Thraupidae], inside the nests of *F. rufus*; *Turdus amaurochalinus* Cabanis, 1850 [Aves: Turdidae], and in one undetermined nest of an in-quiline bird inside a nest of *F. rufus* (Table 1).

A total of 138 gastropods were found in 42 nests, representing 6.04 % of the whole sampled nests (Turienzo & Di Iorio, 2014b), belonging to 14 species in seven families of birds from six Argentine provinces (Table 1). About 69 % of the positive nests were of birds in the family Furnariidae (n = 29), especially in 13 nests of *A. annumbi*. The nests of *F. rufus* are closed domed nests build with mud, which eventually serves as nidification sites for other birds, such as *S. f. pelzelni*, *P. domesticus* and *P. chalybea*, where also snails were found, as well as in nests of *F. rufus* without in-quiline birds (Table 1).

The snails were distributed across 11 species, 10 genera and 8 families. Out of this total, 7 species were soil-related, and 4 taxa were limnic species (Table 2). The average number of snails by bird species was 6.66. However, *Pupisoma latens* accounted for 58 live specimens in a single nest. All the remaining gastropods were collected as empty shells, with a low abundance (1.86 shells by nest). Thirty percent of the specimens were fragmented shells.

### Cochliopidae

#### *Heleobia parchappii* (Orbigny, 1835)

(Fig. 2A)

**Material examined.** Buenos Aires: Chascomús, 11-VIII-2009, 3 exs. [MACN-In 38363], in nest of *A. annumbi* # 1 on *Celtis tala*; Chascomús, 28-I-2010, 8 exs. [MACN-In 38364], in nest of *F. rufus* # 7 (+ *Sicalis flaveola pelzelni*), on *Populus* sp., 1 ex. [MACN-In 38362], in nest of *F. rufus* (+ *Sicalis flaveola pelzelni*); Chascomús, 15-IX-2009, 1 ex. [MACN-In 38365], in nest of *F. rufus* # 1 + *Passer domesticus*, on *Celtis tala*; Chascomús, 23-III-2010, 1 ex. [MACN-In 39097], in nest of *F. rufus* # 9 + nest of *Progne chalybea* (Gmelin, 1789) [Hirundinidae] on *Melia azedarach*; Ciudad Autónoma de Buenos Aires: Ciudad Universitaria, 19-VIII-2008, 1 ex. [MACN-In 37508], in nest of *F. rufus*; Ciudad Universitaria, 28-VII-2008, 1 ex. [MACN-In 37509], in nest of *T. amaurochalinus* on *Celtis australis*

#### **Measurements of the illustrated specimen.**

D: 4.0 x H: 1.5 mm, 5.5 whorls.

**Distribution.** Entre Ríos, Santa Fe, Buenos Aires, La Pampa, Río Negro provinces (Gaillard & Castellanos, 1977).

**Remark.** The analyzed specimens were adults, ranging between 4 to 5 mm in length with seven to eight whorls.

Table 1: Bird families species and numbers of nests positive for Gastropoda in Argentina. Abbreviations of Argentinian provinces: **BA**, Buenos Aires (both province and Ciudad Autónoma); **Cb**, Córdoba; **Ch**, Chaco; **ER**, Entre Ríos; **LP**, La Pampa; **Sa**, Salta.

| Family       | Bird species                                                    | Sa | Ch | Cb | ER | LP | BA | Total |
|--------------|-----------------------------------------------------------------|----|----|----|----|----|----|-------|
| Falconidae   | <i>Milvago chimango</i>                                         |    |    |    |    |    | 1  | 1     |
| Furnariidae  | <i>Anumbius annumbi</i>                                         |    |    |    | 1  | 1  | 11 | 13    |
| Furnariidae  | <i>Asthenes dorbignyi</i>                                       | 1  |    |    |    |    |    | 1     |
| Furnariidae  | <i>Coryphistera alaudina</i>                                    |    | 1  | 2  |    |    |    | 3     |
| Furnariidae  | <i>Furnarius rufus</i>                                          |    |    |    |    |    | 2  | 2     |
| Furnariidae  | <i>Phacellodomus sibilatrix</i>                                 |    | 2  |    |    |    |    | 2     |
| Furnariidae  | <i>Phacellodomus striaticollis</i>                              |    |    |    |    |    | 3  | 3     |
| Furnariidae  | <i>Pseudoseisura lophotes</i> (with <i>M. monachus</i> )        |    |    |    | 2  |    |    | 2     |
| Furnariidae  | <i>Schoeniophylax phryganophila</i>                             |    |    |    |    |    | 3  | 3     |
| Hirundinidae | <i>Progne chalybea</i> (inside <i>F. rufus</i> nest)            |    |    |    |    |    | 1  | 1     |
| Passeridae   | <i>Passer domesticus</i> (outside)                              |    |    |    | 2  |    |    | 2     |
| Passeridae   | <i>Passer domesticus</i> (inside <i>F. rufus</i> nests)         |    |    |    |    |    | 2  | 2     |
| Psittacidae  | <i>Myiopsitta monachus</i>                                      |    |    |    |    | 1  |    | 1     |
| Thraupidae   | <i>Sicalis flaveola pelzelni</i> (inside <i>F. rufus</i> nests) |    |    |    |    |    | 4  | 4     |
| Turdidae     | <i>Turdus amaurochalinus</i>                                    |    |    |    |    |    | 1  | 1     |
| Undetermined | Inquiline bird (inside <i>F. rufus</i> nest)                    |    |    |    |    |    | 1  | 1     |
| Total        |                                                                 | 1  | 3  | 4  | 3  | 2  | 29 | 42    |

Planorbidae  
***Biomphalaria*** sp.  
(Fig. 2B)

**Material examined.** *Entre Ríos*: Crespo, 15-IX-2009, 1 ex. [MACN-In 38366], in nest of *P. domesticus*, on *Acacia caven*; *Buenos Aires*: Vuelta de Obligado, 27-IX-2008, 1 ex. [MACN-In 38368], in nest of *F. rufus* + inquiline bird, on *Broussonetia papyrifera*.

**Measurements of the illustrated specimen.** D: 3.5 x H: 1.5 mm, 4.50 whorls.

**Distribution.** America and Africa (Rumi, 1991).

**Remark.** The analyzed specimens were juveniles.

***Drepanotrema*** sp.  
(Fig. 2C)

**Material examined.** *Entre Ríos*: Crespo, 26-XII-2009, 1 ex. [MACN-In 38367], in nest of *Passer domesticus* # 4 on *Acacia caven*.

**Measurements of the illustrated specimen.** D: 4.5 x H: 4.0 mm, 5 whorls.

**Distribution.** South America (Rumi, 1991).

Succineidae  
***Succinea meridionalis*** Orbigny, 1846  
(Fig. 2D)

**Material examined.** *Córdoba*: Mina Clavero, 14-VII-2009, 3 exs. [MACN-In 38376], in nest of *Pseudoseisura lophotes* # 3 (remodeled by *Myiopsitta monachus*) on *Prosopis flexuosa*; *Buenos Aires*: Junín, 4 exs. [MACN-In 37462], in nest of *Passer domesticus*; Estación Río Luján, 8-I-2009, 2 exs. [MACN-In 37540], in nest of *A. annumbi* on *Schinus* sp.; Estación Río Luján, 30-X-2009, 3 exs. [MACN-In 38341], in nest of *A. annumbi* on *Schinus* sp.; Estación Río Luján, 27-V-2009, 1 ex. [MACN-In 38342], in nest of *A. annumbi* on *Celtis tala*; *La Pampa*: Santa Rosa, 7-II-2008, 2 exs. [MACN-In 38343], in one old nest of *A. annumbi* occupied by inquilines on *Geoffroea decorticans*.

**Measurements of the illustrated specimen.** D: 7.0 x H: 3.5 mm, 3.25 whorls.

**Distribution.** Brazil, Paraguay, Uruguay; Argentina: north and central areas to northern Patagonia (Castellanos & Landoni, 1995; Simone, 2006).

**Remarks:** The average total length of the shells

Table 2. Number of gastropods specimens (mostly shells) found in bird's nests in Argentina, shown for each avian species. \* The only species found alive in a nest is *Pupisoma latens*.

|                                 | <i>Anumbius annumbi</i> | <i>Asthenes dorbignyi</i> | <i>Coryphistera ataudina</i> | <i>Furnarius rufus + Sicalis sp.</i> | <i>Mitvago chimango</i> | <i>Myiopsitta monachus</i> | <i>Passer domesticus</i> | <i>Phacelodomus striatocollis</i> | <i>Phacelodomus sibilatrix</i> | <i>Pseudoseisura lophotes</i> | <i>Schoenophylax phryganophila</i> | <i>Turdus amaurochalinus</i> | TOTAL |
|---------------------------------|-------------------------|---------------------------|------------------------------|--------------------------------------|-------------------------|----------------------------|--------------------------|-----------------------------------|--------------------------------|-------------------------------|------------------------------------|------------------------------|-------|
| <i>Heleobia parchappii</i>      | 3                       |                           |                              | 11                                   |                         |                            |                          |                                   |                                |                               |                                    | 1                            | 13    |
| <i>Biomphalaria</i> sp.         |                         |                           |                              | 1                                    |                         |                            | 1                        |                                   |                                |                               |                                    |                              | 2     |
| <i>Drepanotrema</i> sp.         |                         |                           |                              |                                      |                         |                            | 1                        |                                   |                                |                               |                                    |                              | 1     |
| <i>Succinea meridionalis</i>    | 8                       |                           |                              |                                      |                         |                            | 4                        |                                   |                                | 3                             |                                    |                              | 15    |
| <i>Pupoides paredesi</i>        |                         | 3                         |                              |                                      |                         |                            |                          |                                   |                                |                               |                                    |                              | 3     |
| <i>Bulimulus b. bonariensis</i> | 16                      |                           | 6                            | 2                                    | 2                       |                            |                          | 4                                 | 1                              |                               | 1                                  |                              | 32    |
| <i>Naesiotus deletangi</i>      |                         |                           |                              |                                      |                         |                            |                          |                                   | 2                              |                               |                                    |                              | 2     |
| <i>Lamellaxis gracilis</i>      |                         |                           |                              |                                      |                         | 1                          |                          |                                   |                                |                               |                                    |                              | 1     |
| <i>Paralaoma servilis</i>       | 1                       |                           |                              | 1                                    |                         |                            |                          | 1                                 |                                |                               | 2                                  |                              | 5     |
| <i>Pupisoma latens</i> *        |                         |                           |                              |                                      |                         |                            |                          |                                   |                                | 58                            |                                    |                              | 58    |
| <i>Zonitoides arboreus</i>      |                         |                           |                              | 3                                    |                         |                            |                          |                                   |                                |                               |                                    |                              | 3     |
| TOTAL                           | 28                      | 3                         | 6                            | 18                                   | 2                       | 1                          | 6                        | 5                                 | 3                              | 61                            | 3                                  | 1                            | 138   |

of this species collected from avian nests was 6.8 mm (pre-adults).

#### Pupillidae

##### *Pupoides paredesi* (Orbigny, 1835)

(Fig. 2E)

**Material examined.** *Salta*: La Poma, 27-XI-2008, 3 exs. [MACN-In 37538], in nest of *Asthenes dorbignyi* on *Trichocereus atacamensis*.

**Measurements of the illustrated specimen.**

D: 5.0 x H: 1.5 mm, 6.25 whorls.

**Distribution.** Ecuador, Perú, Bolivia, Chile; Argentina: Jujuy (Hylton Scott, 1945; Fernández, 1973).

#### Subulinidae

##### *Lamellaxis (Allopeas) gracilis* (Hutton, 1834)

**Material examined.** *La Pampa*: Paraje La Araña, 2-III-2008, 1 ex. [MACN-In 37463], broken, in nest of *Myiopsitta monachus* on *Prosopis caldenia*.

**Distribution.** Worldwide, tropical and temperate regions, transported by the man. In

Argentina, Tucumán, Catamarca, Misiones, Corrientes, Entre Ríos, La Pampa and Buenos Aires provinces (Virgillito, 2012).

#### Vallonidae

##### *Pupisoma latens* Hylton Scott, 1960

(Fig. 2F-G)

**Material examined.** *Córdoba*: Mina Clavero, 22-I-2010, 58 exs. [MACN-In 38361], in nest of *Pseudoseisura lophotes* # 3 (occupied by *Myiopsitta monachus*) on *Prosopis flexuosa*.

**Measurements of the illustrated specimen.**

D: 1.0 x H: 1.0 mm, 2.5 whorls.

**Distribution.** Córdoba: Cabana (Hylton Scott, 1960; Fernández, 1973).

**Remarks.** The analyzed specimens ranged from 1.3 to 4.5 mm in size. This species was preliminarily considered to be conspecific with *P. comicolense* (Baker, 1928) by Hausdorf (2007), because there are apparently intermediate specimens between the extreme forms of the latter. This taxonomic statement requires further research.



## Bulimulidae

***Bulimulus bonariensis bonariensis***

(Rafinesque, 1833)

(Fig. 2H)

**Material examined.** *Chaco:* Route 90, Km 21, 3-XII-2008, 1 ex. [MACN-In 37539], in nest of *Coryphistera alaudina* on *Prosopis alba*; *El Espinillo,* 6-I-2010, 1 ex. [MACN-In 38354], in nest of *Phacellodomus sibilatrix* # 4 (with three nestlings), on *Prosopis ruscifolia*; *Córdoba:* Mina Clavero, 14-VII-2009, 4 exs. [MACN-In 38357], in nest of *C. alaudina* # 2 on *Acacia atramentaria*, 1 ex. [MACN-In 38352], in nest of *Coryphistera alaudina* # 3, on *Ulmus* sp.; *Entre Ríos:* Crespo, 24-XII-2009, 1 ex. [MACN-In 38351], in nest of *A. annumbi*, on *Acacia cavendishii*; *Buenos Aires:* Campo de Mayo, 3-XII-2005, 8 exs. [MACN-In 37177], in nest of *A. annumbi* on *Celtis tala*; Campo de Mayo, 27-VIII-2005, 1 ex. [MACN-In 37511], in nest of *A. annumbi* on *Celtis tala*; Campo de Mayo, 16-I-2010, 1 ex. [MACN-In 38349], in nest of *Schoeniophylax phryganophila* on *Celtis tala*; Campo de Mayo, 12-XII-2009, 2 exs. [MACN-In 38358], in nest of *Milvago chimango*; Vuelta de Obligado, 27-IX-2008, 1 ex. [MACN-In 37522], in nest of *Phacellodomus striaticollis*, on *Celtis tala*; Estación Río Luján, 15-IX-2008, 1 ex. [MACN-In 37523], in nest of *P. striaticollis*; Estación Río Luján, 21-IV-2009, 2 exs. [MACN-In 38344], in nest of *A. annumbi* on *Celtis tala*; Estación Río Luján, 30-IX-2009, 1 ex. [MACN-In 38345], in nest of *F. rufus* (+ *Sicalis flaveola pelzelni*) on *Celtis tala*; Estación Río Luján, 30-IX-2009, 1 ex. [MACN-In 38347], in nest of *A. annumbi*; Estación Río Luján, 3-XII-2009, 1 ex. [MACN-In 38353], in nest of *A. annumbi* on *Celtis tala*; Estación Río Luján, 27-V-2009, 1 ex. [MACN-In 38356], in nest of *A. annumbi* on *Celtis tala*; Estación Río Luján, 31-III-2009, 1 ex. [MACN-In 38359], in nest of *F. rufus* # 1 (+ *Sicalis flaveola pelzelni*); Estación Río Luján, 26-VI-2009, 1 ex. [MACN-In 38360], in nest of *A. annumbi* # 2 on *Celtis tala*; Zelaya, 25-VII-2009, 2 exs. [MACN-In 38346], in nest of *Phacellodomus striaticollis* # 1 on *Celtis tala*.

**Measurements of the illustrated specimen.** D: 25.0 x H: 11.0 mm, 6 whorls.

**Distribution.** Uruguay. Chaco-pampean and mesopotamic regions of Argentina (Miquel, 1991; Miquel & Aguirre, 2011).

**Remarks:** Only five out of 32 specimens of this species were adults or pre-adults (shell size between 15.5 and 19.0 mm and 6 whorls).

***Naesiotus deletangi*** (Parodiz, 1946)

(Fig. 2I)

**Material examined.** *Chaco:* El Espinillo, 6-I-2010, 2 exs. [MACN-In 38355], in nest of *Phacellodomus sibilatrix*.

**Measurements of the illustrated specimen.** D: 5.5 x H: 3.0 mm, 5.50 whorls.

**Remark.** The analyzed specimens were juveniles.

**Distribution.** Northwest and central-west areas of Argentina (Miquel, 1989; Miquel & Aguirre, 2011).

## Punctidae

***Paralaoma servilis*** (Shuttleworth, 1852)

(Fig. 2J-K)

**Material examined.** *Buenos Aires:* Junín, 26-VIII-2008, 1 ex. [MACN-In 37510], in nest of *A. annumbi* on *Gleditsia triacanthos*; Estación Ingeniero Otamendi, 15-IX-2008, 1 ex. [MACN-In 37521], in nest of *F. rufus* on *Celtis tala*; Estación Río Luján, 15-IX-2008, 1 ex. [MACN-In 37524], in nest of *P. striaticollis* on *Celtis tala*; Campo de Mayo, 16-I-2010, 2 exs. [MACN-In 38348], in nest of *S. phryganophila* # 1-3 on *Celtis tala*.

**Measurements of the illustrated specimen.** D: 2.5 x 1.5 mm, 4.5 whorls.

**Distribution.** Colombia; Brazil; Peru; Bolivia; Chile; Argentina: Misiones, Tucumán, Formosa, Santa Fe, Entre Ríos, Buenos Aires, Chubut; Tierra del Fuego (Araya, 2015; Miquel & Barker, 2009; Virgillito & Miquel, 2013).

## Zonitidae

***Zonitoides arboreus*** (Say, 1817)

(Fig. 2L)

**Material examined.** *Buenos Aires:* Estación Ingeniero Otamendi, 15-IX-2008, 3 exs. [MACN-In 37520], in nest of *F. rufus* on *Celtis tala*.

**Measurements of the illustrated specimen.** D: 5.0 x H: 2.5 mm, 4.75 whorls.

**Distribution.** Europe, Israel, Kenya, South Africa, Madagascar, Hong Kong, Japan, Hawaii, North America, Australia; New Zealand, distributed by man (Pilsbry, 1946; Virgillito & Miquel, 2013); South America; Argentina: Jujuy, Salta, Catamarca, Tucumán, Misiones, Corrientes, Santiago del Estero, Córdoba, Entre Ríos; Buenos Aires (Virgillito, 2012).

## DISCUSSION

A comparison between the snail families and the species found in birds' nests from the

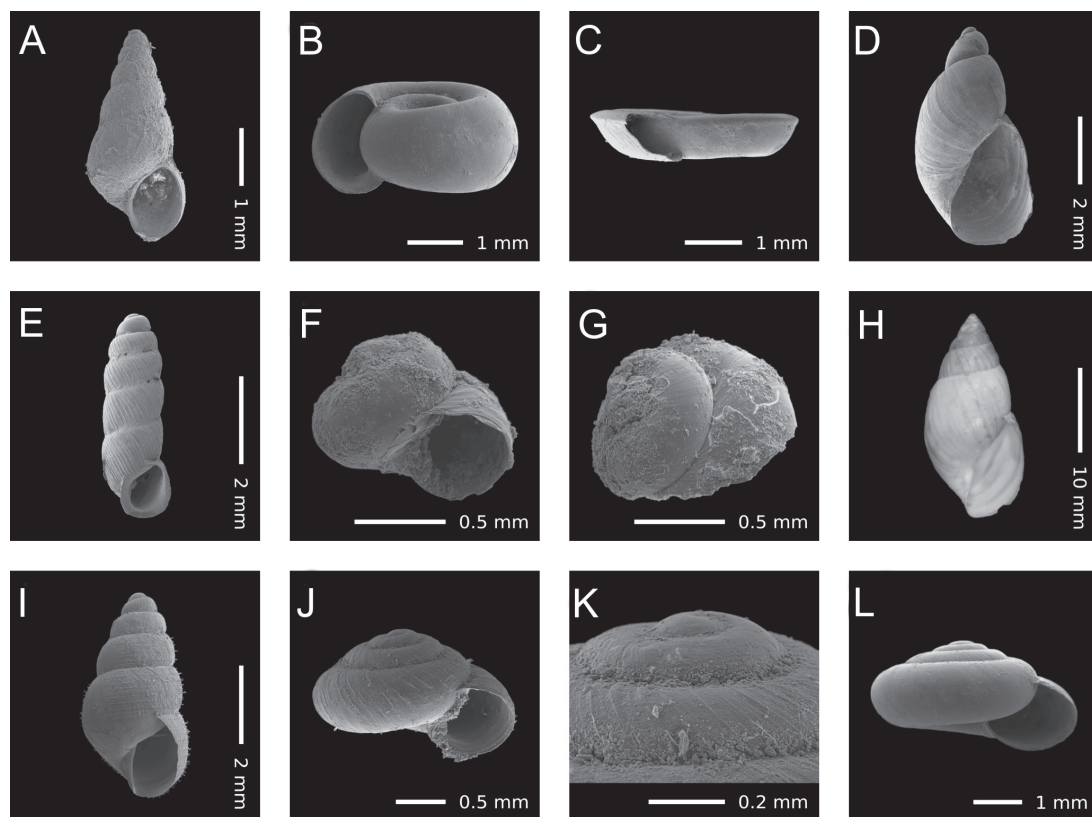


Fig. 2. **A.** *Heleobia parchappii* (Orb., 1835). MACN-In 38364. Buenos Aires: Chascomús, in nest of *Furnarius rufus* (Gmelin, 1788) + *Sicalis* sp., on *Populus* sp. **B.** *Biomphalaria* sp. MACN-In 38366. **C.** *Drepanotrema* sp. MACN-In 38367. **D.** *Succinea meridionalis* Orb., 1846. MACN-In 38343. **E.** *Pupoides paredesi* (Orb., 1835). MACN-In 37538. **F-G.** *Puposoma latens* Hylton Scott, 1960. [MACN-In 38361]. **H.** *Bulimulus b. bonariensis* (Rafinesque, 1833). MACN-In 38358. **I.** *Naesiotus deletangi* (Parodiz, 1946). MACN-In 38355. **J-K.** *Paralaoma servilis* (Shuttleworth, 1852). MACN-In 38348. **L.** *Zonitoides arboreus* (Say, 1817). MACN-In 37520.

Northern and Southern Hemispheres shows several coincidences: Pupillidae and species of *Pupoides* were found in both regions, though *Pupoides albilabris* (C. B. Adams) from Canada was found alive, while *P. paredesi* was found dead; Vallonidae were also found in both regions, though the species found were from different genera (*Cionella* Jeffreys, 1829, *Gastrocopta* Wollaston, 1878, *Vallonia* Risso, 1826, *Novisuccinea* Pilsbry, 1948, and others) and were, notably, found alive in birds' nests (Appendix 1).

Here only one species was found living in a bird nest, a relatively large number of snails belonging to the native species *Puposoma latens*. This species is a micromollusk that lives on trees in the native forests of Cabana (Córdoba province). It is small, corneous-colored and has a few whorls (~ 3.5) (Hylton Scott, 1960). The current record in Mina Clavero extends its natural distribution to the western area of Córdoba province

and confirms its presence in aerial habitats, e.g., nests of the Furnariidae *Pseudoseisura lophotes* as an extension of its natural habitat in the branches and leaves of trees (Hylton Scott, 1960). Another species in this genus (*P. galapagorum* Pilsbry, 1934) was found living in Geospizzini (finch) nests made of bryophytes and liverworts in the Galapagos Islands.

As many of the specimens were found dead (empty shells and/or fragments), they may be part of the diet of the adult birds or nestlings. This is an accidental transport, the most likely form of transporting the aquatic and terrestrial micromollusks cited here. *Succinea meridionalis* and *Bulimulus b. bonariensis*, the two largest snails registered, may be actively selected and transported by the bird as a part of its diet, but also the remaining species of snails found dead in the birds' nests can be regarded here as prey items of the respective birds.

Among the dead gastropods found in the nests, *Bulimulus bonariensis bonariensis* was the most abundant shell, with 32 specimens (40 % of the sample) in eight nests from Chaco and Córdoba. The second most frequent species, *Paralaoma servilis*, was found in four nests in Buenos Aires. The less represented species were *Drepanotrema* sp. (Entre Ríos), *Lamellaxis gracilis* (La Pampa) and *Pupoides paredesi* (Salta), with only one specimen each. Gastropod length was not uniform and there were fewer adults than juveniles. Only 15 % of the specimens of *Bulimulus b. bonariensis* were adults or pre-adults, while the average total length of *Succinea meridionalis* specimens was 6.8 mm (size of an adult usually is over 10 mm). By the other side, only 13 % of the species were freshwater snails (genera *Heleobia* Stimpson, 1865, *Biomphalaria* Preston, 1910, and *Drepanotrema* Crosse & Fischer, 1880), that agree with the predation of aquatic organisms by some of these terrestrial birds recorded in literature (Turienzo & Di Iorio 2014b).

### CONCLUSIONS

The snail species recorded here from Argentine bird's nests can be grouped in two classes: 1) those found living inside a nest, that may be counted as inhabitants of this habitat, and comprise a single species: *Pupisoma latens*, and 2) those found dead inside bird's nests, which may be tentatively counted among the food items of each bird: *Heleobia parchappii*, *Biomphalaria* sp., *Drepanotrema* sp., *Succinea meridionalis*, *Pupoides paredesii*, *Lamellaxis* (*Allopeas*) *gracilis*, *Bulimulus b. bonariensis*, *Naesiotus deletangi*, *Paralaoma servilis*, and *Zonitoides arboreus*.

Two plausible possibilities can be considered regarding the presence of empty shells in the nests. The first one is that these species were passively transported by the birds to their nests, where the snails subsequently died because of inadequate environmental conditions. The second possibility is that bird's nests function as a trap, because their location inside the natural habitats of the snails allows the snails enter them as a natural extension of their natural habitat, but the snails die, as in the first case, due to the complex structure of the nests (as in the cases of Furnariidae oven nests and Psittacidae stick nests in Argentina). Further sampling might help answer these questions, deepening the comprehension of each species' habitat and providing more information about live specimens inside birds' nests.

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## Appendix 1

**Gastropods found in birds' nests from the Western Hemisphere mentioned in literature****Arionidae***Arion hortensis* (Férussac, 1819)

**CANADA: Ontario:** campus of the University of Western Ontario, May 1960, one slug in nest 62-2 (3 feet from the ground in a tangle of leafless vines), identified by H. van der Schalie (University of Michigan, Ann Arbor), from a total of 32 examined nests of *Cardinalis cardinalis* (Linnaeus, 1758) [= *Richmondona cardinalis* (L.)] [Cardinalidae] (Judd, 1963).

**Cionellidae***Cionella lubrica* (Müller, 1774)

**CANADA: Ontario:** campus of the University of Western Ontario, 11-V-1960, five snails in nest 65-2 (3 feet from the ground in flood debris), identified by H. van der Schalie (University of Michigan, Ann Arbor), from a total of 32 examined nests of *Cardinalis cardinalis* (Linnaeus, 1758) [= *Richmondona cardinalis* (L.)] [Cardinalidae] (Judd, 1963).

**Endodontidae***Anguispira alternata* (Say, 1816)

**CANADA: Ontario:** campus of the University of Western Ontario, 15/24-VII-1960, three snails in nest 65-5 (10 feet from the ground in vines), 24-V/16-VI-1960, five snails in nest 66-1 (4 feet from the ground in a Honeysuckle bush), 16-V-1960, 3 snails in nest 613-1 (7 feet from the ground in a red Cedar), identified by H. van der Schalie (University of Michigan, Ann Arbor), from a total of 32 examined nests of *Cardinalis cardinalis* (Linnaeus, 1758) [= *Richmondona cardinalis* (L.)] [Cardinalidae] (Judd, 1963).

**Lymnaeidae***Pseudosuccinea columella* (Say, 1817)

**FRANCE: French Antilles: Guadeloupe:** one adult snail found in the Dadoud pond, in an unidentified bird nest (Nicot *et al.*, 2008).

**Pupillidae***Gastrocopta armifera* (Say, 1821)

**UNITED STATES: Indiana:** near Bloomington, identified by J. E. P. Morrison, casual, one in nest 1 of *Dendroica discolor* (Vieillot, 1809) [Parulidae] (Nolan, 1955).

*Pupoides albilabris* (C. B. Adams, 1841)

**UNITED STATES: Indiana:** near Bloomington, identified by J.P. E. Morrison, probably casual (ordinarily terrestrial, a scavenger on plant and animal material), one in nest 10 (15 inches high in 2 ½-foot blackberry) of *Dendroica discolor* (Vieillot, 1809) [Parulidae] (Nolan, 1959)

**Note:** According to Nolan (1959), "whether this species and *Gastrocopta armifera* (previously reported) were picked up by the warblers or were carried to the nests as they clung to bits of plant fiber, or whether they climbed up under their own power, it is clear that this is another instance in which a bird may become an agent in dispersing small mollusks. Roscoe (1955) tells of the discovery of aquatic snails on birds' plumage, and Ramsden (1914), McAtee (1914), and Paton & Williamson (1943) refer to similar episodes involving terrestrial snails".

**Succineidae***Novisuccinea ovalis* (Say, 1817)

**CANADA: Ontario:** campus of the University of Western Ontario, 18/20-V-1960, one snail in nest 65-3 (3 feet from the ground in flood debris), 16-V-1960, 2 snails in nest 613-1 (7 feet from the ground in a red Cedar), identified by H. van der Schalie (University of Michigan, Ann Arbor), from a total of 32 examined nests of *Cardinalis cardinalis* (Linnaeus, 1758) [= *Richmondona cardinalis* (L.)] [Cardinalidae] (Judd, 1963).

**Vallonidae***Vallonia costata* (Müller, 1774)

**CANADA: Ontario:** campus of the University of Western Ontario, 11-V-1960, one snail in nest 65-2 (3 feet from the ground in flood debris), identified by H. van der Schalie (University of Michigan, Ann Arbor), from a total of 32 examined nests of *Cardinalis cardinalis* (Linnaeus, 1758) [= *Richmondona cardinalis* (L.)] [Cardinalidae] (Judd, 1963).