

Revalidation of *Ditomotarsus hyadesi* Signoret, 1885 stat. rest. (Hemiptera: Heteroptera: Acanthosomatidae) with notes on its Natural History

Revalidación de *Ditomotarsus hyadesi* Signoret, 1885 stat. rest. (Hemiptera: Heteroptera: Acanthosomatidae), con notas acerca de su historia natural

Máriom A. Carvajal^{1,2} & Eduardo I. Faúndez^{1,2}

¹Entomology Department, North Dakota State University, Dept. 7650, P.O. Box 6050; Fargo, ND.

²Departamento de Zoología Médica, Centro de Estudios en Biodiversidad (CEBCh), Magallanes, 1979, Osorno, Chile.
Autor correspondiente: mariom.carvajal@gmail.com

Abstract

Ditomotarsus hyadesi Signoret, 1885 is revalidated. An historical analysis of the references belonging to this species is provided. *Ditomotarsus gayi virens* Jensen-Haarup, 1931 is proposed as new junior synonym of *Ditomotarsus hyadesi*. New data is provided on the biology of *D. hyadesi*. First observations on oviposition process are delivered and discussed. New data on sexual behavior is recorded and discussed. Ontogenic coloration changes for this species are for first time recorded, becoming the first in the Ditomotarsinae. The distribution and life history of the species are summarized.

Keywords: Acanthosomatidae, Heteroptera, *Ditomotarsus hyadesi* Signoret, 1885, revalidation, biology.

Resumen

Ditomotarsus hyadesi Signoret, 1885 es revalidada y se provee un análisis histórico de las referencias bibliográficas correspondientes a esta especie. Se entrega nueva información acerca de la biología de *D. hyadesi*. Se entregan y discuten las primeras observaciones acerca de la oviposición en esta especie; además de nuevos datos acerca de su comportamiento sexual. Se registran también por primera vez para esta especie cambios de coloración ontogénicos, los que serían también los primeros registrados en la subfamilia Ditomotarsinae. Finalmente se analiza y discute la distribución e historia natural de la especie.

Palabras clave: Heteroptera, Acanthosomatidae, *Ditomotarsus hyadesi* Signoret, 1885, revalidación, biología.

INTRODUCTION

Acanthosomatidae is a Pentatomoid (Hemiptera: Heteroptera) family commonly named “shield bugs” that include around 230 species in 57 genera (Faúndez, 2014; Faúndez *et al.*, 2014). Acanthosomatid species can be differentiated from other Pentatomoids by having only two tarsal segments and by the presence of Pendergrast's organs in females of most of its genera. In South America, the biology and/or immature stages of the Acanthosomatidae are poorly known (Faúndez, 2009; Carvajal & Faúndez, 2013). From a total of 30 species in this area, only three, *Sinopla perpunctatus* Signoret, 1864, *Phorbanta variabilis* Stal, 1852 and *Cylindrocneba plana* Mayr, 1864 have several immature stages described (Schlatter, 1976; Martínez *et al.*, 2004, Carvajal, 2014); and just one species, *S. perpunctatus* was studied in detail (i.e. biology and reproductive behavior) (Faúndez & Osorio, 2010).

Ditomotarsus Spinola, 1852 is a monotypic Acanthosomatid genus widely dispersed in Southern South

America (Chile and Argentina). *Ditomotarsus punctiventris* Spinola, 1852, has a large and complex nomenclatorial and taxonomic story, probably due to labelling mistakes in the work in which it was described (see Faúndez & Carvajal, 2010; Faúndez, 2007a). The purpose of this work is to revalidate one species of *Ditomotarsus* and add new data about its biology.

MATERIALS AND METHODS

From 2008 to 2011, specimens of *D. hyadesi* were collected in Punta Arenas city, Magallanes Region (53°55' S; 70°53' W), Chile, in Botanic Garden Carl Skottsberg, Instituto de la Patagonia.

The collected specimens were maintained in wooden boxes and glass bottles, there their development was followed. The boxes measured (15x20x10 cm), with glass in the upper surface, glass bottles and in plastic transparent boxes were tubular with a capacity of 500 ml. The breedings were maintained at environment temperature and photoperiod. Several plant species (including the whole plant; but mainly the fruits) from the families Nothofagaceae (*Nothofagus antarctica*), Rosaceae (*Malus domestica*), Salicaceae (*Salix* sp.), Poaceae, Saxifragaceae (*Ribes magellanicum*, *Ribes rubrum*, *Ribes grossulariae*),

Poligonaceae (*Rumex acetosa*), and Asteraceae (*Chiliodictyon diffusum*) were introduced inside the boxes for the insects feeding. Breeding was cleaned once a week using a humid paper towel.

Fifteen specimens were followed from egg to adult, 7 females and 6 males were used to make observations on the sexual habits, same females were observed for oviposition process, 3 females and 1 male were used in mating and oviposition experiment, and 200 were deposited in the author's collections in different stages of development. About 150 specimens have been observed in the field and returned lately.

The process was followed from mating time, during obtaining the eggs, nymphs and adults, to the hibernation, and posterior return in the spring.

In morphology for developmental stages, we follow Costa *et al.*, (2003). For the oviposition process and breeding we follow Cobben (1968) and Kudo (2006).

RESULTS

Taxonomy:

Ditomotarsus hyadesi Signoret, 1885 stat. rest.

= *Ditomotarsus gayi virens* Jensen-Haarup, 1931 n.syn.

Ditomotarsus hyadesi: Signoret, 1885 - (Description)

Ditomotarsus hyadesi: Lethierry & Severin, 1893 - (Checklist)

Ditomotarsus gayi: Breddin, 1897 - (Description and distribution records)

Ditomotarsus hyadesi: Reed, 1898 - (Description)

Ditomotarsus hyadesi: Enderlein, 1912 - (Distribution)
Ditomotarsus gayi: China, 1963 - (Host and distribution records)

Ditomotarsus punctiventris: Faúndez, 2007a - (Distribution)

Ditomotarsus punctiventris: Faúndez, 2007b - (Biology and hosts)

Ditomotarsus punctiventris: Faúndez *et al.*, 2009 - (Sexual habits)

Ditomotarsus punctiventris: Faúndez & Carvajal, 2011 - (Teratology)

This species was described from Magallanes Region in Chile by Signoret. This taxon was placed as tentatively junior synonym of *Ditomotarsus punctiventris* Spinola, 1852 by Breddin (1897). Authors followed this synonymy without examine the species in detail.

Actually with the study of material including the syntypes of *D. punctiventris* and *D. hyadesi* shows that both taxa are not conspecific. The major differences are in the posterior end of pygophore of males. This structure has a small and very truncate process in the middle in *D. hyadesi* (Fig. 4); whereas it is more wide and rounded in *D. punctiventris* (Fig. 5). The male parameres have a distal lobe wide and truncated in *D. punctiventris* (Fig. 2) whereas the distal lobe is more slender, and rectangular in *D. hyadesi* (Fig. 3). The female genitalia it is not useful for separating both species. Additionally *D. punctiventris* is not present in Magallanes Region of Chile and Tierra del Fuego (Chile and Argentina); whereas *D. hyadesi* is restricted to those

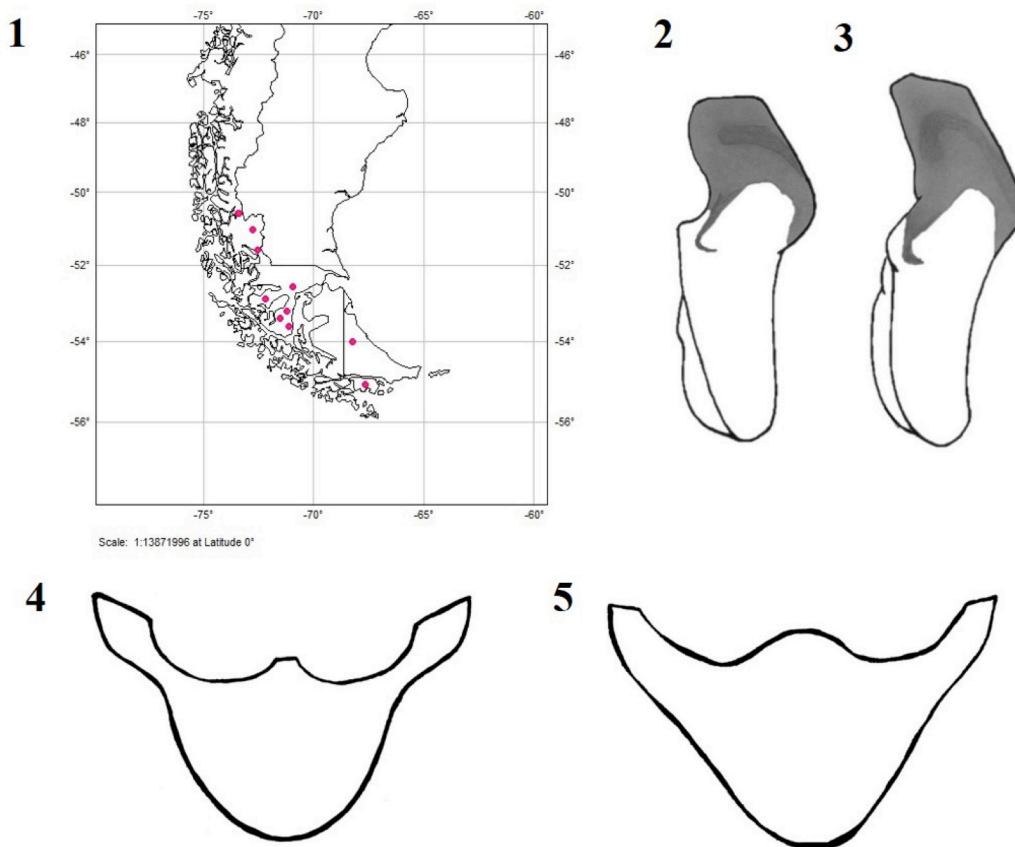


Fig. 1: *Ditomotarsus hyadesi* Signoret, 1885 distribution; Figs. 2, 5: *Ditomotarsus punctiventris* Spinola, 1852: 2. Paramere 5. pygophore ventral view; Figs. 3, 4: *D. hyadesi*: 3. paramere, 4. pygophore ventral view.

Fig. 1: *Ditomotarsus hyadesi* Signoret, 1885, distribución; Figs. 2, 5: *Ditomotarsus punctiventris* Spinola, 1852: 2. Parámetro 5. pigóforo en vista ventral; Figs. 3, 4: *D. hyadesi*: 3. parámetro, 4. pigóforo en vista ventral.

localities (Fig. 1). Therefore we propose the revalidation of *D. hyadesi*.

The subspecies *Ditomotarsus gayi virens* Jensen-Haarup, 1930 is currently listed as junior synonym of *D. punctiventris*; however this taxon correspond to the green morph of *D. hyadesi*. Thus *D. gayi virens* is removed from the synonymy of *D. punctiventris* and placed as a junior synonym of *D. hyadesi*.

Observations on the Biology of *D. hyadesi*:

Mating: In nature, females were observed choosing the place and time for the copulation process. When an aggregation of specimens was present, females were usually not receptive to the intend of males for mating; however, when they were receptive they did not tend to choose one male, instead, they mate more than one male in short periods of time because males tend to aggregate close to the female and fight for her mate. There was one case in which a female mate one male which died while copulating with the female (the couple was catch in coupling) and stayed connected to it for about 4 days. The female was still alive and dragged the male all around the plastic box for the all 4 days; after this period, the female left the male and lived for about a two weeks and then died. The time of each copulation varied from about 15 minutes to 2 or 3 hours. While male and female are copulating, males stand below females and the pygophore rotates 180 degrees as shown in Faúndez (2007b); the patches of hair present on the pygophore match and connect with the pilosity of the Pendergrast's organs of the females, which walk around dragging the male to walk backwards.

During copulation process in laboratory, females were observed choosing the time and place for mating the only male they had contact with. Females tend to choose the higher part of the breeding boxes for copulating, where usually there was a piece of wood and the amount of light was higher (Fig. 10). Once they were copulating for a while, they tend to move to the bottom section of their box to feed preferently on apples. The time of each copulation was different from what we observed in nature varying from about 6 minutes in intermittent mates to about 4 hours (see Table 1). Intermittent mating was not able to be recorded, but consist in very short time copulations that vary from 2 to 10 minutes with an interval of about 3 minutes between each mate, in total about 15. Finally, shortly after mating, males tend to die in about 2 to 5 days, and females proceed with oviposition of the eggs.

Eggs and oviposition: Females laid eggs soon after mating, in the lower surface of the piece of wood inside the boxes, in a piece of paper or even in the plastic surface of the breeding boxes (Fig. 11), or in a leaf of any plant from the families that mentioned above in nature (there is no preference for plants), but usually in the lower surface or in a hidden place difficult to find. When females were at the point of ovipositing in the surface they choose, they started by moving their hind legs against its lower abdomen, close to the Penderdrast's organs. After a minute or 2 of massaging the abdomen the oviduct opened and the eggs started to emerge from the female. Once the egg it was attached to the surface, the female started accommodating it with its hind leg by giving little touches to it and adding a substance from its Pendergrast's organ with its hind leg too (Fig. 11). The lapsus between the appearances of each egg varied from 5 to 14 minutes, and the total time of the oviposition recorded was of about 1 and a half hour. According to our observations one female can lay

TABLE 1

Mating Times: M= male; F= female; N/A= Not Available.

Tiempos de apareamiento: M= macho; F= hembra; N/A= sin información.

Mates	Couple number	Duration (hours:minutes)
M1xF1	1	2:57
	2	N/A
	3	1:16
	4	1:35
	5	N/A
	6	N/A
	7	0:19
	8	N/A
	9	2:30
	10	N/A
	11	1:50
	12	2:20
	13	0:45
	14	4:10
	15	2:40
	16	1:00
M2xF2	1	4:15
M3xF3	1	N/A
	2	N/A
	3	1:32
	4	1:40
	5	1:35
	6	1:00
	7	N/A
	8	2:02
	9	N/A
	10	1:45
	11	N/A
	12	N/A
	13	N/A
	14	2:24
M3xF4	1	2:00
	2	N/A
	3	1:13
	4	2:17
	5	N/A
	6	N/A
M4xF4	1	N/A
	2	N/A
	3	1:29
	4	N/A
	5	N/A
M5xF5	1	2:38
M6xF6	1	N/A
M6xF7	N/A	

approximately 3 batches of eggs, in each batch the number of eggs can vary from 5 to 14 eggs (see Table 2). Females laid their batches of eggs in different places, even when they were in a breeding box; there was not any pattern concerning the shape of the batches, we observed linear, grouped, or rounded ways in which the female laid the eggs (Figs. 12, 15). About a week from the date in which the eggs were laid, they begin to mature, and were close to the date of hatch; in this period the eggs turned darker and less wide.

TABLE 2

Oviposition process data and egg characteristics.

Información para el proceso de ovoposición y características del huevo.

Female and oviposture numbers	Eggs number	Measure and/or shape of the clutch	Weight of the clutch	Time from oviposition to hatch	Colour
Female 1 Batch 1	6	All together	0.06 mg	Unviable eggs	Green
Female 2 - No Eggs					
Female 3 Batch 1	6	0.6 mm. - in line	0.1 mg	8 days	Green
Batch 2	5	In line		8 days	Green
Batch 3	14	4. 5 x 4 mm	0.4 mg	9 days	Green
Female 4 Batch 1	14	Without form		7 days	Gold
Batch 2	14	All together		7 days	Gold
Batch 3	11	All together		8 days	Gold
Female 5 Batch 1	14	All together		7 days	Light blue-green
Female 6 Batch 1	14	All together		Unviable eggs	Reddish gold
Female 7 Batch 1	14	Without form		7 days	Gold

Eggs of *D. hyadesi* could have different colours. In our breeding, for example, we observed green, light blue, gold and reddish eggs (Figs. 12, 15); while in the nature we found same colours besides pink, brown, orange or bluish eggs (Figs. 6-9). One female can only lay eggs of one color during her lifetime; eggs themselves do not change color. Collecting the eggs it was a difficult work because they jump with the contact of the paint brush. Maternal or paternal care was not observed in any stage of the life cycle.

The Experiments:

In an intend of explaining the coloration change in the eggs of *D. hyadesi*, the following experiments were designed:

1- At a temperature of 20C, 2 females of *D. hyadesi* were raised in separate wooden boxes covered by glass, we will call each female FA and FB. The females were feed with *Nothofagus antarctica* (Mirb) Oerst leaves and fruits, and at an environment photoperiod. After the females were collected, they were put in quarantine for 36 hours before the experiment started.

Once the females were ready, one male, called MA, was introduce in each of the boxes and let it there until mating was successful, obtaining the following eggs coloration:

MAxFA = gold eggs MAxFB= light blue eggs

2- At the same environmental conditions mentioned above, a third female, called FC, was raised and mate with 2 males called MB and MC, obtaining the following eggs coloration:

MBxFC = green eggs

MCxFC= green eggs

Nymphs: (see Table 3)

Usually after a week from the appearance of the eggs, which were darker and less wide than in the beginning, nymphs started to hatch. Nymphs emerged from the eggs leaving the exterior of the chorion, which was transparent (Figs. 9, 17). The just emerged nymphs, with a total length of less than a millimetre, were whitish during the first two hours and then light pink to finally turn dark orange after about 10 to 20 hours more. The level of activity of the immatures during the first couple hours it was low; they did not move more than 2 centimetres away in that period of time and no

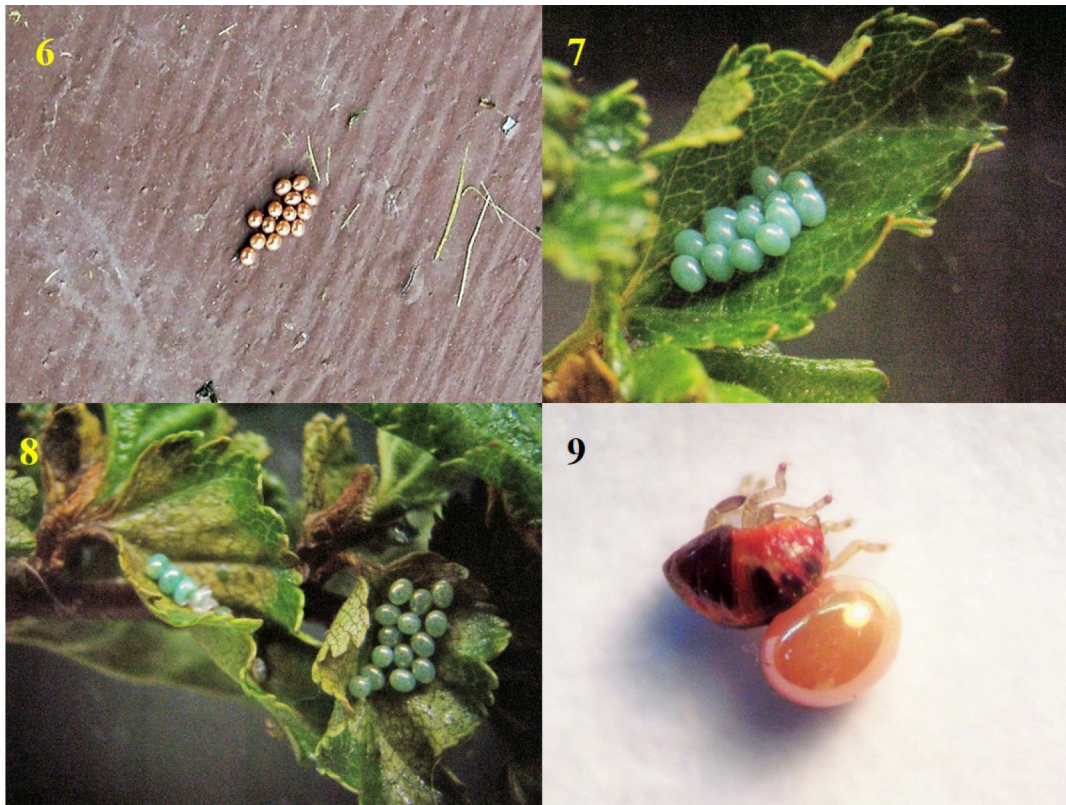
more than 10 centimetres during the first day. In the second day nymphs tended to be more active, walking around their breeding boxes and starting to eat, although nymphs from the same batch of eggs seemed to keep themselves together or very close during the first days (Fig. 16). Different kind of plants were available as food for the immature (Fig.13); however, they presented a preference for feeding on apples or any similar juicy fruit (Fig. 14). Nymphs feeding time could vary from about 10 minutes to 2 hours. Moulting from first instar to second instar nymphs occurred soon from their hatch date, the individuals started by positioning in a high place of the breeding box, turned darker and stayed in the same position for about 5 hours, after that period of time we were able to observe the formation of the exuvia and the darkening of it; finally after about 18 hours the new nymph emerged again. The time

TABLE 3

First Instar nymphs life time.

Ninfas de primer instar.

Female and Oviposture Numbers	Time from hatch to first molt
Female 1 - Unavailable Eggs Batch 1	
Female 2 - No Eggs	
Female 3 Batch 1	6 days
Batch 2	6 days
Batch 3	5 days
Female 4 Batch 1	5 days
Batch 2	3 days
Batch 3	3 days
Female 5 Batch 1	4 days approx.
Female 6 Batch 1	
Female 7 Batch 1	7 days



Figs. 6-9: *Ditomotarsus hyadesi* Signoret, 1885; Fig. 6: Gold eggs on a rain channel on the grass; Figs. 7-8: Blue greenish eggs on *Nothofagus antarctica* leaf; Fig. 9: Nymph emerging from its egg.

Figs. 6-9: *Ditomotarsus hyadesi* Signoret, 1885; Fig. 6: Huevos dorados en una canaleta metálica sobre el pasto; Figs. 7-8: Huevos verde azulado en *Nothofagus antarctica* leaf; Fig. 9: Ninfa emergiendo desde un huevo.

between each moult was increasing progressively as more instars passed by.

Adult observations: During fall the first adults emerge. These adults had brown dorsal coloration, and no mating was observed. Once the winter arrived, they tend to hide in the soil and have a diapause process. Once spring was back, the specimens that came back from the soil had still brown coloration; however, they change its colour to bright green gradually in about one month. The coloration change was observed first in the scutellum, then the pronotum and finally in the hemelytra, the ventral coloration was always reddish (Plate IV).

Adults feed on several plants, in the field in which we collected them they used to be on Nothofagaceae, Saxifragracea, Asteracea and Polygonacea; however any plant that we put in our breeding boxes was successful as food source for the specimens.

DISCUSSION

The life cycle of *D. hyadesi* can be summarized by the following events (see plates IV and V for detailed information): during the spring adults mate, males die soon after mating and females lay eggs; in the spring and summer eggs hatch and nymphs develop; in the fall first adults emerge with brown coloration; nymphs and first emerged adults of the season have a diapause process; finally all the specimens finish they diapause process in the spring and nymphs from the anterior season emerge as brown adults that turn to green coloration in about a month and the cycle starts again.

Mating of acanthosomatids has been scarcely recorded,

especially for the Ditomotarsinae. In South America the known data about mating in Acanthosomatidae has been reported by Faúndez & Osorio (2010), corresponding to *Sinopla perpunctatus* Signoret, 1864 (Blaudusinae) and Faúndez (2007) and Faúndez *et al.* (2009) corresponding to data on the sexual habits of *D. hyadesi*. The new data presented here expand our knowledge of the mating process on *D. hyadesi*, expanding its possible copulation time up to 4 hours. The amount of couples observed helped us to understand the dynamics of mating on this species. It seems like females are mechanically impossibilitated to get out a male when it is in copulation position (e.g. above female). However, we believe that females are selective in the way that this sex is which decide how many longer the couple is. Therefore females control with what male they will produce the offspring.

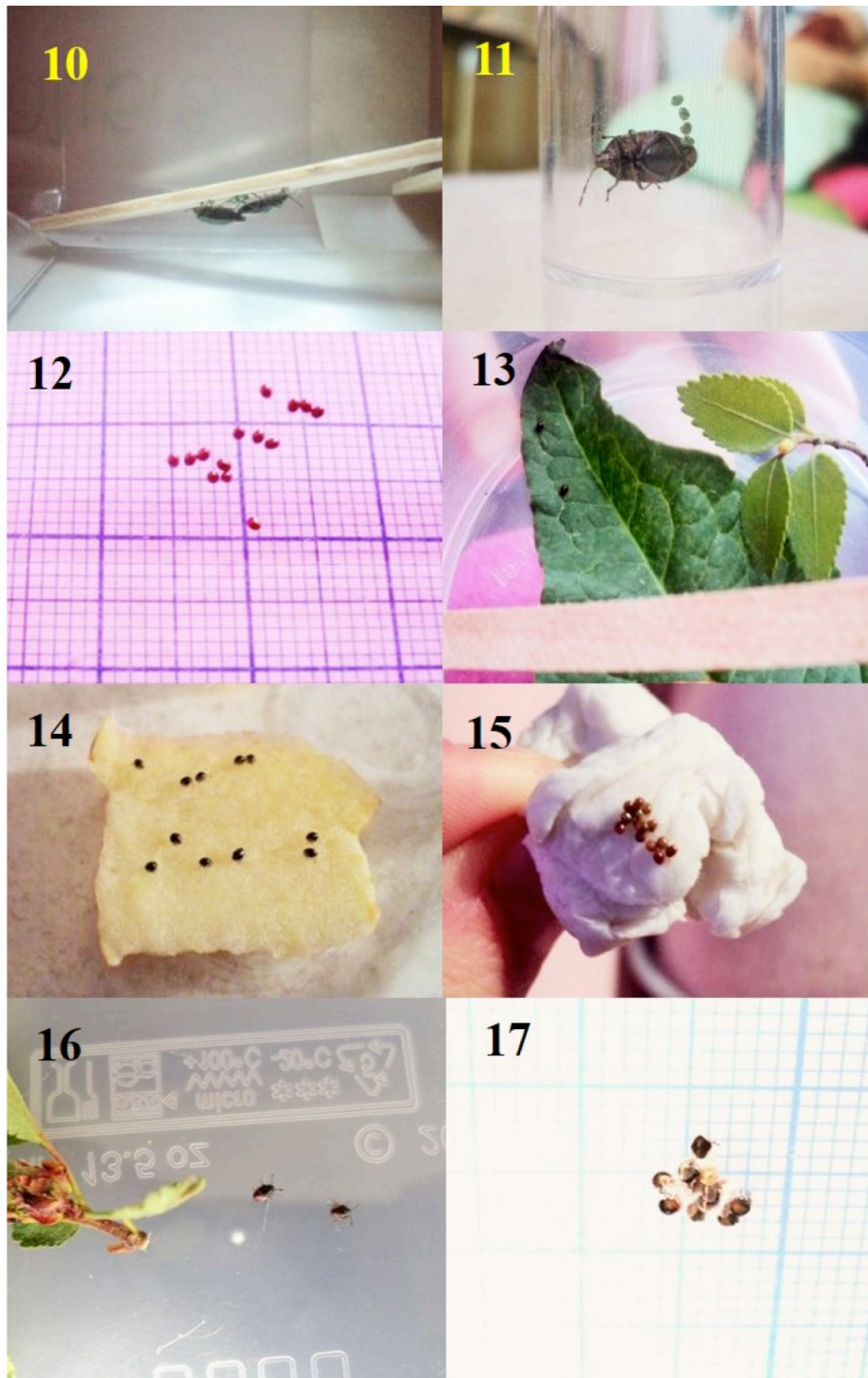
In contrast of most acanthosomatids for which parental care is known (see Faúndez & Osorio 2010), *D. hyadesi* does not present this behaviour. Instead of laying a large batch of 40 to 60 eggs and take care of it, females of *D. hyadesi* lay small batches of about 14 eggs in 3 different times and places; these places are usually underneath leaves of different plant or in the ground. The egg smearing behaviour in Acanthosomatidae observed when females laid their eggs and covered them by a setose substance that they took from their Pendergrast's organs has been explained by Tsai *et al.* (2014). According to our experiment, the variation in the coloration of the eggs could not be explained by environmental factors or the mates of the females.

Coloration changes, in adults and eggs could be due to a kind of camouflage like in other acanthosomatids (Faúndez & Osorio, 2010). The variant colours of eggs help

to camouflage them in different places of oviposition (as we observed, this species oviposits in many different places like wood, leaves, grasses). On the other hand, adults are green when leaves of trees are green, and are brown when trees leaves are darker, and next to falling down in autumn. Coloration changes in this family have been described for *S.*

perpunctatus, in which also it is used for camouflage, and are controlled possibly by photoperiod and temperature (Faúndez & Osorio, 2010).

The general phytophagy of this species has been reported by Faúndez (2007b). This in addition to the big aggregations observed, show the potential economic risk in



Figs. 10-17: *Ditomotarsus hydesi* Signoret, 1885 from breeding boxes; Fig. 10: Mating; Fig. 11: Female ovipositing its egg batch in half moon shape; Fig. 12: Golden egg batch; Fig.13: 1- instar nymphs on *Rumex acetosa*; Fig. 14: First instar nymphs on a piece of apple; Fig. 15: Brownish egg batch; Fig. 16: 2- instar nymphs on breeding box; Fig. 17: Nymphs emerging from the egg.

Figs. 10-17: *Ditomotarsus hydesi* Signoret, 1885 en cajas de crianza. Fig. 10: Cópula; Fig. 11: Hembra ovipositando en forma de media luna. Fig. 12: Masa de huevos dorados; Fig. 13: ninfa de primer instar en *Rumex acetosa*; Fig. 14: Ninfas de primer instar en un trozo de manzana; Fig. 15: Masa de huevos color pardo; Fig. 16. Ninfas de segundo instar en caja de crianza; Fig. 17: Ninfas emergiendo del huevo.

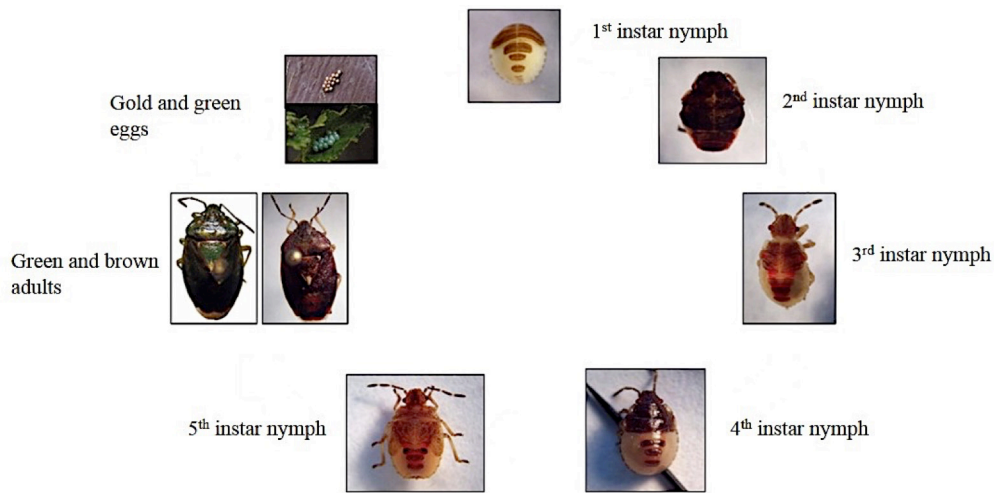


Fig. 18: *Ditomotarsus hydesi* Signoret, 1885 life cycle illustration.

Fig. 18: Diagrama del ciclo de vida de *Ditomotarsus hydesi* Signoret, 1885.

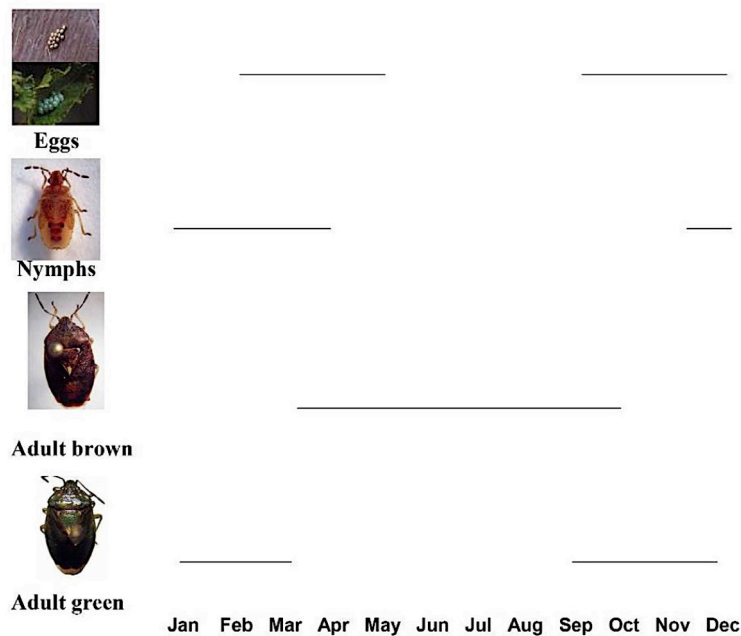


Fig.19: *Ditomotarsus hydesi* Signoret, 1885, life history scheme.

Fig.19: Esquema de la historia de vida de *Ditomotarsus hydesi* Signoret, 1885.

regards *D. hydesi*. In Magallanes, this species attack fruits of exportation shrubs (e.g. Magellan Barberry and Red Currant), and forestry interest species (*Nothofagus* spp.) Therefore the knowledge of oviposition and morphology of eggs and nymphs is very important for their detection before the insects cause economic damage.

Acknowledgements

We thank Dmitry Musolin, David A. Rider, María del C. Coscarón, Manuel Baena, Shin-ichi Kudo and Petr Kment for their valuable help obtaining bibliography and answering our questions.

This work is dedicated to the memory of Carl W. Schaefer

REFERENCES

Breddin, G. (1897). Hemipteren. In: Hamburger Megalaensischen Sammelreise. *Zweite Lieferung*, No. 4. Hamburg. pp. 36.

Carvajal, M.A. (2014). Descripción de la ninfa de V de *Cylindrocnema plana* Mayr, 1864 (Hemiptera: Heteroptera: Acanthosomatidae). *Boletín de la Sociedad Entomológica Aragonesa* 55: 243-245.

Carvajal, M.A., Faúndez, E.I. (2013). Rediscovery of *Sinopla humeralis* Signoret, 1864 (Hemiptera: Heteroptera: Acanthosomatidae). *Zootaxa* 367: 190-196.

China, W.E. (1963). Hemiptera-Heteroptera collected by the Royal Society expedition to South Chile 1958-1959. *Annals and Magazine of Natural History* 13:705-723.

Costa, C., Ide, S., Simonka, C.E. (2006). *Insectos*

- Inmaduros. Metamorfosis e Identificación. Monografías 3er Milenio, SEA, CYTED & RIBES, Zaragoza.
- Cobben, R.H. (1968). Evolutionary Trends in Heteroptera. Part I. Eggs, Architecture of the Shell, Gross Embryology and Eclosion. Centre for Agricultural Publishing and Documentation, Wageningen, Netherlands.
- Enderlein, G. (1912). Die insekten des Antarkto-Archiplata-Gebietes (Feuerland, Falklands-Inseln, Süd-Georgien). 20. Beitrag zur kenntnis der Antarktischen fauna. Kongliga Svenska Vetenskaps-Akademiens Handlingar 48: 1-170.
- Faúndez, E.I. (2007a). List of Acanthosomatidae species (Insecta: Hemiptera) from the Magallanes region. Anales del Instituto de la Patagonia 35:75-78.
- Faúndez, E.I. (2007b). Notes on the biology of *Ditomotarsus punctiventris* Spinola, 1852 (Hemiptera: Acanthosomatidae) in the Magellan region, and comments about the crypsis in Acanthosomatidae. Anales del Instituto de la Patagonia 35: 67-70.
- Faúndez, E.I. (2009). Contribution to the knowledge of the genus *Acrophyma* Bergroth, 1917 (Hemiptera: Heteroptera: Acanthosomatidae). Zootaxa 2137: 57-65.
- Faúndez, E.I. (2014). A new genus for a Chilean species of Acanthosomatidae (Hemiptera: Heteroptera). Zootaxa 3768: 596-600.
- Faúndez, E.I., Osorio, G.A., Bahamondez, C.P., Monsalve, E.A. (2009). Comportamiento gregario en los hábitos sexuales de *Ditomotarsus punctiventris* Spinola, 1852 (Hemiptera: Heteroptera: Acanthosomatidae). Boletín de Biodiversidad de Chile 1: 15-18.
- Faúndez, E.I., Osorio, G.A. (2010). New data on the biology of *Sinopla perpunctatus* Signoret, 1864 (Hemiptera: Heteroptera: Acanthosomatidae). Boletín de Biodiversidad de Chile 3: 24-31.
- Faúndez, E.I., Carvajal, M.A. (2010). Additions to Pentatomoidea (Hemiptera: Heteroptera) wrongly labelled in Gay's "Atlas de la Historia Física y Política de Chile (1854)." Zootaxa 2659: 67-68.
- Faúndez, E.I., Carvajal, M.A. (2011). Un caso teratológico en un ejemplar de *Ditomotarsus punctiventris* Spinola, 1852 (Hemiptera: Heteroptera: Acanthosomatidae) de Magallanes (Chile). Boletín de la Sociedad Entomológica Aragonesa 48: 431-432.
- Faúndez, E. I., Carvajal, M. A., & Rider, D. A. 2014. *Archaeoditomotarsus crassitylus*, gen. and sp. nov. Acanthosomatidae (Hemiptera: Heteroptera: Acanthosomatidae). Zootaxa 3860(1): 87-91.
- Jensen-Haarup, A.C. (1931). New or little known Hemiptera-Heteroptera I. Deutsche Entomologische Zeitschrift 17: 215-222.
- Kudo, S. (2006). Within-clutch egg-size variation in a subsocial bug: the positional effect hypothesis. Canadian Journal of Zoology 84: 1540-1544.
- Lethierry, L., Severin, G. (1893). Catalogue général des Hémiptères. Bruxelles, Pentatomidae 1: 286.
- Martínez, P., Dellapé, P.M., Coscarón, M.C., Giganti, H. (2003). Immature stages of *Sinopla perpunctatus* (Heteroptera: Acanthosomatidae) from Argentina. Entomological News 114: 147-151.
- Reed, E. C. 1898-1899. Sinopsis de los Hemípteros de Chile. Primera parte: Heterópteros. Revista Chilena de Historia Natural 2: 80-87; 2: 110-113; 2: 128-113; 2: 153-160; 3: 5-14.
- Schlatter, R.P. (1976). Primer hallazgo de *Phorbanta variabilis* (Signoret), 1863, Hemiptera, Pentatomidae, para Chile, con notas ecológicas de la especie. Boletín de la Sociedad de Biología de Concepción 49: 17-24.
- Signoret, V. (1885). Liste des Hémiptères recueillis a la Terre de Feu par la mission de la Romanche et description des espèces nouvelles. Annales de la Société Entomologique de France 6: 63-70.
- Tsai, J.F., Kudo, S., Yoshizawa, K. (2014). Evolution of Maternal Care in Acanthosomatinae: a possible correlation with lack of pendergrast's organ. Proceedings of the Fifth Quadrennial Meeting of the International Heteropterists' Society. Washington DC, USA.