



Infestation of *Lithodes santolla* (Decapoda: Lithodidae) by *Pseudione tuberculata* (Isopoda: Bopyridae) in San Jorge Gulf, Southwestern Atlantic Ocean.

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Complete List of Authors:	Vinuesa, Julio; Universidad Nacional de la Patagonia San Juan Bosco, Instituto de Desarrollo Costero
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4 **Infestation of *Lithodes santolla* (Decapoda: Lithodidae) by *Pseudione tuberculata***
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6 **(Isopoda: Bopyridae) in San Jorge Gulf, Southwestern Atlantic Ocean.**
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11 JULIO H. VINUESA^{1,2} & PAMELA BALZI³
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16 ¹ *Centro de Desarrollo Costero, Universidad Nacional de la Patagonia San Juan*
17
18 *Bosco (UNPSJB) Ciudad Universitaria Km.4, Comodoro Rivadavia, Chubut, Argentina*
19

20
21 ² *Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET), Argentina,*
22
23 *and* ³ *Departamento de Biología General Universidad Nacional de la Patagonia San*
24
25 *Juan Bosco (UNPSJB) Ciudad Universitaria km.4, Comodoro Rivadavia, Chubut,*
26
27 *Argentina*
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33 Corresponding autor: Julio H. Vinuesa. E-mail: jvinuesa@speedy.com.ar or
34
35 julio.vinuesa@gmail.com . Fax number: 54-297-455-7318.
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42 Running head: *Infestation of Lithodes santolla by Pseudione tuberculata*
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Abstract

The bopyrid isopod *Pseudione tuberculata* infests decapod crustacean species of family Lithodidae. It has previously been found in *Neolithodes diomedea* from Chile, and in *Lithodes santolla* and *Paralomis granulosa* from the Beagle Channel. A case was detected in 1980 in San Jorge Gulf, and since then no bopyrid has been found in any of the 12,300 specimens of *Lithodes santolla* obtained from commercial captures. In the present study we collected and analyzed 648 juveniles of *Lithodes santolla* measuring between 8.38 and 49.02 mm CL from shallow waters in the central area of San Jorge Gulf. Females *Pseudione tuberculata* were recorded in 16 of 22 parasitized crabs and only 11 males, with higher prevalences in specimens of up to 25-30 mm CL. Infestation in the right branchial chamber was observed only once; ten bopyrid females were mature and the rest were immature. Low infestation is related with oceanographic conditions. The absence of infested crabs larger than 32 mm -older than two years- seems be related to the life cycle of the parasite.

Key words: Infestation – prevalence – reproduction- *Pseudione tuberculata*- southern king crab

Introduction

The two lithodid species inhabiting San Jorge Gulf, in the Southwestern Atlantic Ocean (between 45° and 47° SL) are commonly found in coastal waters of the Magellan Region: the southern king crab *Lithodes santolla* and the false king crab or stone crab *Paralomis granulosa* (Vinuesa 2005). The former species is very abundant and exploited by a commercial mixed fishery that includes hake (*Merluccius hubbsi*), pink cusk-eel (*Genypterus blacodes*), cock fish (*Callorhynchus callorhynchus*), soles and rays, among others. Although the southern king crab is not subjected to intensive fishing pressure, between 200 and 600 tons are landed annually. The false king crab is found at low densities at the southern and northern ends of San Jorge Gulf, and currently it is not being commercially exploited (Vinuesa 2005).

Both species have been reported as hosts of a bopyrid isopod in the Beagle Channel (Vinuesa 1989), which was subsequently identified as *Pseudione tuberculata* Richardson, 1904 (Roccatagliata & Lovrich 1999; Miranda-Vargas & Roccatagliata 2004). The parasite reported in this study was assigned to the same species. It was originally described from *Neolithodes diomedae* in Chile (Richardson 1904). Another species of the genus, *Pseudione galacanthae* Hansen, 1897 has been found in the galatheid *Munida subrugosa* in San Jorge Gulf (Vinuesa 2002).

In San Jorge Gulf, parasitism by *P. tuberculata* was first detected in December 1980; a *L. santolla* female of 45 mm carapace length (CL) harbored no parasite within the branchial chamber but showed the typical swelling on the left side of the carapace indicative of previous infestation. Over the following eighteen years, neither bopyrid nor rhizocephalan parasites have been documented in more than 12300 specimens of *L. santolla* analyzed.

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4 This study reports the first finding of *P. tuberculata* in the southern king crab
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6 population in San Jorge Gulf and surroundings. Prevalence was related to the size,
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8 intermolt stage and sex of the host and sexual maturity of the parasite.
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10 11 12 13 14 **Material and Methods**

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16 We collected 469 juvenile specimens of *L. santolla* from rocky bottoms in the
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18 surroundings of the localities of Punta del Marqués, Punta Maqueda and Caleta del
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20 Fondo, located to the south of Comodoro Rivadavia (ca 46° SL)), between 2004 and
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22 2007. Southern king crabs were collected by scuba diving at depths between 1 and 15 m
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24 and samples were fixed in 5% formol-saline for later analysis at the laboratory. The sex,
25
26 size, and intermolt stage were recorded for each animal. The carapace length (CL) was
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28 measured as usual for lithodids (Vinuesa & Lombardo 1982; Lovrich & Vinuesa 1993)
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30 using a digital caliper to the nearest 0.1 mm. Specimens with distension of the branchial
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32 region were separated. Taking into account that recent infestations may be missed due
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34 to the lack of carapace distortion, the branchial chambers of all animals were carefully
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36 examined.
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40 Each crab was assigned to one of the following intermolt stages: 1- beginning of molt:
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42 carapace light red to orange, new carapace in preparation for molting. 2- Ecdysis:
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44 shedding of the old carapace; 3- Recent postmolt: the carapace is soft and bright red; 4-
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46 Late postmolt: the carapace is hardened but legs are partially calcified, still bright red in
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48 color; 5- Intermolt: well-calcified carapace and legs, carapace varies from red to
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50 brownish red and is lighter in color than those of previous stages, with or without
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4 We also analyzed 179 carapaces ranging from 25 to 47 mm CL with or without remains
5 of appendages, collected in the locality of Rada Tilly (45° 56'S). These were exuviae or
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7 belonged to recently molted individuals that were stranded on a beach during a storm in
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9 July 2004. Sex was impossible to determine in most cases but the typical swelling of the
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11 carapace could be visualized.
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16 Parasitic females were classified as mature and immature according to oostegite
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18 development (Miranda-Vargas & Roccatagliata 2004); their total length and that of the
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20 accompanying males, if present, were measured too with a calibrated ocular
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22 micrometer.
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28 **Results**

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30 A total of 648 specimens of southern king crab with CL ranging between 8.38 and
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32 49.04 mm were analyzed (Fig. 2). Of these, 258 were males, 228 females and the
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34 remaining were exuviae between 25.4 and 46.6 mm CL for which sex could not be
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36 determined. Only 16 of the specimens captured by scuba diving were parasitized. In the
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38 material from the beach, one female, one male and four exuviae harbored no parasites
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40 but exhibited the conspicuous bulge indicative of a bopyrid infestation. Prevalence
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42 (number of infested crabs out of total crabs examined) was extremely low (0.034) and
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44 decreased with increasing host size, while it was zero for carapace lengths greater than
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46 31 mm.
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51 Bopyrid females exhibited the characteristic features described in literature, including
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53 the visualization of the pleopods on both sides of the body, which has been reported for
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55 parasites from *L. santolla*, but not from *P. granulosa* (Miranda-Vargas & Roccatagliata
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57 2004).
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4 The characteristics of the hosts and parasites are presented in Table 1. Ten adult and six
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6 immature parasitic females were recovered. Females size between 3.38 to 15.33 mm of
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8 total length (TL). In males, segments were fused, widely separated or had intermediate
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10 morphology, similarly to that observed for specimens of *P. granulosa* in the Beagle
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12 Channel (Miranda-Vargas & Roccatagliata 2004). Males size between 0.6 to 5.07 mm.
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15 One female have two dwarf males in their pleon.
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19 There was a positive direct relationship between the carapace length of crabs and
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21 bopyrid females, thus suggesting parallel growth of host and parasite. Parasites had a
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23 strong preference for the left branchial chamber since only one out of 22 hosts showed a
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25 bulge in the right chamber.
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29 The distension of the carapace became visible in specimens with carapace length greater
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31 than 13 mm, although it was absent in a male of 14.9 mm CL. In addition, a female of
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33 13.3 mm CL had a distorted carapace but no parasite in the branchial chamber.
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37 38 **Discussion**

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40 The bopyrid *P. tuberculata* was found to be parasitizing the southern king crab,
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42 *Lithodes santolla*, in San Jorge Gulf, as previously reported for the same species in the
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44 Beagle Channel (Roccatagliata & Lovrich 1999).
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48 The adults of *L. santolla*, in contrast to the smallest juveniles, are distributed almost
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50 over the entire San Jorge Gulf. Juveniles occupy a cryptic habitat during the first
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52 months after birth, and reach sizes between 12 and 18 mm CL in the first year of life.
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54 During the first two years, the juveniles develop in rocky coastal areas with abundant
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56 vegetation and a diverse sessile fauna (Vinuesa 2001; Vinuesa & Balzi 2002). These
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4 irregular areas supporting a dense biotic cover with numerous species of algae and
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6 invertebrates provide juveniles with food and shelter.
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9 The great majority of the infested *L. santolla* in San Jorge Gulf harbored bopyrids in
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11 their left branchial chamber. Preponderance of sinistral infestation has also been
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13 reported for *P. granulosa*, both in single (98.4%, n= 251) and double infestations (three
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15 cases) (Roccatagliata and Lovrich 1999). The parasite has been found in *P. granulosa*
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17 specimens of up to 90 mm CL, which corresponds approximately to 8-year-old crabs
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19 (Lovrich & Roccatagliata 1999). This fact implies a long life span for the bopyrid. On
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21 this basis and taking into account that the southern king crab can live as much as 20
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23 years in the Beagle Channel (Vinuesa et al. 1991), it seems reasonable to assume that a
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25 bopyrid parasitizing *L. santolla* also shows a remarkable longevity. If this is so, why
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27 have we not found parasites in large animals?. It may be due to host mortality, parasite
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29 elimination or a reduction in the catchability of large animals. However, the third
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31 possibility looks unlikely because *L. santolla* is caught by trawl nets with no size
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33 selectivity. A fourth cause, parasite death after reproduction, needs to be explored
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35 considering the potentially long life span of bopyrids infesting *P. granulosa* in Beagle
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37 channel.
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41 Females of southern king crabs undergo their first gametogenesis at about 40 mm CL in
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43 San Jorge Gulf (Vinuesa & Labal 1989; Vinuesa & Balzi 2002) and at about 50 mm CL
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45 (3 years old) in the Beagle Channel (Vinuesa et al. 1991).
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49 Infestation of the southern king crab from San Jorge Gulf with *P. tuberculata* occurs in
50
51 an early stage of host development. Juvenile crabs become infested a few months after
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53 birth, and bopyrid females attain sexual maturity when hosts are approximately 2 years
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55 old and reach sizes of more than 18 mm CL. The incidence is zero in 3-year-old
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4 juveniles (larger than 35-40 mm CL), suggesting parasite-associated host death or
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7 selective elimination of the bopyrid.

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9 The parasite no inhibit the gonad development of *L. santolla* in San Jorge Gulf because
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11 it seems to infest immature stages only. Southern king crabs experience a pronounced
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13 shift in habitat during their life history: 2-year-old juveniles leave the rocky coastal area,
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15 moving to soft bottoms in deeper waters where they disperse out (Vinuesa 2001). Most
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17 of the individuals remain on soft bottoms at depths under 50-60 m until reaching sexual
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19 maturity. During springtime, the adult population performs a reproductive migration to
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21 coastal waters (Vinuesa 2001; Vinuesa & Balzi 2002). In this way, parasite reproduction
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23 occurs in a limited coastal area, and larvae can infest new juveniles present in shallow
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25 waters at densities much higher than those observed for larger individuals in deeper
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27 waters. Thus, the rocky coastal area would act as a gathering site where larvae have
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29 increased availability of hosts. A similar situation, but with low dispersion of larvae, has
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31 been described for *Lithodes aequispina* from deep fjords in British Columbia (Sloan
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33 1984) and for *L. santolla* from some Chilean fjords near the Magellan Strait
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35 (Campodónico 1983).
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TABLE 1

Host					Parasite		
Sex	CL(mm)	Moult stage	Branchial Chamber	Carapace distortion	Total length ♀(mm)	Female Maturity	Total length ♂(mm)
♀	9,89	Late PM	Left	No visible	3,38	Immature	No male
♀	11,1	premoult	Left	No visible	4,05	Immature	No male
♀	11,75	Intermoult	Left	No visible	5,22	Immature	1,21 y 0,60
♀	12,38	Late PM	Left	No visible	4,43	Immature	No male
♀	12,48	Late PM	Left	No visible	6,05	Immature	No male
♀	13,3	Intermoult	Left	Visible	Absent	-	-
♂	14,92	Early PM	Right	No visible	4,78	Immature	No male
♂	18,11	Early PM	Left	Visible	11,12	Mature	3,82
♀	18,52	Intermoult	Left	Visible	10,95	Mature	3,16
♂	21,39	Intermoult	Left	Visible	11,61	Mature	3,93
?	21,55	Exuviae	Left	Visible	Absent	-	-
♂	23,65	Intermoult	Left	Visible	12,96	Mature	4,11
♂	26,17	Intermoult	Left	Visible	13,42	Mature	4,76
♀	26,67	Intermoult	Left	Visible	11,2	Mature	4,78
♂	26,68	Intermoult	Left	Visible	14,47	Mature	5,05
?	27	Intermoult	Left	Visible	Absent	-	-
♀	27,07	Intermoult	Left	Visible	14,38	Mature	5,07
♂	27,12	Intermoult	Left	Visible	15,31	Mature	4,90
?	29,7	Exuviae	Left	Visible	Absent	-	-
♂	30,43	Intermoult	Left	Visible	15,33	Mature	4,59
?	31	Exuviae	Left	Visible	Absent	-	-

FIGURE LEGENDS

Figure 1. Size and number of studied juvenile crabs of *Lithodes santolla* from San Jorge Gulf. In black: size of infested crabs.

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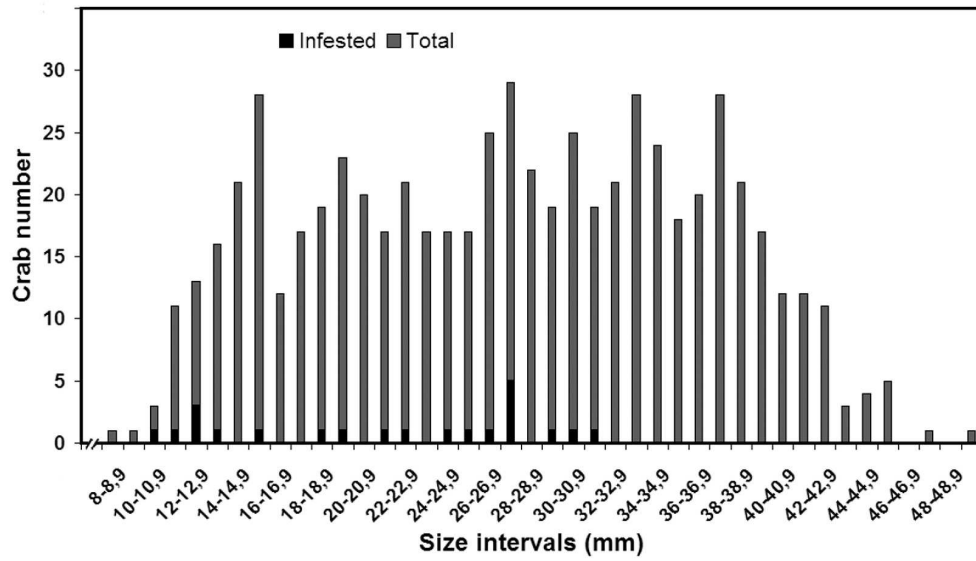


Figure 1. Size and number of studied juvenile crabs of *Lithodes santolla* from San Jorge Gulf. In black: size of infested crabs.
209x130mm (600 x 600 DPI)