New Records on Acanthocephalans from California Sea Lions *Zalophus californianus* (Pinnipedia, Otariidae) from California, USA

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New Records on Acanthocephalans from California Sea Lions *Zalophus californianus* (Pinnipedia, Otariidae) from California, USA. Lisitsyna, O. I. Kudlai, O., Spraker, T. R., Kuzmina, T. A. — To increase the currently limited knowledge addressing acanthocephalans parasitizing California sea lions (*Zalophus californianus*), 33 animals including pups, juvenile and adult males and females from the Marine Mammal Center (TMMC), Sausalito, California, USA were examined. Totally, 2,268 specimens of acanthocephalans representing five species from the genera *Andracantha* (A. phalacrocoracis and *Andracantha* sp.), *Corynosoma* (*C. strumosum* and *C. obtusens*) and *Profilicollis* (*P. altmani*) were found. *Profilicollis altmani* and *A. phalacrocoracis*, predominantly parasitize fish-eating birds; they were registered in *Z. californianus* for the first time. Prevalence and intensity of California sea lion infection and transmission of acanthocephalans in these hosts of different age groups were analyzed and discussed. We provide brief morphological descriptions of the five species of acanthocephalan found in California sea lions.

Key words: Acanthocephala, *Andracantha*, *Corynosoma*, *Profilicollis*, California sea lions.

Introduction

California sea lion (*Zalophus californianus* Lesson, 1828) is one of the most abundant and recognized pinniped species in the North Pacific ranging along the Pacific coast of North America from British Columbia, Canada to Baja California, Mexico (Carretta et al., 2007). The population of California sea lions has been growing steadily since their protection under the Marine Mammal Protection Act of 1972 from approximately 50,000 to 340,000 individuals in the last 40 years (Carretta et al., 2007; McClatchie et al., 2016).
Research on the biology and ecology of California sea lions has been conducted at the National Marine Mammal Laboratory, NOAA, Seattle, Washington, for over four decades (Laake et al., 2016). However, not many studies on helminths parasitizing California sea lions have been performed and published (Lincicome, 1943; Dailey, 1969; Dailey & Hill, 1970; Lyons et al., 1997, 2001, 2005; Kuzmina & Kuzmin, 2015). To date, eleven helminth species including five species of nematodes from the genera Dujardin, 1845, other helminths were found in sea lions of this age group. Acanthocephalans were found in California sea lions twice; the first report documenting acanthocephalans from California sea lions was published by Lincicome (1943), who reported two species, Corynosoma osmeri Fujita, 1921 and C. obtuszens Lincicome, 1943, from four dead California sea lions from the San Diego Zoo. Later, C. osmeri was synonymized with Corynosoma strumosum (Rudolphi, 1802) (Van Cleave, 1953 a; Golvan, 1959). Dailey and Hill (1970) examined 14 dead Z. californianus collected from southern and central California and found C. obtuszens in one of the sea lions. Since then, acanthocephalans have not been reported in central California sea lions, but these two findings have been mentioned in several revisions on parasites of marine mammals (Van Cleave, 1953 a, b; Delyamure, 1955; Petroschenko, 1958; Dailey & Brownell, 1972). The aim of our work was to study the species diversity of acanthocephalans parasitizing California sea lions of different age groups. We also performed morphological studies of the species found and provide their brief morphological descriptions herein. Distribution of the acanthocephalans in California sea lions of different ages and possible transmission routes of these acanthocephalan species are also discussed.

Material and methods

This study was carried out in February–March 2012, 2015 and 2016 at The Marine Mammal Center (TMMC), Sausalito, California, USA. Thirty-three California sea lions of three age groups (22 pups 8–10 month old, 4 yearlings 1.8 year old and 7 adult animals 3–16 years old) were studied. All these animals were found stranded on the Pacific coast near San Francisco (37°46´ N; 122°25´ W), picked up and brought to TMMC for rehabilitation. They have been kept in TMMC for several days to several weeks, and eventually died. The causes of their death were starvation, trauma or domoic acid intoxication (Silvagni et al., 2005). The ages of these animals approximated by the clinical veterinarians at TMMC based on the overall body size and size of the teeth.

Gastrointestinal tracts of these California sea lions were examined following methodology described by Bowman and Lynn (1995). Acanthocephalans were collected manually, washed with saline, and placed in Petri dishes containing tap water for approximately 1–2 hours to ensure evagination of the proboscis. Later, all acanthocephalans were fixed and stored in 70 % ethanol.

Specimens intended for morphological analysis were mounted in Berlese’s medium and examined under light microscope Zeiss Axiom Imager M1. Specimens were identified on the basis of their morphology using descriptions by Perry (1942), Lincicome (1943), Van Cleave (1953 a), Petrochenko (1958), Golvan (1959). Photomicrographs were made from a representative specimen of each species with a digital camera mounted on Zeiss Axiom Imager M1 microscope. All measurements are in micrometers unless otherwise stated. Trunk length does not include proboscis, neck or bursa. Mature and immature males were distinguished by the presence or absence of sperm, mature and immature females — by the presence or absence of eggs.

Results

Twenty-four of 33 California sea lions of all ages were found to be infected with acanthocephalans; prevalence of 73 % (table 1). Intensity of infection varied from 1 to 1,226 specimens per host (average 94.5; mediana 19.5). Only one 9-month old pup (10 % of the pups of this age group) was found to be infected with one specimen of C. strumosum; no other helminths were found in sea lions of this age group. Acanthocephalans were found in all yearlings and adult sea lions (prevalence 100 %).

A total of 2,268 specimens of acanthocephalans representing five species from three genera of the family Polymorphidae Meyer, 1931: Andracantha phalacrocoracis (Yamaguti, 1939) Schmidt, 1975, Andracantha sp., Corynosoma strumosum (Rudolphi, 1802), C. obtuszens Lincicome, 1943 and Profilicolis altmani (Perry, 1942), were collected. Prevalence and intensity of infections with separate species of acanthocephalans varied widely between sea lions of different age groups (table 1). Corynosoma strumosum and C. obtuszens dominated in the acanthocephalan community, while P. altmani, A. phalacrocoracis and Andracan-
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Table 1. Prevalence and intensity of infection in California sea lions of different age groups with five species of acanthocephalans

<table>
<thead>
<tr>
<th>Age group (No of animals)</th>
<th>Totally</th>
<th>Andracantha sp.</th>
<th>Andracantha phalacrocoracis</th>
<th>Corynosoma strumosum</th>
<th>Corynosoma obtusens</th>
<th>Profilocollis altmani</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>P, %</td>
<td>I</td>
<td>P, %</td>
<td>I</td>
<td>P, %</td>
<td>I</td>
</tr>
<tr>
<td>Pups 8–9 months old (n = 10)</td>
<td>10 1</td>
<td>— —</td>
<td>10 1</td>
<td>— —</td>
<td>— —</td>
<td></td>
</tr>
<tr>
<td>Pups 10 months old (n = 12)</td>
<td>100 1–269</td>
<td>9.1 3</td>
<td>— —</td>
<td>100 1–268</td>
<td>18.2 3–14</td>
<td></td>
</tr>
<tr>
<td>Yearlings of 1.8 years old (n = 4)</td>
<td>100 19–1,226</td>
<td>25 9</td>
<td>25 1</td>
<td>75 4–24</td>
<td>100 15–1,201</td>
<td>— —</td>
</tr>
<tr>
<td>Adults of 3–16 years old (n = 7)</td>
<td>100 14–112</td>
<td>14.3 1</td>
<td>— —</td>
<td>100 1–12</td>
<td>85.7 2–111</td>
<td>— —</td>
</tr>
</tbody>
</table>

Note. Abbreviations: P — prevalence; I — intensity of infection.

tha sp., the typical parasites of fish-eating birds, were registered only in young animals: two pups and one yearling.

Short morphological descriptions of the five acanthocephalan species found in this study and information on their hosts and geographic distribution are provided below. The main measurements of the specimens studied including males and females are presented in table 2.

Family Polymorphidae Meyer, 1931

Andracantha Schmidt, 1975

Andracantha phalacrocoracis (Yamaguti, 1939) Schmidt, 1975

Description (figs 1, D; 2, D, K; table 2)


Remarks. Andracantha phalacrocoracis is a common parasite of fish-eating birds. It was initially described by Yamaguti (1939) from pelagic cormorants (Phalacrocorax pelagicus Pallas) from Shikoku Islands, Japan. This species was also reported from black-legged kittiwakes Rissa tridactyla (Linnaeus), slaty-backed gull (Larus schistisagus Steineger), black-throated loon (Gavia arctica Linnaeus), hooded crow Corvus cornix (Linnaeus), carrion crow Corvus corone (Linnaeus) and P. pelagicus from the Far East from Chukotka to the Prymorye, Russia (Khokhlova, 1986), from P. pelagicus and bald eagles (Haliaeetus leucocephalus Linnaeus, 1766) from Alaska (Schmidt, 1975; Richardson & Cole, 1997), from the great cormorant Phalacrocorax carbo (Blumenbach) from South Moravia, Poland, on their seasonal migrations (Okulewicz, 2014; Moravec & Scholz, 2016).

Intermediate hosts for A. phalacrocoracis are unknown. However, several species from the genus Andracantha are known to use amphipods as their intermediate hosts (Atrashkevich, 2008). Fishes from three families, Nototheniidae, Bathylagidae and Channichthyidae, were reported as the paratenic hosts for these acanthocephalans (Rocka, 2006; Laskowski et al., 2008; Laskowski & Zdjitowiecki, 2009).
Table 2. Morphological features of Acanthocephala specimens found in California sea lions (*Zalophus californianus*). All measurements are in micrometers unless otherwise stated.

<table>
<thead>
<tr>
<th>Characters</th>
<th><em>Andracantha</em> sp.</th>
<th><em>Andracantha phalacrocoracis</em></th>
<th><em>Corynosoma strumosum</em></th>
<th><em>C. obtusens</em></th>
<th><em>Profilocollis altmani</em></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>males (n = 4)</td>
<td>females (n = 5)</td>
<td>female (n = 1)</td>
<td>males (n = 10)</td>
<td>females (n = 12)</td>
</tr>
<tr>
<td>Total body length, mm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>2.70–3.76 (3.1)</td>
<td>2.80–3.88 (3.4)</td>
<td>3.15</td>
<td>2.46–3.10 (2.8)</td>
<td>2.50–3.55 (3.1)</td>
</tr>
<tr>
<td>Female</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximal body width, mm</td>
<td>1.15–1.40 (1.3)</td>
<td>1.50–1.59 (1.5)</td>
<td>1.02</td>
<td>0.93–1.30 (1.1)</td>
<td>1.28–1.50 (1.4)</td>
</tr>
<tr>
<td>Length of spines (anterior)</td>
<td>29–40 (36.3)</td>
<td>22–29 (25.3)</td>
<td>48</td>
<td>31–36 (33.5)</td>
<td>30–37 (34.4)</td>
</tr>
<tr>
<td>Length of spines (posterior)</td>
<td>24–43 (36)</td>
<td>27–29 (28.3)</td>
<td>25</td>
<td>23–36 (28.8)</td>
<td>34–44 (37.4)</td>
</tr>
<tr>
<td>Genital spines</td>
<td>absent</td>
<td>present</td>
<td>absent</td>
<td>present</td>
<td>present</td>
</tr>
<tr>
<td>Length of proboscis</td>
<td>791–875 (833)</td>
<td>767–916 (819.7)</td>
<td>650</td>
<td>474–620 (526.3)</td>
<td>490–660 (559)</td>
</tr>
<tr>
<td>Width of proboscis</td>
<td>300–337 (318.5)</td>
<td>410–538 (456)</td>
<td>380</td>
<td>260–302 (275.9)</td>
<td>270–347 (300.4)</td>
</tr>
<tr>
<td>Number of hooks rows</td>
<td>15–16 (15.8)</td>
<td></td>
<td>18</td>
<td>17–19 (18.1)</td>
<td>17–19 (17.9)</td>
</tr>
<tr>
<td>Number of hooks per row</td>
<td>10–13 (11.5)</td>
<td></td>
<td>11</td>
<td>10–11 (10.7)</td>
<td>10–12 (10.6)</td>
</tr>
<tr>
<td>Number of rooted hooks</td>
<td>6–8 (6.9)</td>
<td>6–7</td>
<td>6–7</td>
<td>6–7 (6.4)</td>
<td>6–7 (6.4)</td>
</tr>
<tr>
<td>Number of spiniform hooks</td>
<td>4–6 (5.2)</td>
<td>4–5 (4.7)</td>
<td>4–5</td>
<td>4–5 (4.4)</td>
<td>4–5 (4.4)</td>
</tr>
<tr>
<td>Length of blades of largest hook</td>
<td>90–103 (98.7)</td>
<td>103–125 (115)</td>
<td>85–90</td>
<td>54–72 (60.9)</td>
<td>55–68 (63.3)</td>
</tr>
<tr>
<td>Length of roots of largest hook</td>
<td>86–102 (94)</td>
<td>90–130 (108)</td>
<td>85–88</td>
<td>66–84 (72.6)</td>
<td>69–87 (78.4)</td>
</tr>
<tr>
<td>Length of blades of spiniform hooks</td>
<td>51–72 (63.3)</td>
<td>119–142 (128.2)</td>
<td>48–63</td>
<td>31–46 (38.2)</td>
<td>34–42 (37.7)</td>
</tr>
<tr>
<td>Testes, length</td>
<td>385–700 (575)</td>
<td>–</td>
<td>214–460 (316)</td>
<td></td>
<td>225–470 (358.2)</td>
</tr>
<tr>
<td>Testes, width</td>
<td>162–400 (307.3)</td>
<td>–</td>
<td>150–400 (251.6)</td>
<td></td>
<td>289–520 (370.4)</td>
</tr>
<tr>
<td>Eggs</td>
<td>–</td>
<td>absent</td>
<td>–</td>
<td>–</td>
<td>98–113 (105.1)</td>
</tr>
<tr>
<td>Gonopore</td>
<td>terminal</td>
<td>terminal</td>
<td>subterminal</td>
<td>subterminal</td>
<td>subterminal</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

**Andracantha** sp.

Description (figs 1, E; 2, A, B, C, H, J; table 2).


Remarks. The genus *Andracantha* now comprises nine valid species (Schmidt, 1975; Amin, 2013; Presswell et al., 2017). The specimens found in the present study closely resemble *Andracantha baylisi* (Zdzitowiecki, 1986) based on the shape and size of the body and hooks, arrangement of the tegumental spines and location of the gonopore in females. However, they differ from *A. baylisi* in the armature of the proboscis (15–16 rows of 10–13 hooks each in females and 15–17 rows of 13 hooks each in males vs 16 rows of 10–11 hooks in both sexes in *A. baylisi*), the presence of bare zone between two fields of spines in the anterior part of the trunk, and a peculiar system of muscles in the posterior part of the female trunk (Zdzitowiecki, 1985, 1986, 1989). A complex system of foretrunk muscles was described in the species of the genera *Andracantha* and *Corynosoma* (Aznar et al., 2006); however these muscles in the area of female genital system were not studied. In our specimens of *Andracantha* sp., the muscles which support female genital system (fig. 2, H), possibly, act as ligaments.

Due to the presence of only immature individuals of both sexes in our material, a formal description of this putative new species was impossible, and requires examination of the mature specimens.

**Corynosoma** Lühe, 1904

**Corynosoma strumosum** (Rudolphi, 1802)

Description (figs 1, A; 2, E; table 2).

**General.** Small acanthocephalans, males and females similar in size and shape, females slightly larger. Trunk 3,800–6,240 × 933–1,600. Trunk anterior part widened in the form of ellipsoidal swelling, with small spines extended ventrally more than dorsally. Length of spines increasing from apical (32–38) to median (44–61) and decreasing posteriorly (25–36). Trunk posterior part narrowest at middle, slightly dilated at posterior end. Genital spines present or absent. Proboscis 450–620 × 260–290, almost cylindrical, with widening in its posterior third. Proboscis with 17–19 longitudinal rows of 10–11 hooks each. First 6–7 hooks large, with simple roots directed posteriorly. Next 1–2 hooks transitional, with small roots in the shape of an inverted Y (fig. 2, E). Proximal 3–4 hooks spiniform, with simple roots directed anteriorly. Largest hooks are 6th or 7th. Proboscis receptacle double-walled. Lemnisci broad, leaf-shaped, shorter than proboscis receptacle. Neck truncated cone, 211–620 long, often retracted into foretrunk. Reproductive system in narrow posterior part of trunk.

Remarks. *Corynosoma strumosum* was initially described by Rudolphi (1802) from harbor seal (*Phoca vitulina* Linnaeus). This species was also reported in various marine mammals, terrestrial carnivores and aquatic birds throughout the Arctic, Pacific and At-
Fig. 1. Acanthocephalan species from California sea lions (Zalophus californianus): A — Corynosoma strumosum, total view of adult male; B — Corynosoma obtuscens, total view of female; C — Profilocollis altmani, total view of immature male; D — Andracantha phalacrocoracis, anterior part of female; E — Andracantha sp., total view of immature female. Scale bars: A, B, C, E — 1 mm, D — 500 μm.
Corynosoma obtuscens Lincicome, 1943


Remarks. Corynosoma obtuscens is a common parasite of sea lions (Lincicome, 1943; Van Cleave, 1953 a, b). The species was described by Lincicome (1943) from Z. californianus from the San Diego Zoo, California, USA. It was also registered in northern fur seals (Callorhinus ursinus Linnaeus) and South American sea lions (Otaria byronia Péron) from the California coast, in the Gulf of Mexico, off the coast of South America and in Alaska (Van Cleve, 1953 a, b), and from domestic dogs in Peru (Cabrera et al., 1999). Juvenile specimens were also registered in sea otter (Enhydra lutris Linnaeus) (Ward & Winter, 1952). Domestic dogs were successfully infected experimentally with cystacanths collected from fish (Castro & Martínez, 2004). Our material corresponds to the original description provided by Lincicome (1943). Intermediate hosts for C. obtuscens are unknown. Several species of fishes (paratenic hosts) off the Pacific coast of South America were found to be infected with cystacanths of C. obtuscens with prevalence up to 60% (Tantaleán & Huiza, 1994; Tantaleán et al., 2005; Chero et al., 2014).

Proficollis Meyer, 1931
Proficollis altmani (Perry, 1942)

Description (figs 1, C; 2, G; table 2). General. Acanthocephalans of medium size. Trunk with two extensions in its anterior part; posterior part cylindrical. Spines extend to middle of anterior extension, arranged in irregular longitudinal rows. Length of spines decreasing from apical (30) to basal (22–23). Genital spines absent. Proboscis spherical, with 25–30 longitudinal rows of 11–13 hooks each (fig. 2, G). First 3–4 hooks thicker than others, with simple roots directed posteriorly. Next hooks spiniform, with root processes directed anteriorly or without processes. Neck 900–1,620 × 370–480 long. Proboscis receptacle double-walled, attached at proboscis base, extended through neck to trunk, with maximum width in its posterior part. Cerebral ganglion oval, 220 × 89. Lemnisci saciform, attached to neck, extend to bottom of proboscis receptacle or slightly posterior.

Remarks. Specimens collected from Z. californianus in our study correspond to the original description of P. altmani provided by Perry (1942), but differ in the number.
Fig. 2. Acanthocephalan species from California sea lions (*Zalophus californianus*): A — *Andracantha* sp., total view of immature male. Scale bar 1 mm; B — *Andracantha* sp., proboscis of female. Scale bar 500 μm; C — *Andracantha* sp., total view of immature female. Scale bar 1 mm; D — *Andracantha phalacrocoracis*, spines of ventral surface. Scale bar 1 mm; E — *Corynosoma obtusens*, transitional hooks. Scale bar 50 μm; F — *Corynosoma strumosum*, transitional hooks. Scale bar 50 μm; G — *Profiticollis altmani*, longitudinal row of hooks. Scale bar 100 μm; H — *Andracantha* sp., posterior part of female. Scale bar 500 μm; I — *Andracantha* sp., longitudinal row of hooks. Scale bar 100 μm; J — *Andracantha phalacrocoracis*, longitudinal row of hooks. Scale bar 100 μm; K — *Andracantha phalacrocoracis*, longitudinal row of hooks. Scale bar 100 μm.
of hooks in the longitudinal rows (11–13 hooks vs 9–12 hooks). The wide variability in the number of hooks (13–17) was also found in specimens of *P. bullocki*, a synonym of *P. altmani* by Amin (2013) collected from birds, *Larus dominicanus* Lichtenstein, *L. pipixcan* Wagler, *Podiceps occipitalis* Garnot, *Numenius phaeopus* Linnaeus, in South America (Riquelme et al., 2006). We assume that the variability in the number of hooks in a row is typical for this species.

*Proficollis altmani* was described from surf scoters (*Melanitta perspicillata* Linnaeus) and *M. deglandi stejneri* (Ridgway) in North America (Perry, 1942). This species was also reported in gulls (*Chroicocephalus maculipennis* Lichtenstein), *L. dominicanus*, *L. pipixcan*, and *Leucophaeus modestus* von Tschudi), grebe (*Podiceps occipitalis*) and whimbrels (*Numenius phaeopus*) from the Pacific and Atlantic Oceans (Van Cleave, 1947; Bourgeois & Threlfall, 1982; Riquelme et al., 2006; Goulding & Cohen, 2014; Rodriguez et al., 2016), as well as in a sea otter *E. lutris* in California (Near et al., 1998; Mayer et al., 2003). Juvenile worms were found in the intestines of the Peruvian grunt (*Anisotremus scapularis* Tschudi) from the coastal zone of Chorrillos, Peru (Chero et al., 2014). Paratenic hosts were not reported. Crabs of the genera *Emerita* Scopoli and *Blepharipoda* Randall serve as the intermediate hosts for *P. altmani* (Tantaleán et al., 2002; Mayer et al., 2003; Royal et al., 2004; Smith, 2007).

**Discussion**

This study advances our knowledge on species diversity of acanthocephalans from California sea lions, and specifies new host and locality for *P. altmani*, which predominantly parasitizes fish-eating birds. Similarly, species of the genus *Andracantha* known as parasites of fish-eating birds were not reported in *Z. californianus* before. Thereby, the data obtained in our study widens the species composition of the acanthocephalans parasitizing California sea lions to five species.

Comparison of infections of California sea lions of different age groups with acanthocephalans revealed specific patterns associated with the transmission of these helminths through the food-webs. According to our observations, sea lion pups were infected with acanthocephalans more than with others groups of helminths. Moreover, acanthocephalans were found to be the first group of helminths which infect California sea lion pups (Kuzmina et al., 2017). Apparently, when 8–10 months old pups start feeding independently in shallow coastal waters, crustaceans, the intermediate hosts of acanthocephalans, compose significant part of their diet. Pups examined in our study evidently had at least several successful feedings with crustaceans and became infected with cystacanths. Prevalence of California sea lion infection with acanthocephalans increases with their age and reaches 100 % in yearlings and adults.

In our study, *P. altmani* was found only in two 10-month old pups. This may be due to the lack of ability to paratenic parasitism in *P. altmani*, as well as the restriction of their intermediate hosts (crabs from the genera *Emerita* and *Blepharipoda*) to shoal water areas where the pups predominantly feed. Thus, in our opinion, adult California sea lions are not infected by *P. altmani* because they predominantly do not feed in shallow coastal waters. The sources of California sea lion infections with *C. strumosum*, *C. obtusens* and *Andracantha* spp. are both crustaceans, as the intermediate hosts, and fishes as the paratenic hosts; thus these acanthocephalans successfully infect pups as well as adult sea lions. Moreover, the intensity of infection with these species in California sea lions increases with their age.

In our study, only immature specimens of *Andracantha* spp. and *P. altmani* were found. Immature specimens of *Andracantha* sp. were observed in the South American sea lion *Otaria flavescens* (Shaw) in central California (Hernández-Orts et al., 2013). High intensity of *P. altmani* was observed in the sea otter *E. lutris* in California (Near et al., 1998; Mayer et al., 2003); however, authors did not mention if any mature parasites were present. These acanthocephalans are obligate parasites of fish-eating birds (Van Cleave,
1947; Bourgeois & Threlfall, 1982; Zdzitowiecki, 1985, 1986, 1989; Riquelme et al., 2006; Goulding & Cohen, 2014); thus we assume that California sea lion is an accidental host for these species.

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References
Delyamure, S. L. 1955. Helminthofauna of marine mammals (ecology and phylogeny). Izdatelstvo AN USSR, Moscow, 1–518 [In Russian.]


Presswell, B., García-Varela, M., Smales, L. R. 2017. Morphological and molecular characterization of two new species of Andracantha (Acanthocephala: Polymorphidae) from New Zealand shags (Phalacrocoraciidae) and penguins (Spheniscidae) with a key to the species. Journal of Helminthology. https://doi.org/10.1017/S0022149X17001067


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