

Pseudoterranova cattani sp. nov. (Ascaridoidea: Anisakidae), a parasite of the South American sea lion *Otaria byronia* De Blainville from Chile

Pseudoterranova cattani sp. nov. (Ascaridoidea: Anisakidae), un parásito del lobo marino común *Otaria byronia* De Blainville en Chile

MARIO GEORGE-NASCIMENTO & XIMENA URRUTIA

Facultad de Ciencias, Universidad Católica de la Santísima Concepción, casilla 297, Concepción, Chile, e-mail: mgeorgen@david.ucsc.cl

ABSTRACT

The parasitic nematode *Pseudoterranova cattani* sp. nov. is described from the stomach of the South American sea lion *Otaria byronia* De Blainville, sampled along the coastline off central-south Chile, between 1980 and 1997. The adult and larvae of this species have been previously reported in the Southeastern Pacific Ocean as *Phocanema decipiens* Myers. Major differences with species from the North Atlantic and Northwest Pacific are based on the body size, number, distance and size of caudal papillae.

Key words: Ascaridoidea, Anisakidae, new species, *Pseudoterranova*, *Otaria byronia*, South American sea lion, Chile.

RESUMEN

Se describe al nemátodo parásito *Pseudoterranova cattani* sp. nov. encontrado en el estómago del lobo marino común *Otaria byronia* De Blainville, en muestras tomadas entre 1980 y 1997, a lo largo de la costa del centro-sur de Chile. Las larvas y adultos de esta especie han sido registrados en el océano Pacífico sudoriental como *Phocanema decipiens* Myers. Las principales diferencias con las especies del Atlántico norte y del Pacífico noroccidental se basan en el tamaño corporal y en el número, tamaño, distancia y proporciones de las papilas caudales.

Palabras clave: Ascaridoidea, Anisakidae, especie nueva, *Pseudoterranova*, *Otaria byronia*, lobo marino común, Chile.

INTRODUCTION

The codworm *Pseudoterranova decipiens* (Krabbe 1878) was formerly believed to be a worldwide distributed species. However, it is already known that is a species complex composed by at least five species, with minimal morphological and clearcut genetic differentiation (Di Deco et al. 1994, Mattiucci et al. 1998, Paggi et al. 1991, 1998). The only taxonomic study on *Pseudoterranova* in the Southern Pacific is the redescription of *P. decipiens* s. l. in *Otaria flavescens* Shaw (= *O. byronia* De Blainville, see Oliva 1988) (Cattan & Carvajal 1980). These authors mentioned the difficulty in distinguishing species and described the morphometry and general arrangement of caudal papillae. They were

able to discern on the shape of the caudal end of the spicule in adult males, but not on the detailed distances and ratios between the caudal papillae. SEM of *in vitro* cultured *P. decipiens* s. l. cephalic region with lips denticle distribution, and caudal region showing spicules, post anal plates and post anal papillae have been published (Carvajal et al. 1981). In the southeastern Pacific Ocean, off the Chilean coastline, allozymic and morphometric analyses revealed an undescribed *Pseudoterranova* species that was found as the adult stage in the South American sea lion *O. byronia*, and also as larvae in several fish prey species (George-Nascimento & Llanos 1995).

We describe herein this nematode and name it *Pseudoterranova cattani* sp. nov. in the honor of Dr. Pedro E. Cattan, Universidad de Chile, who

was the first to report and study the taxonomy of this parasite in Chile.

MATERIAL AND METHODS

Between 1980 and 1997, fifty five specimens of the South American sea lion were sampled between Cobquecura and Chiloé (between ca. 36 and 39° S), Chile, and examined for nematodes. Fifteen *Pseudoterranova* males and 15 females were examined for each morphometric variable from the material recovered. They were cleared in

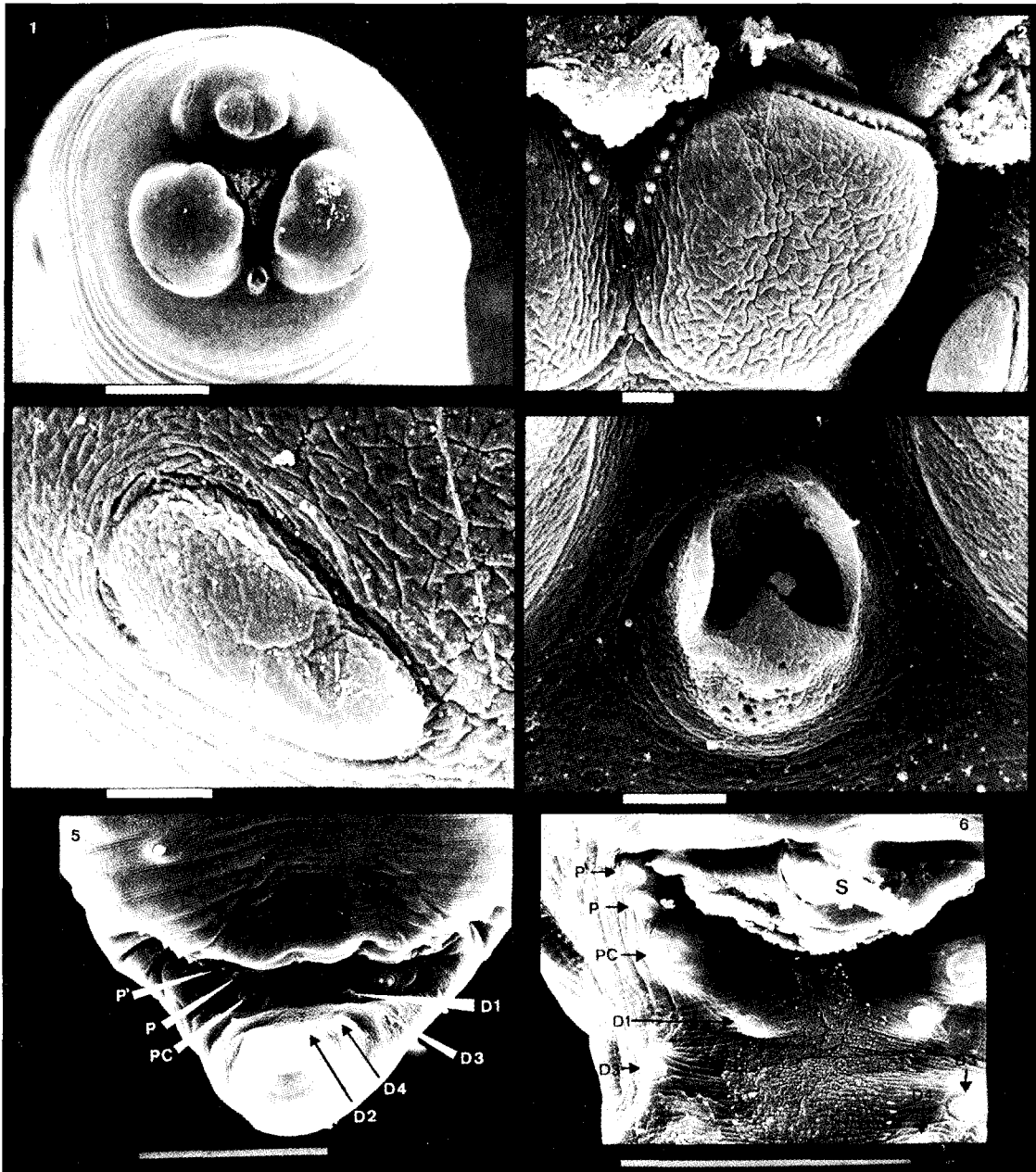


Fig. 1. *Pseudoterranova cattani*. 1: head, frontal view (100 μ m), 2: Denticle ridge in the lips (10 μ m), 3: lip papilla (10 μ m), 4: excretory pore (10 μ m), 5: male tail (100 μ m), 6: Postcloacal papillae (100 μ m). Codes of papillae as in Table 1, s= spicule.

Pseudoterranova cattani. 1: cabeza, vista frontal (100 μ m), 2: Borde de denticulos en los labios (10 μ m), 3: papila labial (10 μ m), 4: poro excretor (10 μ m), 5: cola del macho (100 μ m), 6: Papilas postcloacales (100 μ m), Códigos de papilas como en Tabla 1, s= espícula.

Amman's lactophenol for light microscopic examination. Scanning electron microscopy was also used for the observation of cephalic and caudal structures. Measurements of internal organs were accomplished after dissection and observation by stereomicroscope. The morphometry and morphology were compared to descriptions given by Cattán & Carvajal (1980), Di Deco et al. (1994), and Mattiucci et al. (1998). Type specimens were deposited at Museo Nacional de Historia Natural, Santiago, Chile. Holotype: MNHN Nem N° 11.167, Paratypes: Nem N° 11.168.

RESULTS

Description

Pseudoterranova cattani sp. nov. (Figs. 1- 2, Tables 1- 2)

General description: An Anisakidae with elongate large body, cuticular ridges from neck to tail, three prominent bilobed lips, one dorsal, with a wider base than the two subventral lips, and with the presence of two egg-shaped papillae, while subventral lips harbored one papilla each. Each lip with row of denticles located at its internal anterior fringe, interlabia and teeth absent, small cervical expansions of cuticle (wings), cervical deirids, one in front of the other, posterior to the neck. Excretory pore opening between the subventral lips. Compound esophagus with ventriculus and intestinal caecum anteriorly extended. No ventricular appendix. Nerve ring located in the anterior region of the esophagus. Presence of sexual dimorphism, with females larger in body size than males.

Males: Size smaller than females in length and width, with curvature in the form of a hook at the posterior end. Preanal papillae arranged in two lateral lines; two pairs of proximal post anal

TABLE 1

Morphometry in adult *Pseudoterranova cattani* sp. nov. Mean \pm 1 standard deviation (SD) and range. Measurements are in mm, except indicated

Morfometría en adultos de *Pseudoterranova cattani* sp. nov. Promedio \pm 1 desviación estándar (SD) y rango. Mediciones en mm, excepto cuando se indica

Morphometric variables	Males		Females	
	Mean \pm SD	Range	Mean \pm SD	Range
Total length	39.8 \pm 9.50	26.4 - 61.7	61.5 \pm 13.8	46.4 - 85.0
Maximum width	1.30 \pm 0.23	0.89 - 1.78	1.91 \pm 0.32	1.28 - 2.56
Deirids - anterior end	1.03 \pm 0.18	0.70 - 1.30	1.05 \pm 0.15	0.80 - 1.30
Nerve ring - anterior end	0.60 \pm 0.20	0.41 - 1.26	0.64 \pm 0.15	0.34 - 0.97
Esophagus length	3.48 \pm 0.74	2.40 - 4.89	3.98 \pm 0.94	2.23 - 5.15
Ventriculus length	0.44 \pm 0.14	0.19 - 0.84	0.81 \pm 0.34	0.28 - 1.42
Caecum length	1.06 \pm 0.23	0.63 - 1.57	1.80 \pm 0.39	1.31 - 2.50
Caecum width	0.40 \pm 0.09	0.20 - 0.55	0.53 \pm 0.21	0.21 - 0.90
Distance anus- tail	0.15 \pm 0.04	0.08 - 0.23	0.38 \pm 0.18	0.23 - 1.00
Right spicule	1.75 \pm 0.35	1.32 - 2.67		
Proximal width	0.063 \pm 0.014	0.034 - 0.089		
Medial width	0.046 \pm 0.013	0.025 - 0.068		
Distal width	0.025 \pm 0.009	0.008 - 0.044		
Left spicule	1.914 \pm 0.417	1.32 - 2.70		
Proximal width	0.067 \pm 0.014	0.042 - 0.092		
Medial width	0.050 \pm 0.009	0.034 - 0.065		
Distal width	0.025 \pm 0.007	0.017 - 0.038		
Vulva - anterior end			2.69 \pm 0.41	2.14 - 3.45
Vagina			0.62 \pm 0.11	0.41 - 0.80
Uterus			2.58 \pm 0.33	2.00 - 3.20
Body of uterus			1.18 \pm 0.22	0.80 - 1.60
Horns			1.42 \pm 0.25	1.00 - 1.90
Egg length (μ m)			50.9 \pm 7.71	41.8 - 56.4
Egg width (μ m)			37.3 \pm 1.28	34.5 - 43.6
n		15		15

papillae. Subequal spicules, long and thin, ensheated, more expanded in its proximal end, lance-shaped, without accessory pieces, scarcely developed cuticular wings, three denticular chains located posterior to the cloaca. For morphometrics see Table 1.

Females: Presence of a prominent vulva normally located near the middle of the body.

Deirids and nerve ring are at a larger distance from anterior end than in males. Muscular esophagus, ventriculus, intestinal caecum and the distance anus to tail are greater than in males. Vagina slim, long and followed by a straight uterus with two parts well defined (a single body and two horns). For morphometrics see Table 1.

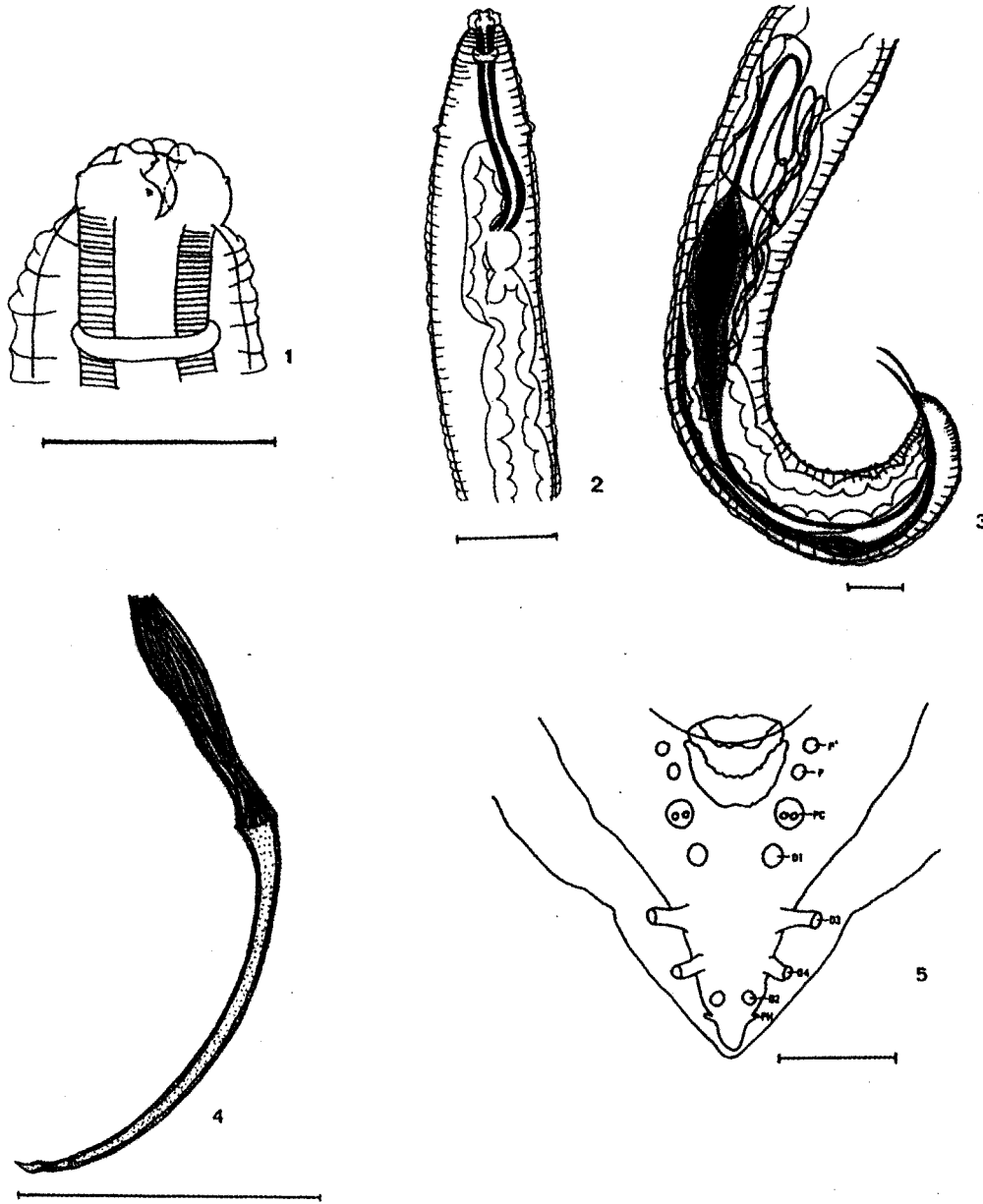


Fig. 2. *Pseudoterranova cattani*. 1: Dorsal view of head (200 μ m), 2: Anterior part of body, lateral view (800 μ m), 3: Male posterior end showing espicules, lateral view (300 μ m), 4: Spicule (10 μ m) and schematic representation of the arrangement of caudal papillae in adult males (100 μ m).

Pseudoterranova cattani. 1: Vista dorsal de la cabeza (200 μ m), 2: Parte anterior del cuerpo, vista lateral (800 μ m), 3: Extremo caudal del macho mostrando las espículas, vista lateral (300 μ m), 4: Espícula (10 μ m) y representación esquemática de la disposición de las papilas caudales en machos adultos (100 μ m).

DISCUSSION

Four out of 5 species already described within *P. decipiens* (A to D) have morphometric descriptions based on the size, distance and ratios between postanal papillae (Table 2). Names of 2 of these species have been proposed: *Pseudoterranova bulbosa* for *P. decipiens* C, *Pseudoterranova azarasi* for *P. decipiens* D, Mattiucci et al. 1998). No such a comparison can be made with *Pseudoterranova decipiens* E, because there is no morphological description yet for this Antarctic species (see Bullini et al. 1994).

Major differences between *Pseudoterranova cattani* sp. nov. and *Pseudoterranova decipiens* A, B, *P. bulbosa* and *P. azarasi* are the smaller mensural values than in *P. cattani* of: the length of spicules, the diameter of proximal papillae p and p', paraocloacal papilla pc and distal papilla

d1, the distance between the posterior papilla and d1, between the distal papilla d1 and d2, between papillae d3 and d4, and the body width at the level of paraocloacal papilla pc. Moreover, a major characteristic that is useful to distinguish *P. cattani* from the other species in the complex the presence of two proximal papillae (p and p') located beneath the anus and pc, the paraocloacal papillae (Table 2).

Pseudoterranova cattani has been reported at larval stage in several fish species in this area (George-Nascimento & Llanos 1995). The Juan Fernández fur seal *Arctocephalus philippii* (Peters) and the South American fur seal *Arctocephalus australis* Zimmerman are the only other potential hosts for this parasite, although the suitability of these species as definitive hosts for *P. cattani* is yet to be shown (see Sepúlveda & Alcaíno 1993).

TABLE 2

Morphometry of 19 variables recorded in 15 *Pseudoterranova cattani* adult males and mean values as reported for *Pseudoterranova* A, B, C and D, according to Di Deco et al. (1994) and Mattiucci et al. (1998). Measurements are in microns, except indicated. (np = not present), (na = not available)

Morfometría de 19 variables registradas en 15 machos adultos de *Pseudoterranova cattani* y valores promedio reportados para *Pseudoterranova* A, B, C y D, según Di Deco et al. (1994) y Mattiucci et al. (1998). Mediciones en micras, excepto cuando se indica. (np = ausente), (na = no disponible)

Variable	<i>P. cattani</i> (range)	<i>Pseudoterranova</i>			
		A	B	C	D
len (mm)	26.4 - 61.7	36.1	44.4	46.6	49.0
spi (mm)	1.3 - 2.7	2.2	2.3	2.8	1.8
dp	6.3 - 7.2	16.6	25.1	18.8	na
dp'	6.3 - 7.2	np	np	np	np
dpc	15.2 - 16.3	37.3	37.2	29.2	na
dd1	8.6 - 8.9	26.2	26.7	19.60	na
dp/dpc	0.4 - 0.5	0.45	0.68	0.65	na
dp'/dpc	0.4 - 0.5	np	np	np	np
dp/dd1	0.7 - 0.8	0.64	0.94	0.96	na
dp'/dd1	0.7 - 0.8	np	np	np	np
dpc/dd1	1.8 - 1.9	1.43	1.40	1.49	na
tail	77.0 - 230.0	243.8	313.7	339.5	276.7
ped1	77.8 - 97.2	168.9	225.0	249.1	216.6
d1d2	42.5 - 61.1	83.0	125.6	160.9	125.3
d3d4	20.0 - 25.0	31.9	55.8	59.5	50.8
d4d2	13.9 - 16.7	3.9	7.7	43.3	28.0
bwcl	181.8 - 202.2	249.1	312.7	274.0	273.3
bwpc	163.9 - 167.3	208.1	262.3	233.5	np
bwd2	75.5 - 90.2	65.1	80.2	61.8	np

Name of morphometric variables, according to Fagerholm (1991): len: total body length, spi: espicule length, dp: diameter of proximal papilla p, dp': diameter of proximal papilla p', dpc: diameter of proximal paraocloacal papilla pc, dd1: diameter of distal papilla d1, tail: distance between the anus and posterior end, ped1: distance between the posterior end and d1, d1d2, d4d2: are distances between corresponding papillae, bwcl body width at the level of cloaca; bwpc: body width at the level of pc, bwd2: body width at the level of d2, and the following ratios: dp/dpc, dp/dd1, dp'/dd1, dpc/dd1.

ACKNOWLEDGMENTS

We are grateful to many people at different stages along time. This study was funded partially through Grants INB-029B, DIUC 98/80, FONDECYT 226/88, and from FONDAP O & B M, Programa Mayor 3, while preparing the manuscript.

LITERATURE CITED

- BULLINI L, P ARDUINO, R CIANCHI, G NASCETTI, S D'AMELIO, S MATTIUCCI, L PAGGI & P ORECCHIA (1994) Genetic and ecological studies on nematode endoparasites of the genera *Contraecum* and *Pseudoterranova* in the Antarctic and Arctic-Boreal regions. In: Battaglia B, PM Bisol, V Varotto (eds) Proceedings, 2nd meeting on Antarctic Biology, Padova, 1992: 131-146. Scienza e Cultura, Aldo Martello, Ed. Univ. Patav, Padova.
- CARVAJAL J, C BARROS, G SANTANDER & C AL-CALDE (1981) In vitro culture of larval anisakid parasites of the Chilean hake *Merluccius gayi*. Journal of Parasitology 67: 958-959.
- CATTAN PE & J CARVAJAL (1980) *Phocanema decipiens* (Krabbe 1878); nematodo parásito del lobo común *Otaria flavescens*, en Chile. Algunas consideraciones taxonómicas. Revista Ibérica de Parasitología 40: 1-9.
- DIDECO MA, P ORECCHIA, L PAGGI & V PETRARCA (1994) Morphometric stepwise discriminant analysis of three genetically identified species within *Pseudoterranova decipiens* (Krabbe. 1878) (Nematoda: Ascaridida). Systematic Parasitology 29: 81-88.
- FAGERHOLM HP (1991) Systematic implications of male caudal morphology in ascaridoid nematode parasites. Systematic Parasitology 19: 215-229.
- GEORGE-NASCIMENTO M & A LLANOS (1995) Micro - evolutionary implications of allozymic and morphometric variations in sealworms *Pseudoterranova* sp. (Ascaridoidea: Anisakidae) among sympatric hosts from the Southeastern Pacific Ocean. International Journal for Parasitology 25: 1163-1171.
- MATTIUCCI S, L PAGGI, G NASCETTI, H ISHIKURA, K KIKUCHI, N SATO, R CIANCHI & L BULLINI (1998) Allozyme and morphological identification of *Anisakis*, *Contraecum* and *Pseudoterranova* from Japanese waters (Nematoda, Ascaridoidea). Systematic Parasitology 40: 81-92.
- OLIVA D (1988) *Otaria byronia* (de Blainville, 1820), the valid scientific name for the southern sea lion (Carnivora: Otariidae) Journal of Natural History 22: 767-772.
- PAGGI L, G NASCETTI, R CIANCHI, P ORECCHIA, S MATTIUCCI, S D'AMELIO, B BERLAND, J BRATTEY, JW SMITH & L BULLINI (1991) Genetic evidence for three species within *Pseudoterranova decipiens* (Nematoda. Ascaridida. Ascaridoidea) in the North Atlantic and Norwegian and Barents seas. International Journal for Parasitology 21: 195 - 212.
- PAGGI L, S MATTIUCCI, H ISHIKURA, K KIKUCHI, N SATO, G NASCETTI, R CIANCHI & L BULLINI (1998) Molecular genetics in anisakid nematodes from the Pacific Boreal region. In: Aikawa M, H Itakura, K Kikuchi (eds) Host response to International Parasitic Zoonoses: 83-107. Springer Verlag, Tokyo.
- SEPULVEDA M & H ALCAINO (1993) Fauna helmintológica en el lobo fino de Juan Fernández, *Arctocephalus philippii* (Peters, 1866) Parasitología al Día 17 (Chile): 19-24.