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The tanaidacean fauna of the Beagle Channel (southern Chile) and its relationship to the fauna of the Antarctic continental shelf

ANJA SCHMIDT and ANGELIKA BRANDT*

Zoological Institute and Zoological Museum, University of Hamburg, Martin-Luther-King-Platz 3, D-20146 Hamburg, Germany
**abrandt@zoologie.uni-hamburg.de*

Abstract: In November 1994 epibenthic sledge samples were taken in the Beagle Channel. This study presents the first systematic account of Tanaidacea of the Beagle Channel and an adjacent area on the Atlantic continental slope. The material of this part from the Magellan Strait comprised 2175 specimens and 27 species of eight families of Tanaidomorpha and two families of Apseudomorpha. Eleven species were sampled in the Magellan region for the first time. The genus *Stenotanais* (Anarthruridae) was reported for the first time in the Southern Hemisphere and, the bathymetric range of seven species was extended. The tanaidacean fauna in the Beagle Channel is highly heterogeneous with 36 tanaidacean species now known from the Magellan region. On the basis of a zoogeographic comparison of the Magellan region with sub-Antarctica and Antarctica, Sieg's (1988) hypothesis of a phylogenetically young, derived Antarctic tanaidacean fauna is examined and the zoogeographic relationship between the Magellanic Tanaidacea and the Antarctic tanaidaceans is discussed.

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Key words: biogeography, Magellan region, Peracarida, sub-Antarctic, Tanaidacea

Introduction

The Beagle Channel, situated in the Magellan region, is the southernmost fjord of South America. Because of its proximity to the Antarctic Peninsula and the historical-geological development of the Scotia Arc region, the Beagle Channel and the Magellan region are especially interesting for faunistic comparisons with the sub-Antarctic and Antarctic. South America is the continent closest to Antarctica (about 1000 km), and for that reason these continents show the most faunistic affinities. Deep-water circulation between South America and the Antarctic was probably established about 22 Ma ago, when the circum-Antarctic Current became effective and separated both continents faunistically (Barker *et al.* 1991, Storey *et al.* 1996, Crame 2000).

Tanaidacea are an almost exclusively marine order of the Peracarida. With increasing depth this taxon generally increases in diversity. Due to their small size of 2–3 mm, tanaids were often neglected in the past, or inadequate sampling gear with large mesh sizes (like the Agassiz trawl) was used to collect these animals. For that reason only a few reports of tanaid species were published from the Magellan region before 1986, e.g. *Nototanais dimorphus* from the Belgian Antarctic Expedition 1897–99 (Monod 1925), *Apseudes spectabilis* from the XXII Chilean Antarctic Expedition (Shiino 1970), and *Allotanais hirsutus* from the Falkland Islands (Stebbing 1914).

An initial extensive taxonomic inventory was published for this area by Sieg (1986a) on the basis of qualitative samples from several expeditions with RV *Hero*. A few years later, in November 1994, the joint Chilean-Italian-German project "Joint Magellan" *Victor Hensen* Campaign took place with the aim of investigating the marine fauna and flora of the Magellan region. One aspect of this project was to compare the tanaidacean fauna of the Magellan region and Antarctica.

For the first time an inventory of the Beagle Channel Tanaidacea and those of the adjacent Atlantic continental slope could be done. The new data are used here to update Sieg's (1986a) species list for the Magellan region. In addition, reports of Tanaidacea from the sub-Antarctic and Antarctic were extracted from the literature to determine degrees of endemism and species similarities between zoogeographic regions.

Material and methods

Tanaidacea were sampled from RV *Victor Hensen* in October/November 1994 at 18 stations with an epibenthic sledge (EBS) from off the eastern entrance to the Beagle Channel and throughout the channel. Additional material came from three stations sampled with the same sledge (except station 40/117: dredge) in May 1996 from expedition ANT XIII/4 on RV *Polarstern*, on the Atlantic continental slope. For exact locations see Table I. For further information as well as additional data on hydrography and faunal composition at stations see Arntz & Gorny (1996), Fahrbach & Gerdes (1997), Linse & Brandt (1998), Antezana *et al.* (1996), Brambati *et al.* (1992), Brandt (1999), Brandt *et al.* (1997).

The EBS was equipped with a 500-µm plankton net and a 300-µm cod end. Construction and use of this improved Rothlisberg-Pearcy sledge was described by Brandt & Barthel (1995). When the sledge reached the deck of the vessel, samples were suspended, decanted through a 300-µm mesh

Table I. Station list of epibenthic-sledge samples* from the expeditions of RV *Victor Hensen* (= VH) and ANT XIII/4 with RV *Polarstern* (= ANT).

station	date	position				depth (m)	station locality	expedition
		S latitude		W longitude				
		start	end	start	end			
1206	14.11.94	55°48.13	55°48.10	66°58.45	66°58.62	66	off Isla Barnevelt	VH
1200	14.11.94	55°38.52	55°38.57	67°12.86	67°13.26	40	Isla Wollaston	VH
1184	12.11.94	55°06.84	55°06.95	66°55.54	66°55.67	110	Isla Picton	VH
1194	13.11.94	55°08,48	55°08.19	66°57.81	66°58.08	118	Isla Picton	VH
1197	13.11.94	55°07.92	55°08.00	66°58.28	66°58.31	117	Isla Picton	VH
1178	12.11.94	55°07.30	55°07.28	66°52.78	66°52.90	25	Punta Rico	VH
1213	15.11.94	55°06.89	55°06.72	66°39.95	66°39.92	63	south-east of Isla Picton	VH
1237	18.11.94	55°00.51	55°00.48	66°53.14	66°53.29	103	Canal Beagle, Yendegaia	VH
1246	19.11.94	54°58.00	54°57.85	68°49.31	68°49.04	253	Canal Beagle	VH
1247	19.11.94	54°59.43	54°59.51	69°04.64	64°04.28	100	Canal Beagle	VH
1248	19.11.94	54°58.80	54°58.78	69°01.75	69°01.98	217	Canal Beagle	VH
1253	19.11.94	54°55.12	54°55.11	69°19.89	69°20.13	265	Canal Beagle	VH
1257	19.11.94	54°53.43	54°53.32	69°30.94	69°31.14	350	Canal Beagle, Romanche	VH
1261	20.11.94	54°53.64	54°53.81	69°58.98	69°59.03	120	Canal Beagle, Romanche	VH
1263	20.11.94	54°54.04	54°54.00	70°12.76	70°12.52	665	Canal Beagle, Isla Timbal Chico	VH
1270	21.11.94	54°55.17	54°55.23	70°45.15	70°44.81	135	Canal Ballenero	VH
1279	21.11.94	54°46.48	54°46.90	71°08.48	71°08.35	580	Canal Ballenero, off Punta Baja	VH
1307	23.11.94	54°17.37	54°17.55	70°51.81	70°51.90	271	Canal Magdalena, Punta Sánchez	VH
40/110	16.05.96	55°26.5	55°26.4	66°15.0	66°15.3	102–104	Paso Richmond, south-east of Isla Nueva	ANT
40/111	17.05.96	55°28.8	55°28.8	66°03.4	66°03.5	1253–1279	Paso Richmond, south-east of Isla Nueva	ANT
40/117*	18.05.96	55°24.6	55°24.1	66°15.6	66°15.3	97–99	south-east of Isla Nueva	ANT

*station 40/117 dredge

screen and preserved in 4% buffered formaldehyde solution. Samples were washed and transferred into 70% ethanol three months after the expedition (on *Polarstern* samples were washed after two days). All organisms larger than 300 µm were analysed.

Results

The sampling from RVs *Victor Hensen* and *Polarstern* provided 2175 specimens of Tanaidacea. Of these, 349 were members of suborder Apseudomorpha and 1826 represented suborder Tanaidomorpha. The suborder Neotanaidomorpha was not represented in the samples. The material comprised 27 species from 10 families.

In Table II numbers of species and absolute numbers of individuals at different stations are presented. *Allotanais hirsutus* was the most frequent species. During the *Victor Hensen* expedition, most tanaid individuals in general and also most individuals of *Allotanais hirsutus* were located at the eastern entrance of the Beagle Channel near the Atlantic Ocean. In the western entrance of the Beagle Channel, abundances of *Allotanais hirsutus* were distinctly lower. The second most frequent species was *Apseudes heroae*. *Araphura* sp. and *Meromonacantha macrocephala* occurred only in the middle of the Beagle Channel. *Leptognathia armata* was the only species which was restricted to the western entrance of the channel. *Tanaella unisetosa* was only sampled at the Atlantic entrance on shelf stations, but not on the adjacent continental slope. Several individuals of *Heterotanoides meridionalis* were collected at the eastern entrance only. The tanaid assemblages of the station on the continental slope (40/111) were very distinct and showed no similarities with other stations.

The present investigations have increased the number of species of Tanaidacea recorded from the Magellan region to 36. Eleven species reported in the present paper from the Beagle Channel are new records for the Magellan region (marked in bold in Table III). Two genera, *Araphura* and *Stenotanais*, were found in this region for the first time. Until now *Araphura* was only known from the north-east Atlantic, Mediterranean Sea, Barents Sea, Scotia Sea, West Antarctic, East Antarctic and north-eastern Pacific (Sieg & Dojiri 1989). The genus *Stenotanais* was previously known only from the north-eastern deep Atlantic (Bird & Holdich 1984), and was sampled for the first time on the continental slope of the Southern Hemisphere.

Apart from the last genus, all the other new records for the Magellan area have also been reported on the Antarctic continental shelf or in the Antarctic deep sea.

Reports of *Leptognathia breviremis* from the Scotia Sea (1425 m) published by Kudinova-Pasternak (1975) were questioned by Sieg (1986b) due to the fact that this species was frequently identified as *L. breviremoides* in the past. Sieg supposed that *L. breviremis* does not show a bipolar distribution and can only be found in the Northern Hemisphere. We have no doubts that we have sampled *L. breviremis*, as the antennules of the specimens bear fewer plumose setae and only on the first peduncular article. Moreover, the uropod exopod is minute, only about half as long as first segment of uropod endopod. Due to the new records of this species in the Magellan region

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Table II. Numbers of species and absolute numbers of individuals at stations ordered from west to east.

Species	stations	1307	1279	1270	1263	1261	1257	1253	1247	1248	1246	1237	1184	1178	1197	1194	1213	1200	1206	40/110	40/111	40/117	total
	depth (m)	271	580	135	665	120	350	265	100	217	253	103	110	25	117	118	63	40	66	104	1279	99	-
Apseudes heroae																	21	319	3				343
Synapseudes idios																			1			5	6
Allotanais hirsutus																	8	635	865	42		102	1652
Heterotanoides meridionales														29			1						30
Pseudonototanais werthi										1			1							6			8
Leptocheliidae sp.1										1													1
Leptocheliidae sp.2														1									1
Leptocheliidae sp.3																				1			1
Leptocheliidae sp.4										1													1
Leptocheliidae sp.5																	1						1
Leptocheliidae sp.6																				2			2
Paratanais oculatus																				20		11	31
Paratanaidae sp.1																				1			1
Paratanaidae sp.2																				1			1
Nototanais dimorphus												1											1
Nototanaidae sp.									1														1
Pseudotanais sp.											1												1
Meromonakantha macrocephala								1	6	1													8
Peraeospinosus adipatus																				10			10
Akanthophoreus australis									1														1
Araphura sp.						1		2	2	3												8	
Libanius monacanthus																					1		1
Stenotanais sp.																				1		1	
Tanaella unisetosa																		15	16	2			33
Anarthrurinae sp.								1															1
Siphonolabrum fastigatum											1												1
Dimorphognathia heroae														1			10			9			20
Leptognathia armata			1	2																			3
Leptognathia breviremis									2	1													3
Mirandotanais vorax																					1		1
Paratanaoidea sp.1																	1						1
Paratanaoidea sp.2																					1		1
Manca indet.1 (Paratanaoidea)																				1			1
Manca indet.2 (Paratanaoidea)									1														1
number of specimens		0	1	2	0	0	1	2	13	7	5	1	1	31	0	0	42	969	885	75	4	118	2157
number of species		0	1	1	0	0	1	2	5	5	3	1	1	3	0	0	6	3	4	10	4	3	27

the presence of *Leptognathia breviremis* in the Scotia Sea is probably no longer doubtful.

In Table III all Magellan species are compiled, their eastern range is indicated to the Falkland Islands, and further zoogeographic information is included in Table IV.

The present paper provides a synopsis of the distributions of all Tanaidacea reported for the Antarctic and sub-Antarctic (including the Magellan region); it includes all known zoogeographic data (Table IV) from taxonomic literature published so far. Thus, 129 species of Tanaidacea are known from the Antarctic, the sub-Antarctic and the Magellan region; 50 of these are Antarctic-shelf species. Forty-eight species were reported from the Antarctic deep sea, and 29 from the sub-Antarctic deep sea. The West Antarctic comprises as many species as the East Antarctic (34); 25 species were reported from the Kerguelen region (Table VI). The zoogeographic definition of the different Antarctic regions follows that of De Broyer & Jazdzewski (1996).

The occurrence of tanaidacean species in different Magellanic, sub-Antarctic, and Antarctic zoogeographic regions is documented in Table IV with a summary of shared species of several zoogeographic regions in Table V. Endemic tanaidacean species and percentages of some zoogeographic regions are presented in Table VI. These data provide the basis for general discussions on both the zoogeography of Southern Ocean Tanaidacea and questions about evolution in these Peracarida.

Discussion

The Magellan region and South America have been zoogeographically defined in different ways (Hedgpeth 1969, Dell 1971, Brattström & Johansen 1983). Knox (1960), Hedgpeth (1969), and Brandt (1991) also included the Falkland Islands in the Magellan region, while Linse (1997) and Powell (1965) consider the Falkland Islands as a separate region. In the present study the Falkland Islands are considered to be part of the Magellan region. So far, only six tanaid species have

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Table III. List of all Tanaidacea in the Magellanic region and their sampling localities from present samples and Sieg (1983a, 1986a). bold = new record for this region.

species	Strait of Magellan	Beagle Channel	Patagonian Shelf (Atlantic *c.* 42°S)	Atlantic shelf south-east of the Magellan Strait**	Atlantic continental slope	Falkland Islands
*Apseudes heroae**	+	+		+		
Apseudes spectabilis	+					
Saltipedis paulensis			+			
Bacescapseudes patagoniensis			+			
Synapseudes aflagellatus	+			+		
*Synapseudes idios**	+			+		
*Allotanais hirsutus**		+	+	+		+
Pancoloides litoralis	+			+		
Zeuxo phytalensis				+		
Zeuxoides ohlini	+			+		+
*Heterotanoides meridionales**	+	+		+		
Pseudoleptochelia antarctica	+		+	+		+
Pseudonototanais werthi*		+		+		
Paratanaidae sp. 1*				+		
*Paratanais oculatus**	+			+		+
*Nototanais dimorphus**	+	+				
Nototanaidae sp.*		+				
Protanaissus macrotrichos			+			
Pseudotanais guillei	+					
Pseudotanais nordenskioldi						+
Meromonakantha macrocephala*		+				
Peraeospinosus adipatus*				+		
Typhlotanais greenwichensis				+		
Typhlotanais parvus				+		
Typhlotanoides rostralis				+		
*Akanthophoreus australis**		+		+		
Araphura* sp		+				
Stenotanais* sp					+	
Libanius monacanthus*					+	
*Tanaella unisetosa**				+		
Siphonolabrum fastigatum*		+				
*Dimorphognathia heroae**	+	+		+		
Leptognathia breviremis*		+				
Mirandotanais vorax*					+	
Tanaopsis antarctica						+
Leptognathia armata*		+				

*found in our samples

**East tip of Tierra del Fuego and Islas de los Estados, Isla Navarino, Isla Barnevelt, off the eastern entrance of the Beagle Channel

been recorded from the Falkland Islands and none of them is endemic (c.f. Table III). Due to our very limited knowledge of the Falkland Islands Tanaidacea we include these Islands in the Magellan region, which ranges from the southern tip of Cape Horn and Tierra del Fuego up to the island of Chiloe in the north of the Pacific coast (42°S) and the Gulf of Luego on the Atlantic coast, the borders being defined by Carcelles & Williamson (1951) and Linse (1997) on the basis of the zoogeography of molluscs.

Table IV summarizes all species of Tanaidacea from the Antarctic and sub-Antarctic. The sub-Antarctic areas are listed separately because the zoogeographic status of some islands, e.g. Bouvet Island, is not certain. De Broyer & Jazdzewski (1996) include this island in the West Antarctic, whilst Hedgpeth (1969) places it in the "Kerguelen subregion". *Apseudes spectabilis* is the only tanaid species reported from Bouvet Island, therefore the biogeography of Tanaidacea cannot be used to solve this zoogeographic problem. The sub-Antarctic was divided into subregions, the Kerguelen and Macquarie regions by Brandt (1991) and De Broyer & Jazdzewski (1993).

The family Neotanaidae was not sampled in the Beagle Channel at all, and Sieg (1986a) did not report this taxon. This might be explained by the fact that this is a typically a deep-sea group.

The most plesiomorphic (phylogenetically ancient) taxon of the Tanaidacea, the Apseudomorpha, was represented by only two species in the Beagle Channel, *Apseudes heroae* (Apseudidae) and *Synapseudes idios* (Metapseudidae). Four more species of this group occur in the Magellan region, (*Apseudes spectabilis, Saltipedis paulensis* (Parapseudidae), *Bacescapseudes patagoniensis* (Kalliapseudidae) and *Synapseudes aflagellatus* (Synapseudidae)). The family Pseudozeuxidae is only represented by one species (see

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Table IV. List of all Tanaidacean species (+ = for presence, ? = uncertain evidence) of the Antarctic and sub-Antarctic regions based on literature data (especially Sieg 1988, Kudinova-Pasternak 1986, 1990, 1993) and present results.

species	Antarctic continental slope		ADS	sub-Antarctic regions						SDS	outside
	W	E		MR	BI	KR	PA	MQ	TC		
Apseudidae											Br
Apseudes crozetensis Shiino, 1978						+					
Apseudes diversus Lang, 1968										TB	GP
Apseudes heroae Sieg, 1986				+							Br
Apseudes paragracilis Kudinova-Pasternak, 1975			SsaT								
Apseudes setosus Lang, 1968										TB	
Apseudes spectabilis Studer, 1883	SG			+	+	+					Jap
Apseudes spinosus (M. Sars, 1858)			ScB								NEA
Apseudes unicus Kudinova-Pasternak et Pasternak 1981										IAB	NI
Leviapseudes aberrans(Lang, 1968)										TB	KT
Leviapseudes conspicuus (Lang, 1968)										TB	
Leviapseudes galathea (Wolff, 1956)										SPR	KT
Leviapseudes gracillimus Hansen (1913)										KRi	NA, SA, OI
Leviapseudes shiinoi (Lang, 1968)										SPR	SAuB
Sphyrapus dispar Lang, 1968										TB	
Pugiodactylus antarcticus (Shiino, 1978)						+					
Parapseudidae											
Saltipedis paulensis (Brum, 1971)				+							Br
Kalliapseudidae											
Bacescapseudes patagoniensis Sieg, 1986				+							
Metapseudidae											
Metapseudes aucklandia Stephensen, 1927								+			NZ
Cyclopoapseudes diceneon Gardiner, 1973								+			NZ
Synapseudes aflagellatus Sieg, 1986				+							
Synapseudes idios Gardiner, 1973				+							
Whiteleggiidae											
Whiteleggia multicarinata (Whitelegge, 1901)									+		Au
Neotanaidae											
Carololangia plumata (Kudinova-Pasternak, 1975)										AB	NZ, SA
Neotanais affinis Wolff, 1956										AB	NZ, SA
Neotanais americanus Beddard, 1886		WS	ScB						+	AB	A, P
Neotanais antarcticus Kussakin, 1967		EA	ScB, IAB, AIAB								
Neotanais armiger (Wolff, 1956)										CR	NP NA
Neotanais giganteus Hansen, 1913										TB	A, SP
Neotanais hadalis (Wolff, 1956)			AIAB							AB,	AngB
Neotanais hessleri Gardiner, 1975			IAB								
Neotanais kurchatovi Kudinova -Pasternak, 1975			SaSR							SPB	
Neotanais magnificus Kudinova-Pasternak, 1972			ScB							KRi	
Neotanais tricarinatus Gardiner, 1975			PAR							IAB	Br
Tanaidae											
Allotanais hirsutus (Beddard, 1886)	SG			+		+					
Anatanais novaezealandiae (Thomsen, 1879)								+			NZ
Langitanais angustifrons Tzareva, 1982						+					
Langitanais bifidirostris Shiino, 1978						+					
Langitanais magnus Shiino, 1978						+					
Langitanais willemoesi (Studer, 1883)			AIAB			+					
Pancoloides litoralis (Vanhöffen, 1914)	SR			+		+		+			
Zeuxo phytalensis Sieg, 1980				+		+	+	+?			
Zeuxoides helleri (Gerstaecker,1888)						+	+	+			
Zeuxoides ohlini (Stebbing, 1914)	SR			+							
Zeuxoides pseudolitoralis Sieg, 1980						+					
Pseudozeuxidae											
Heterotanoides meridionales Sieg 1986				+							

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Table IV. (cont.) List of all Tanaidacean species (+ = for presence, ? = uncertain evidence) of the Antarctic and sub-Antarctic regions based on literature data (especially Sieg 1988, Kudinova-Pasternak 1986, 1990, 1993) and present results.

species	Antarctic continental slope		ADS	sub-Antarctic regions						SDS	outside
	W	E		MR	BI	KR	PA	MQ	TC		
Leptocheliidae											
Leptochelia barnardi Brown, 1957						+?					Safr
Pseudoleptochelia antarctica (Lang, 1953)				+							
Pseudonototanais bransfieldensis Sieg, 1986	SR										
Pseudonototanais werthi (Vanhöffen, 1914)	SG			+	+						KuI
Paratanaidae											
Paratanaidae indet. Sieg, 1986				+							
Paratanais oculatus (Vanhöffen, 1914)				+	+		+				
Nototanaidae											
Nototanais antarcticus (Hodgson, 1902)	SR	RS, EA, WS	WS, ScB								
Nototanais dimorphus (Beddard, 1886)	SR	RS, EA		+	+		+				
Protanaissus longidactylus (Shiino, 1970)	SR	RS, EA									
Protanaissus macrotrichos Sieg, 1986				+							
Tanaissus lilljeborgii (Stebbing, 1891)										AB	NA
Pseudotanaidae											
Cryptocopoides arcticus (Hansen, 1913)	SR	RS, EA, WS	+								Arc
Cryptocopoides rotundata Tzareva, 1982						+?					
Paraiungentitanais longidigitatus (Kudinova-Pasternak, 1975)										AB	
Pseudotanais abyssi Hansen, 1913	SR	EA, WS	ScB								Arc
Pseudotanais affinis Hansen, 11876			ScB							CB	Arc
Pseudotanais gaussi Vanhöffen, 1914		EA	SsaT, AIAB ScB								
Pseudotanais guillei Shiino, 1978				+	+						
Pseudotanais longisetosus Sieg, 1973	SG		ScB								
Pseudotanais nordenskioldi Sieg, 1973	SG, SR		SOT	+						AB	Ind, BoT
Typhlotanaidae											
Meromonakantha macrocephala (Hansen, 1913)	SR	WS, EA	ScB	+							Arc, IL
Paratyphlotanais armatus (Vanhöffen, 1914)	SR,	RS, EA	ScB								
Peraeospinosus adipatus (Tzareva, 1982)	SR	EA, WS		+							
Peraeospinosus pushkini (Tzareva, 1982)	SR										
Typhlotanais brachyurus Beddard, 1886						+					
Typhlotanais dubius Tzareva, 1982		EA									
Typhlotanais filatovae Kudinova-Pasternak, 1975			SsaT								
Typhlotanais greenwichensis Shiino, 1970	SR	RS, WS, EA	SOB, ScB, IAB	+		+		+			MaB
Typhlotanais gruzovi Tzareva, 1982						+?					
Typhlotanais kerguelensis Beddard, 1886						+					
Typhlotanais longisetosus Kudinova-Pasternak, 1990			ScB, SOT							CB	
Typhlotanais longus Kudinova-Pasternak, 1975										AB	
Typhlotanais magnificus Kudinova-Pasternak, 1970			ScB							AB	NP
Typhlotanais parangularis Kudinova-Pasternak, 1975			ScB								
Typhlotanais parvus Sieg, 1986				+							
Typhlotanais plicatus Kudinova-Pasternak, 1993			WS								
Typhlotanais rectus Kudinova-Pasternak, 1966			ScB								CNP
Typhlotanoides rostralis (Tzareva, 1982)	SR	RS, WS	+	+							+
Anarthruridae											
Akanthophoreinae											
Akanthophoreus antarcticus (Vanhöffen, 1914)	SG, SR	RS, EA, WS	ScB								
Akanthophoreus australis (Beddard, 1886)	SR		ScB, +	+	+						
Akanthophoreus plumosa (Sieg, 1983)		RS									
Akanthophoreus wedellensis Sieg, 1986		WS	ScB								
Araphura elongata (Shiino, 1970)	SR	EA, RS									
Araphura joubinensis Sieg et Dojiri, 1989	SR		SOT?								
Araphura parabrevimana (Lang, 1968)			ScB								GP
Araphuroides parabreviremis Sieg, 1986	SR		SOT, ScB								
Filitanais curticaudus Kudinova-Pasternak, 1993			WS								
Filitanais rebainsi Kudinova-Pasternak, 1975[1]			ScB								
Libanius monacanthus (Vanhöffen, 1914)	SR	EA, WS		+							

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Table IV. (cont.) List of all Tanaidacean species (+ = for presence, ? = uncertain evidence) of the Antarctic and sub-Antarctic regions based on literature data (especially Sieg 1988, Kudinova-Pasternak 1986, 1990, 1993) and present results.

species	Antarctic continental slope		ADS	sub-Antarctic regions						SDS	outside
	W	E		MR	BI	KR	PA	MQ	TC		
Mimicarhaphura immanis Sieg, 1986		RS, WS									
Paraleptognathia antarctica Sieg, 1986		RS,WS									
Stenotanais sp				+							NEA
Tanaella rotundicephala Sieg, 1986	SR										
Tanaella unisetosa Sieg, 1986	SR	WS		+							
Anarthrurinae											
Agathotanaini											
Agathotanais hanseni Lang, 1971	SG									CB	EP?, NEA?
Allodaposia abbreviata (Vanhöffen, 1914)	SR	EA, WS	+								
Paranarthrura fortispina Sieg, 1986		WS	+								
Paranarthrura insignis Hansen, 1913			ScB							CB, AB	NEA
Paranarthrura meridionalis Sieg, 1986		WS									
Anarthrurini											
Anarthrura simplex G.O. Sars, 1882			ScB								
Siphonolabrum fastigatum Sieg, 1986	SR			+							
Leptognathiinae											
Dimorphognathia heroae Sieg, 1986				+							
Exspina typica Lang, 1968		RS, EA, WS	+								+
Leptognathia breviremis (Lilljeborg, 1864)			ScB!	+							NA
Leptognathia breviremoides Sieg, 1986		EA, WS	SOT								
Leptognathia paraforcifera Lang, 1968			SsaT								SoB
Leptognathioides rectus Kudinova-Pasternak, 1993			WS								
Leptognathia vanhoeffeni Gutu, 1972		EA									
Leptognathiella subaequalis (Hansen, 1913)			ScB							CB	NA
Mirandotanais vorax Kussakin et Tzareva, 1974	SR	EA, WS		+							
Pseudoleptognathia setosa Sieg, 1986	SR	RS									
Pseudoparatanais antarcticus Sieg, 1983		RS									
Pseudoparatanais brachycephalus Sieg, 1986		RS, WS									
Robustochelia robusta (Kudinova-Pasternak, 1970)			SsaT								NEA, NP
Tanaopsis antarctica Lang, 1967	SG, SR	RS		+							+
Tanaopsis kerguelensis Shiino, 1978						+					
Collettea antarctica (Vanhöffen, 1914)[1]		EA	WS								+
Collettea arnaudi (Shiino, 1978)[1]						+					
Leptognathia armata Hansen, 1913[1]			ScB	+						CB, AB	NA, WI
Leptognathia gallardoi Shiino, 1970[1]	SR										
Leptognathia glandiceps Shiino, 1978[1]						+					
Leptognathia lineata Shiino, 1978[1]						+					
Leptognathia luykeni Vanhöffen, 1914[1]						+					

[1]Anarthruridae *incertae sedis*

AB = Argentine Basin, ADS = Antarctic deep sea, AIAB = Atlantic Indian Antarctic Basin, AngB = Angola Basin, ANS = North and South Atlantic, Arc = Arctic, AU = Australia, Az = Azores, BI = Bouvet Island, BoT = Bonin Trench, Br = Brasilia, CB = Cape Basin, CR = Chile Ridge, E = East Antarctic Subregion, EA = East Antarctic, EI = East Indian Ocean, EP = East Pacific, GP = Gulf of Panama, IAB = Indic-Antarctic Basin, IL = Iceland, Ind = Indonesia, Jap = Japan, KR = Kerguelen Region (Kerguelen Islands, Crozet Islands, Heard Island, Possession Island, Cochons Island, Prince Edward Islands, Marion Island), KRi = Kerguelen Ridge, KT = Kermadec Trench, Ku = Kurilen Islands, MaB = Madagascar Basin, MQ = Macquarie-Region (Macquarie Island, Campbell Island, Auckland Islands, Antipodes Islands, Bounty Island, Steward Island), MR = Magellan Region, NA = North Atlantic, NEA = Northeast Atlantic, NI = North Indian Ocean, NP = North Pacific, NZ = New Zealand, PA = St. Paul Island and Amsterdam Island, PAR = Pacific Antarctic Ridge, RS = Ross Sea, SA = South Atlantic, Safr = South Africa, SAuB = South Australian Basin, ScB = Scotia Basin, SG = South Georgia, SoB = Somali Basin, SOT = South Orkney Trench, SP = South Pacific, SPR = South Pacific Ridge, SR = Scotia Region, SSaT = South Sandwich Trench, SSaR = South Sandwich Ridge, SPB = Southwest Pacific Basin, SDS = sub-Antarctic deep sea, TC = Tristan da Cunha region, TB = Tasmanian Basin, W = West Antarctic subregion, WS = Weddell Sea, CNP = Central and North Pacific. *Araphura* sp. and Nototanaidae sp. are not considered in this table, as the species could not be identified (due to damage), however, in the sub-Antarctic and in the Antarctic several species have been reported.

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Table V. Shared species of several Antarctic and sub-Antarctic regions.

regions	shared species	shared species (%)
West Antarctic and East Antarctic	18	36.0
West Antarctic and Magellanic region	18	36.0
Magellanic region and Antarctic continental shelf	18	27.3
Antarctic deep-sea basins and East Antarctic	17	26.2
Magellanic region and Kerguelen region	9	18.0
Antarctic deep-sea basins and West Antarctic	12	17.1
Magellanic region and East Antarctic	8	13.3
West Antarctic and Kerguelen region	6	11.3
Antarctic deep-sea basins and Magellanic region	6	7.9
Antarctic deep-sea basins and Kerguelen region	3	4.3
East Antarctic and Kerguelen region	2	3.5

Table IV).

Mirandotanais vorax was previously only known from the Antarctic continental shelf, but it is now also reported from the Magellan region. This species seem to have a much wider bathymetric range than previously thought and possibly shows submergence into the deep sea.

The surroundings of the Islas de los Estados show the highest numbers of tanaidacean species (18), but were also sampled most intensively (Sieg 1986a). Only a little information is available on the zoogeography of Tanaidacea from the region north of the Magellan Strait (Sieg 1986a) with five species listed from the area of the Atlantic Patagonian shelf around 42°S. Of these only *Allotanais hirsutus* and *Pseudoleptochelia antarctica* were also sampled further south. The only record of *Bacescapseudes patagoniensis* is from that area (Sieg 1986a). Gutu (1996) reports *Saltipedis paulensis* from the Brazilian coast. *Apseudes heroae* seems to be widely distributed in the south of South America, and this species was also reported from Brazil (identification of undetermined material in the Crustacean collection of the Zoological Museum of Hamburg). Such tanaid distribution supports the theory of Dell (1972) that the Magellan region is characterised by temperate, subtropical and cold-temperate species. Therefore it seems likely that an investigation of the area north of the Magellan Strait would reveal many species common to Argentina, Chile, or Brazil. Another argument for this theory is the presence of *Synapseudes idios* and *S. aflagellatus* (the only representatives for the Metapseudidae) in cold sub-Antarctic waters (Sieg 1986a). This family is primarily distributed in subtropical and tropical waters, especially on coral reefs.

Table VI. Species numbers and endemic species of Tanaidacea from several sub-Antarctic and high-Antarctic regions.

region	total number of species	number of endemic species	endemic species (%)
Kerguelen region	25	13	52.0
sub-Antarctic islands*	30	13	43.3
total Antarctic continental shelf	50	15	30.0
Magellan region	34	9	26.5
East Antarctic	34	7	20.6
Antarctic deep-sea basins	48	10	20.1
West Antarctic	34	4	11.8
sub-Antarctic deep-sea	29		

*(Kerguelen region + Macquarie region + Bouvet Island)

The Tanaidacea of the Magellan region are very heterogenous. All families of the Tanaidomorpha are present, and especially well represented are the Anarthruridae with three subfamilies (see species list in Tables III & IV). Many genera in this area are monotypic. Only the genera *Apseudes* and *Typhlotanais* have two or three species. The three species from the continental slope (*Libanius monacanthus, Stenotanais* sp., *Mirandotanais vorax*, *Paratanoidea* sp.2) were not recorded anywhere else in the Magellan region. The record of the single individual from station 1279 is the only one for the Pacific side ever made in this area. Shared species with other regions are only documented for the Apseudomorpha (Table III).

Table V documents tanaidacean species shared between zoogeographic regions. Most species are shared between the East and West Antarctic (36%) in the high Antarctic. The Magellan regions shares more than twice as many species with the West Antarctic than with the East Antarctic, probably due to the zoogeographic proximity and the possible exchange via the islands of the Scotia Arc. All other regions also share less species with the Magellan region than the West Antarctic. Sieg (1988) considers the tanaidacean fauna of the Magellan region and the Antarctic continental shelf as heterogenous, with many not closely related genera occuring monotypically. Sieg used this argument to support his theory that the Antarctic shelf Tanaidacea are relatively young and a phylogenetically derived fauna. Sieg (1988) generally divided the Antarctic Tanaidacea into West and East Antarctic species postulating that the Antarctic tanaidacean fauna was almost completely extinguished during the climatic deterioration in the Oligocene (38 Ma). In his opinion, the East Antarctic was recolonised with phylogenetically young cold-stenothermal species of Tanaidacea from the deep sea (polar emergence). Antarctic Tanaidacea from the West Antarctic, however, were replaced by phylogenetically more ancient taxa from the Magellan region. The new records for six additional West Antarctic species (*Siphonolabrum fastigatum, Pseudonototanais werthi, Meromonakantha macrocephala, Peraeospinosus adipatus, Libanius monacanthus, Mirandotanais vorax*) in the Magellan region underlines the close connection of these two regions. The fact that these areas also share as many species as West and East Antarctica might argue for Sieg's (1988) hypothesis of the origin of the West Antarctic fauna from the Magellan region. However, phylogenetic analyses of species which occur both in waters of South America and in the Antarctic, like members of the family Anarthruridae or of the Typhlotanaidae, must be performed in order to test these hypotheses. Moreover, if we consider his hypothesis of the origin of the East Antarctic Tanaidacean evolution (emergence, i.e. from deep-sea ancestors) and we take into consideration that the Apseudidae

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are a major component of the deep-sea fauna (e.g. *Apseudes paragracilis, Apseudes spinosus*), it seems plausible that cold stenothermal, eurybathic taxa of this family may show polar emergence in the East Antarctic.

The West Antarctic shares almost as many species (12) with the deep sea as the East Antarctic (17). Table VI illustrates numbers of species and numbers of endemics, as well as percentages of endemics of the various zoogeographic areas. Interestingly, the Kerguelen region shows the highest percentage of endemism (52%). If we follow Hedgpeth's (1969) definition of the Kerguelen region as including the Macquarie region, the high value of 43.3%, of endemic species is obtained. This high percentage of endemism supports the view that these islands must be considered as a distinct subregion. Sieg (1988) evaluated percentages of endemism for the East Antarctic as 73.6%. The updated values based on new records of Antarctic shelf and adjacent deep-sea tanaidacean species (Kudinova-Pasternak 1986, 1990, 1993) and those from the other deep-sea basins in the Southern Hemisphere differ considerably from those of Sieg (1988). Moreover, the new records of some species in the Antarctic deep sea could argue for polar emergence, such as *Leptognathia breviremoides, Akanthophoreus weddellensis, Akanthophoreus antarcticus,* and *Paratyphlotanais antarcticus*. If this proves true, polar emergence would not be limited to the East Antarctic. The Magellan region is characterized by a relatively high percentage of endemism in many groups (e.g. Isopoda 45% (Menzies 1962), 50% Mollusca (Linse 1997), 61% Pelecypoda (Soot-Ryan 1959), 52% Pisces (Norman 1937)) whilst Antarctica shows even higher percentages (e.g. Isopoda 87% (Brandt (1991)), Pisces 90% (Andriashev (1965)). South America is the continent with the least distance to the Antarctic, the deep-water circulation (Circumpolar Current) between Antarctica and South America became effective and served as a zoogeographic barrier only about 22 Ma ago (e.g. Barker *et al.* 1991, Crame 2000). The Polar Front with its distinct temperature gradient also serves as a temperature barrier between north and south (Menzies *et al.* 1973). These hydrographical barriers make the immigration of northern species into the south difficult and increase the isolation of the Magellan area. However, some authors (e.g. Sieg 1988, Dell 1972) argue for faunal exchange between the Magellan area and the area of the Antarctic Peninsula via the islands of the Scotia Arc, a theory which Brandt (1991) regard as rather speculative, as these islands are surrounded by deep sea and shallow water species could presumably only be transported from island to island via floating devices, such as seaweed or wood. However, as said, tanaidaceans increase in importance and diversity with increasing depth. The deep-sea fauna of the Antarctic and the Scotia Sea are poorly known. In order to rectify this, a series of Antarctic deep-sea expeditions will be undertaken in the near future to:

i) investigate the colonization and exchange processes of the deep-sea fauna in relation to changes in sea-bed topography over geological time,

ii) to investigate the influence of sea-floor habitat diversity on species and genetic diversity in the Antarctic deep sea, and

iii) to investigate the evolutionary processes and oceanographic changes which have resulted in the present biodiversity and distributional patterns in the Antarctic deep seas.

These investigations will most certainly also yield a high number of tanaidacean species and individuals. Phylogenetic analyses of these species and of deep-sea species from more northern Atlantic deep-sea areas, like the Angola Basin, will help to give a final answer to Sieg's question on the age and origin of the Antarctic Tanaidacea.

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