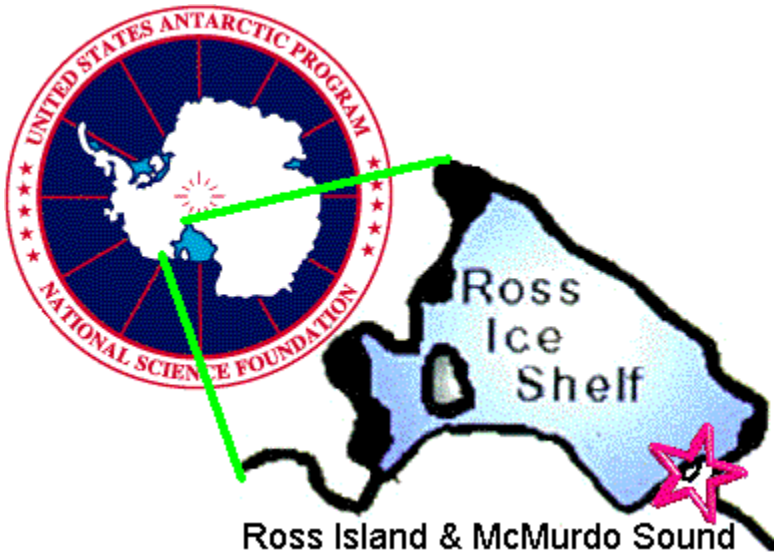
Arthropoda – Other: copepods, krill, ostracods, mysids, tanaids, barnacles, shrimp, etc.

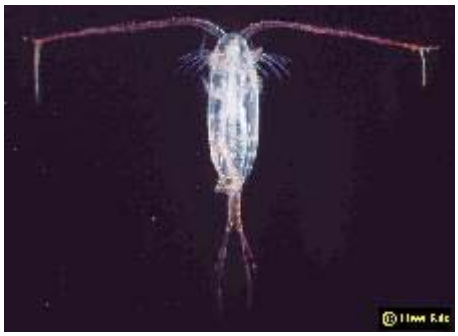
UNDERWATER FIELD GUIDE TO ROSS ISLAND & MCMURDO SOUND, ANTARCTICA

Peter Brueggeman

Photographs: Norbert Wu, Steve Alexander, Peter Brueggeman, Canadian Museum of Nature (Kathleen Conlan), Paul Cziko, Shawn Harper, Uwe Kils, & Rob Robbins



The National Science Foundation's Office of Polar Programs sponsored Norbert Wu on an Artist's and Writer's Grant project, in which Peter Brueggeman participated. One outcome from Wu's endeavor is this Field Guide. This Field Guide builds upon principal photography by Norbert Wu, with photos from other photographers, who are credited on their photographs and above. This Field Guide is intended to facilitate underwater/topside field identification from visual characters. Organisms were identified from photographs with no specimen collection. Therefore these identifications are to the taxonomic level possible from photographs, and there can be some uncertainty in identifications solely from photographs.



calanoid copepod

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parasitic copepod, possibly *Eubrachiella antarctica*

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ice krill *Euphausia crystallorophias*

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Antarctic krill *Euphausia superba*

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myodocopid ostracod (order Myodocopida)

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podocopid ostracod (order Podocopida)

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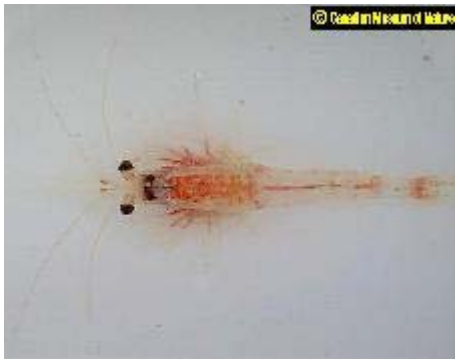

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tanaid *Nototanais dimorphus*

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stalked barnacle, probably *Weltnerium weltneri*

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shrimp, probably *Chorismus antarcticus*

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Antarctic crabs?

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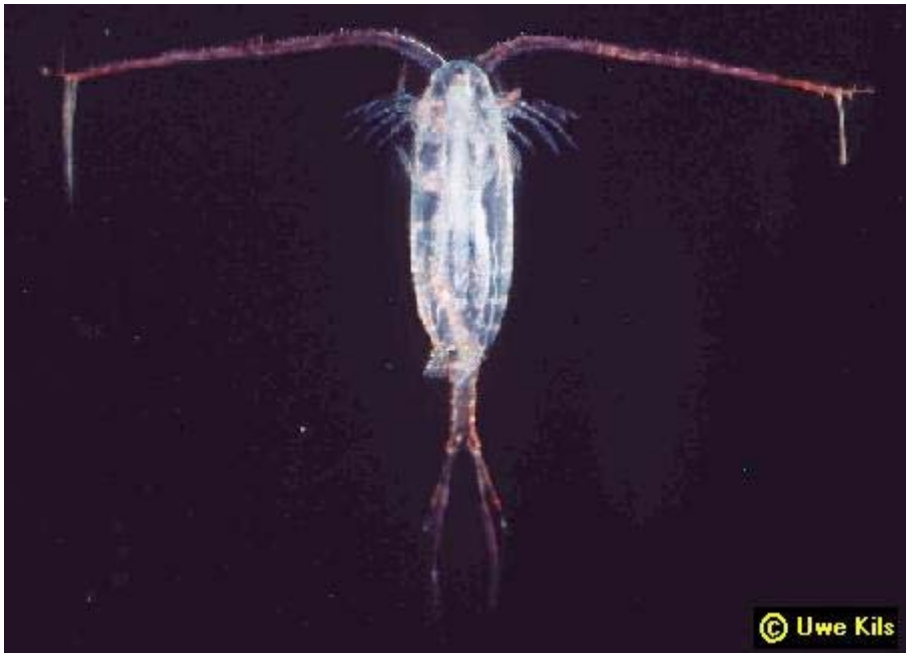
calanoid copepod

This calanoid copepod is carrying eggs.

Copepods are ecologically important in the ocean food chain, feeding on diatoms and other plankton and, as the largest biomass in the oceans, being food for zooplankton, fish, seabirds, and whales. Most copepods species are free-living in the ocean, found from the surface to great depths.



The long, feathered antennae of calanoid copepods facilitate their drifting in the ocean. Copepod fecal pellets contribute to the marine snow, bringing nutrients and minerals from surface waters to the deep sea.

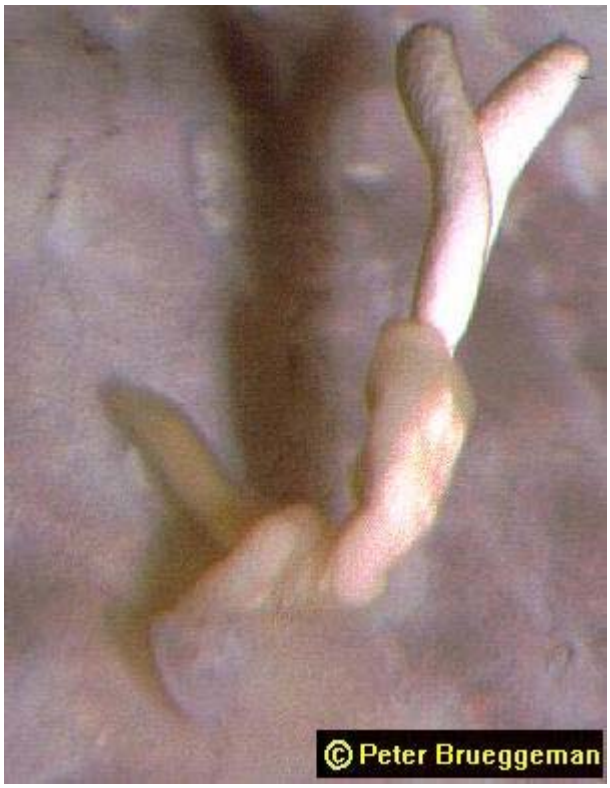
parasitic copepod, possibly *Eubrachiella antarctica*

A common parasitic copepod on Antarctic fish is *Eubrachiella antarctica* [6,7,8]

Parasitic copepods like these on the tail fin of the Antarctic cod *Dissostichus mawsoni* are free-swimming as juveniles [1,2].

Females find a host, attach, and are stationary for life, diverting their energy to reproduction; males move or swim around to find females to reproduce [1,2].

Eubrachiella antarctica pygmy males attach to the female *E. antarctica* near its genital porus [7] This female parasitic copepod is burrowed into the skin, sucking blood and fluids or grinding away at flesh [1,3]. The female stores the male's sperm and fertilizes its eggs as it expels them into chitinous sausage-like ovisacs [3,4]. The ovisacs gradually lengthen as eggs are expelled [4].



In adapting to their parasitic lifestyle, these copepods have changed substantially from non-parasitic copepods in order to secure a hold on the host and increase their reproductive activity [5]. Parasitic copepods developed various grasping mechanisms like antennae or body outgrowths to hold on or embed themselves into hosts [5].

Parasitic copepods can be relatively benign or life-threatening for a fish, depending on the number of parasites, the organ system affected (fins, skin, gills, internal organs), the age of the fish, environmental conditions, and other factors [3].

References: 1: Copepod Parasites of Marine Fishes. NK Pillai. Calcutta : Zoological Survey of India, 1985; **2:** Parasitic Copepoda of British Fishes. Z Kabata. London : Ray Society, 1979; **3:** Parasitic Copepodes on the Fishes of the USSR = Paraziticheskie Veslonogie Ryb SSSR. AP Markewitch. New Delhi : Published for the Smithsonian Institution and the National Science Foundation by the Indian National Scientific Documentation Centre ; Springfield, VA : available from the National Technical Information Service, 1976; **4:** British Parasitic Copepoda. T Scott & A Scott. London : Ray Society, 1913; **5:** Copepods Parasitic on Fishes. Z Kabata. Synopses of the British Fauna (New Series) No. 47. Oegstgeest, Netherlands : Universal Book Services/Dr W Backhuys, 1992; **6:** Proceedings of the NIPR Symposium on Polar Biology 9:169-177, 1996; **7:** Archiv fuer Fischereiwissenschaft 28(2/3):149-156, 1977; **8:** Meeresforschung 28(2-3): 146-156, 1980

ice krill *Euphausia crystallorophias*

Euphausia crystallorophias is found throughout Antarctica and the Antarctic Peninsula from the surface down to usually 300 to 650 meters depth and has been recorded near 4,000 meters depth [1,5]. *E. crystallorophias* reaches a maximum length of 3.4 centimeters, with females slightly larger than males [1,2,5]. *E. crystallorophias* is a swarming species and an important food source for coastal predators, eaten by whales and other large animals (Minke whales, Weddell seals, Adelie penguins, fish particularly *Pleuragramma antarcticum*) [1,4,5,6]. *E. crystallorophias* replaces *E. superba* in dominance in regions of pack and floating ice and the pelagic shelf community [1,4,5,6]. *E. crystallorophias* may be the major single pelagic consumer of phytoplankton on the Antarctic shelf [4]. *E. crystallorophias* undertakes a vertical diel migration and breeds from the end of December to February under the ice [1]. Coastal polynas are areas of enhanced spawning and grazing for *E. crystallorophias* [4].

E. crystallorophias was first described from specimens collected through holes cut in the ice by Scott's Discovery Expedtion [3].

Euphausiids are small translucent shrimp-like crustaceans commonly known as krill; seven species belonging to two genera *Euphausia* and *Thysanoessa* occur in the Southern Ocean [1,2]. The genus name *Euphausia* refers to the luminescence produced by large light organs (photophores) [2]. An Antarctic midwater trawling fishery based on *Euphausia superba* catches krill for human and domentic animal consuption [1]. *E. crystallorophias* is similar to *E. superba* but has a longer rostrum, larger eyes, a shorter mandibular palp, and is shorter in overall length [5].

References: 1: FAO Species Identification Sheets for Fishery Purposes : Southern Ocean (Fishing Areas 48, 58 and 88) (CCAMLR Convention Area) / W Fischer & JC Hureau, eds. Rome : Food and Agriculture Organization of the United Nations, 1985; **2:** A Practical Guide to the Euphausiids of the World. A de C Baker, BP Boden & E Brinton. London : Natural History Museum Publications, 1990; **3:** Annals and Magazine of Natural History 17(Seventh Series):1-11, 1906; **4:** Antarctic Communities: Species, Structure, and Survival. B Battaglia, J Valencia, and DWH Walton, eds. Cambridge: Cambridge University Press, 1997; **5:** A Guide to the Euphausiacea of the Southern Ocean. JM Kirkwood. ANARE Research Notes 1 (Australian National Antarctic Research Expedition). Kingston, Tasmania, Australia: Australia Dept of Science and Technology, Antarctic Division, 1984; **6:** Polar Biology 8(5):327-331, 1988

Antarctic krill *Euphausia superba*

Euphausia superba is found around Antarctica between the continent and the Polar Front within the upper 100 meters of depth [1]. *E. superba* reaches a maximum length of five centimeters [1]. This photo is an adult male in the typical oblique hovering position with its pleopods beating [4]. *E. superba* is a swarming species and an important food source for baleen whales including minke whales, seals, fish, birds, and cephalopods [1]. *E. crystallorophias* replaces *E. superba* in dominance in regions of pack and floating ice and the pelagic shelf community [1]. *E. superba* spawns during late spring and summer, peaking from early January to mid-February [1]. *E. superba* lives two years with recent research suggesting seven years [1]. *E. superba* feeds preferentially on phytoplankton and is a dominant herbivore in the food web [1]. *E. superba* feeds on planktonic and ice-attached diatoms, dinoflagellates, silicoflagellates, tintinnids, foraminiferans, radiolarians, heliozoans, *Calanus/Calanoides* copepods, invertebrate eggs, siphonophores, its own species, other zooplankton [1,5].

Euphausiids are small translucent shrimp-like crustaceans commonly known as krill; seven species belonging to two genera *Euphausia* and *Thysanoessa* occur in the Southern Ocean [1,2]. The genus name *Euphausia* refers to the luminescence produced by large light organs (photophores) [2]. An Antarctic midwater trawling fishery based on *Euphausia superba* catches krill for human and domentic animal consuption [1]. *E. crystallorophias* is similar to *E. superba* but has a longer rostrum, larger eyes, a shorter mandibular palp, and is shorter in overall length [3].

References: 1: FAO Species Identification Sheets for Fishery Purposes : Southern Ocean (Fishing Areas 48, 58 and 88) (CCAMLR Convention Area) / W Fischer & JC Hureau, eds. Rome : Food and Agriculture Organization of the United Nations, 1985; **2:** A Practical Guide to the Euphausiids of the World. A de C Baker, BP Boden & E Brinton. London : Natural History Museum Publications, 1990; **3:** A Guide to the Euphausiacea of the Southern Ocean. JM Kirkwood. ANARE Research Notes 1 (Australian National Antarctic Research Expedition). Kingston, Tasmania, Australia: Australia Dept of Science and Technology, Antarctic Division, 1984; **4:** www.ecoscope.com/krill ; **5:** Polar Biology 13(6):389-397, 1993

myodocopid ostracod (order Myodocopida)

The carapace of myodocopid ostracods is less strongly calcified than other ostracods; it consists of two valves hinged dorsally with the body of the ostracod suspended from the dorsal margins of those valves [1]. Benthic myodocopid ostracods are usually found at the sediment surface, within the top centimeter of sediment, or swimming near the bottom [1]. Predators of the myodocopid ostracod *Philomedes* sp. are the fish *Trematomus bernacchii* and the phoxocephalid amphipod *Heterophoxus videns* [1,3].

Ostracods are also called mussel shrimp or seed shrimp. Mussel shrimp differ from most crustaceans in having a very short trunk without external segmentation; nearly all of its body is encased in a hard covering. Most ostracods live on or near the bottom, feeding on microorganisms and organic debris or preying on small invertebrates.

References: 1: Antarctic and Subantarctic Myodocopina (Ostracoda). LS Kornicker. Synopses of the Antarctic Benthos Volume 5. Koenigstein, Germany ; Champaign, Ill. : Koeltz Scientific Books, 1993; **2:** Ophelia 24(3):155-175, 1985; **3:** Polar Biology 13:291-296, 1993

podocopid ostracod (order Podocopida)

Ostracods are also called mussel shrimp or seed shrimp.

Mussel shrimp differ from most crustaceans in having a very short trunk without external segmentation; nearly all of its body is encased in a hard covering.

Most ostracods live on or near the bottom, feeding on microorganisms and organic debris or preying on small invertebrates. Predators of McMurdo podocopid ostracods include the fish *Trematomus bernacchii* [2].

References: 1: Antarktische und Subantarktische Podocopa (Ostracoda). G Hartmann. Synopses of the Antarctic Benthos Volume 7. Koenigstein : Koeltz Scientific Books, 1997; **2:** Polar Biology 13:291-296, 1993

mysid

Mysids are small, shrimp-like crustaceans, known as "opposum shrimp" due to a brood pouch in mature females. Most Antarctic mysids are hyperbenthic, living above the bottom [1]. There are 37 mysid species in the Antarctic region, with nineteen being endemic [1]. Depending on the species, mysids may feed on small particles collected by grooming their body surface, capture zooplankton, or scavenge. Mysids may be found in large swarms and are an important part of many fish diets. Antarctic mysid predators include brittle stars (Astrotoma agassizii), fish (dragonfish *Cygnodraco mawsoni*; mackerel icefish *Champsocephalus gunnari*; Antarctic cod *Dissostichus mawsoni*; spiny plunderfishes - family Harpagiferidae), birds (blackbellied storm petrel *Fregetta tropica*; Wilson's storm petrel *Oceanites oceanicus*), and the crabeater seal *Lobodon carcinophaga* [2,3,4,5,6,7,8,9].

References: 1: Antarctic Science 10(1):3-11, 1998; **2:** Antarctic Science 10(1):55-61, 1998; **3:** Polar Biology 19(5):354- 357, 1998; **4:** Marine Ecology Progress Series 108(1-2):43-57, 1994; **5:** Journal of Zoology 216(1):83-102, 1988; **6:** Polar Biology 6(1):43-45, 1986; **7:** Biology of the Antarctic Seas XVII. Washington DC : American Geophysical Union, 1986. pp.1-28. Antarctic Research Series, volume 44; **8:** Antarctic Nutrient Cycles and Food Webs. Proceedings of the 4th SCAR Symposium on Antarctic Biology, September 1983. WR Siegfried, PR Condy, and RM Laws, eds. Berlin : Springer-Verlag, 1985. pp.430-436; **9:** Copeia 3:686- 693, 1981

tanaid *Nototanais dimorphus*

Nototanais dimorphus is found in Antarctica and the Antarctic Peninsula, Kerguelen Island, Marion and Prince Edward Islands, Macquarie Island, and southern tip of South America, from 4 to 230 meters depth [1,2,4,5,6,7]. *N. dimorphus* is a dominant species in the McMurdo jetty soft-bottom macrofaunal community and is a foundation species for the ecological community there, regulating species composition and population size (age) structure by preying on small species and small individuals of large species [8]. *N. dimorphus* lives in a tube and is located in or near its tube [8]. Its gut contents include diatoms, bacteria, and amorphous organic material [8,9]. The predators of *N. dimorphus* include the anemone *Edwardsia meridionalis* and the fish *Trematomus bernacchii* and *Trematomus hansoni* [8]. *N. dimorphus* transforms from female to male [1]. In this photo, the male is above the female [3].

The tanaid's upper body (thorax) has seven pairs of walking legs, the first of which has a large pincerlike claw for clasping and the second specialized for burrowing. The tanaid's abdomen has five pairs of swimming limbs and a pair of posterior appendages. Tanaids live on or in soft sediments and feed on organic detritus and plankton. The female carries eggs and developing young in a brood pouch on its underside.

References: 1: Journal of Crustacean Biology 4(2):298-306, 1984; **2:** Mitteilungen aus dem Zoologischen Museum in Berlin 56(1):45-71, 1980; **3:** Kathleen Conlan, personal communication, 1999; **4:** Journal of the Royal Society of New Zealand 13(4):279-294, 1983; **5:** South African Journal of Antarctic Research 21(1):3-44, 1991; **6:** A Survey of the Marine Fauna in Shallow Coastal Waters of the Vestfold Hills and Rauer Islands, Antarctica. MJ Tucker & HR Burton. ANARE Research Notes 55, 1987; **7:** Tethys 6(3):631-653, 1974; **8:** Ophelia 24(3):155-175, 1985; **9:** Antarctic Science 14(1):3- 10, 2002

acorn barnacle *Bathylasma corolliforme*

The acorn barnacle *Bathylasma corolliforme* is found throughout Antarctica and the Antarctic Peninsula, South Sandwich Islands, Scotia Bank off South Georgia Island, and Kerguelen Islands from 6 to 1,500 meters depth [1,2,4,5,6].

Bathylasma corolliforme is not typically known to live at depths of less than one hundred meters in Antarctica; here it was photographed at Cape Armitage at six meters depth and it has been observed near Cape Evans at 24 meters depth [1,2].

The presence of *B. corolliforme* may be linked to the presence of currents sufficiently strong to bring food into its grasp and thus ensure survival [1].

In these photos, *Bathylasma corolliforme* doesn't have complemental males on or near its top opercular plates; small-sized male barnacles are found attached to larger hermaphroditic individuals to facilitate reproduction [1,3].

References: 1: Journal of Biogeography 9:95-109, 1982; **2:** Rob Robbins, personal communication, 2005; **3:** William A Newman, personal communication, 2005; **4:** Revision of the balanomorph barnacles; including a catalog of the species. WA Newman & A Ross.San Diego Society of Natural History Memoir 9, 1976; **5:** Antarctic Cirripedia; monographic account based on specimens collected chiefly under the United States Antarctic research program, 1962-1965. WA Newman & A Ross. Washington DC: American Geophysical Union, 1971; **6:** Crustacea Cirripedia Thoracica: Chionelasmatoidea and Pachylasmatoidea (Balanomorpha) of New Caledonia, Vanuatu and Wallis and Futuna Islands, with a review of all Currently Assigned Taxa. D. Jones. IN: A. Crosnier, ed. Resultats des Campagnes MUSORSTOM, Volume 21. Memoires du Museum National d'Histoire Naturelle 184:141-283, 2000

stalked barnacle, probably *Weltnerium weltneri*

Weltnerium weltneri has been collected from Antarctica and the South Orkney Islands from 298 to 403 meters depth [1]. This specimen was collected from Cinder Cones at about 18 meters depth [4]. The capitular plates of *W. weltneri* are separated by narrow, translucent, chitonous spaces [1]. *W. weltneri* has been collected up to 7.5 millimeters total height and has been found attached to hydroids and bryozoans [1].

Stalked or lepadiform barnacle species vastly outnumber stalkless or balaniform barnacle species in Antarctica (32 to 1) [1,2]. The greater number of stalked species in Antarctica may be due to the lack of littoral fauna (in which stalkless barnacles are well represented) and also due to periods of heavy glaciation in geologic history which impacts stalkless barnacles heavily since they tend to live in shallow water [1,2].

After their larval stage, barnacles are sedentary organisms, secreting calcareous plates which they open and close to extend and retract appendages to filter feed.

Taxonomic Note: Genus was changed from *Arcoscalpellum* to *Weltnerium* [3].

References: 1: Antarctic Cirripedia, Monographic Account Based on Specimens Collected Chiefly Under the United States Antarctic Research Program, 1962-1965. WA Newman & A Ross. Washington DC : American Geophysical Union, 1971; **2:**Advances in Marine Biology 10:1-216, 1972; **3:**Zoologicheskii Zhurnal 57(9):1343-1352, 1978; **4:**Kathleen Conlan, personal communication, 1999

shrimp, probably *Chorismus antarcticus*

Chorismus antarcticus is found throughout Antarctica and South Georgia Island, South Shetland Islands, Marion and Prince Edward Islands, and Chile from 9 to 1,450 meters depth [3,4,5,8,9]. *C. antarcticus* can be up to ten centimeters long with the rostrum as long as the carapace [5]. Carapace length of *C. antarcticus* can be over two centimeters (from eyestalk base to central dorsal carapace edge) [1]. *C. antarcticus* reaches a likely age of ten years in the Weddell Sea [1]. *C. antarcticus* is a hermaphrodite and undergoes a sex transition from male to female during its the fourth year of life [1,2,6]. *C. antarcticus* adults are carnivorous and feed on moving prey like amphipods [1].

Shrimp have a semitransparent body flattened from side to side with a flexible abdomen and a fan-shaped tail. Shrimp use their appendages for swimming, swimming backward rapidly by flexing their abdomen and tail. Shrimp usually eat phytoplankton and zooplankton; some feed on dead animals.

Predators of *Chorismus antarcticus* include the fish *Trematomus hansoni*, *Trematomus bernacchii* and *Trematomus loennbergii*, the Weddell seal, and the brittle star *Ophiosparte gigas* [7,10,11,12]. Due to slow growth, low mortality rate, and low average abundance, *C. antarcticus* has little potential for commercial fishing; commercial bottom trawling would over- exploit the stock and destroy its sponge community habitat [1].

References: 1: Journal of Experimental Marine Biology and Ecology 174:261-275, 1993; **2:** Polar Biology 17(4):384-388, 1997; **3:** Proceedings of the NIPR Symposium on Polar Biology 9:179-206, 1996; **4:** Instituto Antartico Chileno. Serie Cientifica 4(1):89-94, 1976; **5:** Fauna der Antarktis. J Sieg & JW Wagele, eds. Berlin : P. Parey, 1990; **6:** Adaptations within Antarctic Ecosystems, Proceedings of the Third SCAR Symposium on Antarctic Biology. GA Llano, ed. Washington, DC : Smithsonian Institution, 1977. pp.335-342; **7:** Journal of Mammalogy 46(1):37-43, 1965; **8:** South African Journal of Antarctic Research 21(1):3- 44, 1991; **9:** A Survey of the Marine Fauna in Shallow Coastal Waters of the Vestfold Hills and Rauer Islands, Antarctica. MJ Tucker & HR Burton. ANARE Research Notes 55, 1987; **10:** Polar Biology 16(5):309-320, 1996; **11:** Polar Biology 17(1):62-68, 1997; **12:** Polar Biology 27(11):721-728, 2004

Unidentified shrimp

Unidentified shrimp

Antarctic crabs?

Crabs are almost entirely absent from the Antarctic continent, though abundant around the sub-Antarctic islands [1]. Crabs fossils appear in Cretaceous formations in Antarctica, and persist into the Eocene period through the Cretaceous-Tertiary boundary [1]. Then something happened in the Eocene, making crabs extinct (or nearly so) in waters surrounding the Antarctic continent [1]. Antarctica was subtropical to temperate in temperature until 22 million years ago [1]. Then Antarctica was subject to massive cooling which affected its relatively isolated organisms [1]. Crabs didn't survive. Exceptions to the observed absence of crabs in Antarctic continental waters are the stone (lithodid) crabs *Paralomis birsteini* and *Neolithodes capensis*, which have been observed on the Antarctic continental slope in the Bellingshausen Sea below 1,000 meters depth [2]. Lithodid crabs are considered likely candidates to re-establish themselves in the shallow waters of Antarctica under conditions of climate change [2].

References: 1: American Zoologist 34:90-99, 1994; **2:** Polar Biology 31(9):1143-1148, 2008