Marine Biology Research
Publication details, including instructions for authors and subscription information:
http://www.informaworld.com/smpp/title~content=t713735885

Parasites of the deep-sea smelt *Bathylagus euryops* (Argentiniformes: Microstomatidae) from the Charlie-Gibbs Fracture Zone (CGFZ)

Markus Wilhelm Busch[a]; Sven Klimpel[a]; Tracey Sutton[b]; Uwe Piatkowski[c]
[a] Heinrich-Heine-University Düsseldorf, Institute of Zoomorphology, Cell Biology and Parasitology, Düsseldorf, Germany [b] Harbor Branch Oceanographic Institution, Center for Ocean Exploration, Fort Pierce, FL, USA [c] Leibniz Institute of Marine Sciences, Research Division of Marine Ecology, Kiel, Germany

To cite this Article Wilhelm Busch, Markus , Klimpel, Sven , Sutton, Tracey and Piatkowski, Uwe(2008) 'Parasites of the deep-sea smelt *Bathylagus euryops* (Argentiniformes: Microstomatidae) from the Charlie-Gibbs Fracture Zone (CGFZ)', Marine Biology Research, 4: 4, 313 — 317

To link to this Article: DOI: 10.1080/17451000801907963

URL: http://dx.doi.org/10.1080/17451000801907963

Marine Biology Research, 2008; 4: 313–317

SHORT REPORT

Parasites of the deep-sea smelt *Bathylagus euryops* (Argentiniformes: Microstomatidae) from the Charlie-Gibbs Fracture Zone (CGFZ)

MARKUS WILHELM BUSCH[1], SVEN KLIMPEL[1], TRACEY SUTTON[2] & UWE PIATKOWSKI[3]

[1]*Heinrich-Heine-University Düsseldorf, Institute of Zoomorphology, Cell Biology and Parasitology, Düsseldorf, Germany,* [2]*Harbor Branch Oceanographic Institution, Center for Ocean Exploration, Fort Pierce, FL, USA, and* [3]*Leibniz Institute of Marine Sciences, Research Division of Marine Ecology, Kiel, Germany*

Abstract

The deep-sea smelt *Bathylagus euryops*, caught in July 2004 at the Charlie-Gibbs Fracture Zone (CGFZ) of the Mid-Atlantic Ridge (North Atlantic), was studied for metazoan parasites and diet composition. A total of 86 specimens with standard lengths between 6.4 and 22.1 cm (mean 13.6 cm) were examined. The parasite fauna consisted of five species: three Digenea, one Cestoda and one Nematoda. The predominant parasites were *Lecithaster* sp. (Digenea) and an unidentified bothriocephalidean cestode. The only nematode, *Anisakis* sp., occurred with a low prevalence. *Bathylagus euryops* at CGFZ serves as final host for the three digeneans, and as intermediate host for the cestodes and *Anisakis* sp. Stomach content analysis revealed a mesozooplankton crustacean diet, while 95.3% of the stomachs contained unidentified tissue.

Key words: Bathylagus euryops*, Charlie-Gibbs Fracture Zone, deep-sea fish, metazoan parasites*

Introduction

One of the most abundant fish species in the open waters of the north Atlantic Ocean and the Charlie-Gibbs Fracture Zone (CGFZ, a part of the Mid-Atlantic Ridge (MAR)) and a food source for predators of higher trophic levels is the lower-meso/bathypelagic deep-sea smelt *Bathylagus euryops* (Mauchline & Gordon 1983a; Sutton et al. 2008). *Bathylagus euryops* frequently occurs at the MAR and prefers a depth range of 500–1500 m, but it is also found deeper and feeds mostly on copepods and amphipods (Orias et al. 1978; Mauchline & Gordon 1983b, Sutton et al. 2008).

Previous parasitological investigations show that *B. euryops* is poorly infested with different parasite species (e.g. Klimpel et al. 2001). Orias et al. (1978) studied nine *B. euryops* from the west coast of Ireland and identified the parasitic copepod genus *Periplexis*. Mauchline & Gordon (1984) studied the parasite fauna in 38 *B. euryops* from the Rockall Trough (Northeast Atlantic Ocean) and found a cestode prevalence of 3.0%. Gaevskaya (1989) recorded the digenean trematode *Lecithophyllum botryophorum* (Olsson, 1868) from *B. euryops* collected at the CGFZ. Hogans (1986) described and Ho et al. (2003) redescribed the parasitic copepod *Paeonocanthus hogansi* (Ho, Kim, Nagasawa & Saruwatari, 2003) from a *B. euryops* collected in the Northwest Atlantic Ocean. The first comprehensive study of the parasite fauna of *B. euryops* recording three different parasite species was conducted from the Irminger Sea (Klimpel et al. 2006).

The aim of the present study is to investigate the parasite fauna of *B. euryops* from the CGFZ. Using the patterns of infection and stomach content analyses of *B. euryops* new data are provided of the host and its parasites.

Correspondence: M. W. Busch, Heinrich-Heine-University Düsseldorf, Institute of Zoomorphology, Cell Biology and Parasitology, Universitätsstr. 1, D-40225 Düsseldorf, Germany. E-mail: mawilbusch@gmx.de

Published in collaboration with the University of Bergen and the Institute of Marine Research, Norway, and the Marine Biological Laboratory, University of Copenhagen, Denmark

(Accepted 7 January 2008; Printed 31 August 2008)

ISSN 1745-1000 print/ISSN 1745-1019 online
DOI: 10.1080/17451000801907963

Materials and methods

Sample collection

Fish were sampled in July 2004 along the MAR aboard the Norwegian research vessel *G.O. Sars* as an element of MAR-ECO, a field project under the Census of Marine Life. The stations were located on the CGFZ between 51°45.04′–52°58.54′N and 29°32.89′–34°52.15′W (Figure 1). Sampling was conducted with a pelagic trawl in water depths between 1630 and 1959 m as described in Wenneck et al. (2008). All 86 fish were deep-frozen at −40°C immediately after catch. Prior to examination each fish was defrosted by 0 to 1°C. Morphometrical fish data, standard length and total weight were recorded to the nearest 0.1 cm and 0.1 g.

Analysis of stomach contents

The stomach weight was taken before and after the parasitological examination (to the nearest 0.001 g). The stomach content was removed and all food items were sorted and identified to the lowest possible taxonomic level, and grouped into taxonomic categories.The numerical percentage of prey, N (%), the weight percentage of prey, W (%), and the frequency of occurrence, F (%), were calculated according to Hyslop (1980). Using these three indices, an index of relative importance (IRI) was calculated (Pinkas et al. 1971). The importance of a specific prey item increases with higher values for N, W, F and IRI.

Parasitological examination

Eyes, skin, fins, gills, nostrils and mouth cavity of each fish specimen were studied for ectoparasites by using a stereomicroscope. The body cavity was opened to examine microscopically the liver, stomach, pyloric caeca, intestine and gonads for endoparasites. The isolated parasites were fixed in 4% borax-buffered formalin and preserved in 70% ethanol/5% glycerine. For identification purposes, nematodes were dehydrated in a graduated ethanol series and transferred to 100% glycerine. Digenea and Cestoda were stained with acetic carmine, dehydrated, cleared with eugenol or creosote, and mounted in Canada balsam. Parasite identification literature included original descriptions. The parasitological terminology used follows Bush et al. (1997). Voucher material of Digenea specimens (*Lecithophyllum botryophorum* collection number HHUP D225/BE/04, D226/BE/04; Hemiuridae indet. HHUP D245/BE/04; *Lecithaster* sp. HHUP D311/BE/04, D312/BE/04) were deposited in the helminthological collection of the Heinrich-Heine University, Düsseldorf.

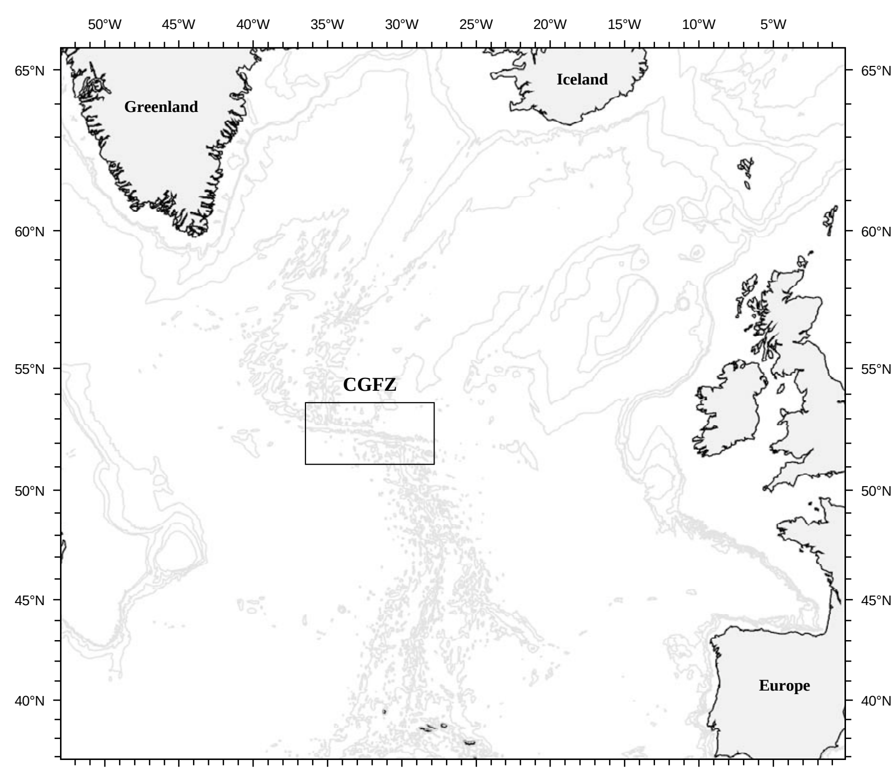

Figure 1. Map of the area of investigation. CGFZ, Charlie-Gibbs Fracture Zone.

Results

The 86 specimens of *Bathylagus euryops* had a mean standard length of 13.6 cm (range 6.4–22.1 cm) and a mean total weight of 23.2 g (range 1.1–106.3). While in 11 (12.8%) *B. euryops* the sex could not be determined, the remaining fishes are 34.9% (n = 30) females and 52.3% (n = 45) males.

Parasite fauna

The infected *Bathylagus euryops* carried either one or two (mean 1.1) parasite species (Figure 2). With a prevalence of 18.6%, adult stages of the *Lecithaster* sp. (Digenea) were located in the intestine (I = 1–3, mI = 1.3, mA = 0.24 ± SD 0.54). Specimens of the *Lecithophyllum botryophorum* (Digenea) were isolated in the pyloric caeca and intestinal lumen (P = 3.5%, I = 1–2, mI = 1.3, mA = 0.05 ± SD 0.26). One digenean (Hemiuridae) was found in the pyloric caeca with a prevalence of 1.2% (I = 1, mI = 1, mA = 0.01 ± SD 0.10). Preadult specimens of the cestode order Bothriocephalidea were isolated from the stomach with a prevalence of 11.6% (I = 1–10, mI = 3.8, mA = 0.44 ± SD 1.70). In the body cavity third-stage larvae of the nematode *Anisakis* sp. were isolated (P = 4.7%, I = 1–2, mI = 1.3, mA = 0.06 ± SD 0.28).

Diet composition

All of the identifiable prey items detected were small crustaceans, mainly in an advanced stage of digestion. The stomachs contained Copepoda (F = 11%), Euphausiacea (F = 11%) and indeterminate Crustacea (F = 89%). Sorted by quantity and weight percentage Crustacea (N = 75.0%, W = 92.3%) was followed by Copepoda (N = 16.7%, W = 6.0%) and Euphausiacea (N = 8.3%, W = 1.7%). The IRI was 14,873 for Crustacea (indet.), 252 for Copepoda and 111 for Euphausiacea. Unidentified tissue was found in 95.3% (n = 82) of the stomachs (Figure 2).

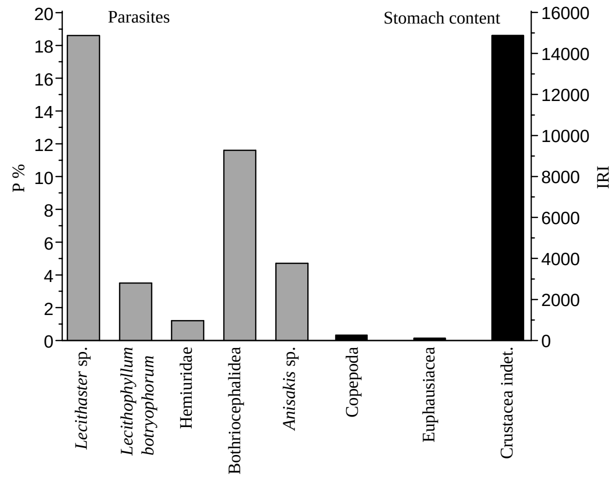

Figure 2. Prevalence (P%) of parasite infestation opposed to the index of relative importance (IRI) of the different food groups.

Discussion

The predominant parasite was the digenetic trematode *Lecithaster* sp. Members of the family Lecithasteridae are distributed in both shallow waters and in the deep sea (Klimpel et al. 2001; Bray 2004). The prevalence of 18.6% in the present study revealed that the life cycle of *Lecithaster* sp. can be completed at the CGFZ.

The digenean *Lecithophyllum botryophorum* has previously been recorded from *Bathylagus euryops* at CGFZ by Gaevskaya (1989), however, she did not provide infestation rates. *Lecithaster botryophorum* is a typical deep-sea parasite species (Bray 2004). The deepest host record is noted for the deep-sea fish *Alepocephalus bairdii* at 1653 m (Bray 2004), which corresponds closely to the depth distribution of *B. euryops* at the CGFZ. The typical first obligatory intermediate hosts of *L. botryophorum* are deep-water Scaphopoda (Køie et al. 2002), while the second intermediate host is unknown. Scott (1969) assumed Amphipoda as second intermediate host. Less than 1% of the molluscs in shallow waters are Scaphopoda (Køie et al. 2002), but their abundance increases with water depths (Bray 2004). The specimen of *B. euryops* from the Irminger Sea had been sampled in a mean trawling depth of 700 m (range 680–708 m), while the mean trawling depth at the CGFZ is 1781 m (range 1630–1959 m). The lower parasite infestation rate at the CGFZ in comparison with the Irminger Sea (Klimpel et al. 2006) can be explained by a combination of different factors, especially the availability of the first intermediate host and the habitat preferences of the fish.

In the family Hemiuridae a heteroxenic life cycle with prosobranch gastropods (molluscs) as first intermediate host and especially pelagic invertebrates (e.g. copepods, chaetognaths) as second intermediate hosts is most common. However, with an infection of just one fish with one hemiurid species, *B. euryops* seems not to have a significant function in the life cycle of this digenean parasite.

Specimens of an unidentified cestode with two shallow bothria and an apical disk were isolated in the stomach lumen of *B. euryops*. They belong to the new proposed order Bothriocephalidea, formerly Pseudophyllidea (Kuchta et al. 2008). Due to the lack of developed genitalia no conclusive identification is possible without genetic analyses. Klimpel et al. (2006) found similar-looking specimens in *B. euryops* from the Irminger Sea. According to the authors the preadult tapeworms resembled *Philobythos atlanticus*. This species appeared in *Acanthochaenus lutkenii*, *Coryphaenoides rupestris* and *Macrourus berglax* (Klimpel et al. 2001), which occurred along the MAR and could serve as paratenic or final hosts. Within the former order Pseudophyllidea pelagic crustaceans act as first intermediate hosts and harbour the procercoid, while plerocercoids may develop in planktivorous fishes (Khalil et al. 1994).

Larval stages of the nematode genus *Anisakis* occurred with a low prevalence in the body cavity of *B. euryops*. Members of genus *Anisakis* use different invertebrates (mainly euphausiaceans and copepods) as first intermediate hosts, and larger invertebrates and fishes as second intermediate or paratenic hosts. The adults are found in cetaceans and sometimes in pinnipeds (Klimpel et al. 2004; Klimpel 2005). Whales, including *Balanaeoptera physalis* (fin whale), *B. borealis* (sei whale), *B. acutorostrata* (minke whale) and *Globicephala melas* (long-finned pilot whale), were sighted along the MAR, and especially at the CGFZ, during the 2004 RV *G.O. Sars* expedition (Skov et al. 2008) and could serve as final hosts for nematodes of the genus *Anisakis*. The present observations indicate that *Anisakis* sp. may reach the deep sea *via* the food web.

The absence of copepod parasites in the present study and in Klimpel et al. (2006) may be explained by their general rare occurrence or loss due to abrasion in the trawl codend.

The high proportion of stomachs containing unidentified tissue (95.3%) exceeds the results of Mauchline & Gordon (1983b) and Klimpel et al. (2006), who found unidentified tissue in 61.5 and 69.1%, respectively, of the stomachs examined. The high number of stomachs with unidentified tissue may be due to the rapid digestion of soft-bodied prey. Mauchline & Gordon (1983b) found Ctenophora in the stomachs of small specimens of *B. euryops*. Gelatinous zooplankton is digested faster than similar-sized pieces of tissue from other taxa and may dissolve in minutes (Arai et al. 2003). The stomach content data do not provide definitive intermediate host pathways and information about the feeding ecology (Figure 2). Further studies are necessary to elucidate the trophic position of *B. euryops* along the MAR, perhaps looking at other potential parasite vectors (e.g. gelatinous zooplankton) that were not obvious using traditional techniques.

Compared with results from the Irminger Sea (Klimpel et al. 2006), the parasite fauna of *B. euryops* from the CGFZ appears slightly greater and more diverse. This can be explained by the more complex water mass circulation at the MAR, especially at the CGFZ, which causes local enrichment of pelagic biomass from various origins on which *B. euryops* might prey. Nevertheless, the parasite fauna is scant compared with that of benthopelagic fishes, e.g. macrourids (Klimpel et al. 2006).

Acknowledgements

The scientific staff and crew of the research vessel *G.O. Sars* are thanked for their help during the collections. The present study was initiated by the international Census of Marine Life project MAR-ECO and financially supported by the German Research Council (DFG KL 2087/1-1).

References

Arai MN, Welch DW, Dunsmuir AL, Jacobs MC, Ladocouceur AR. 2003. Digestion of pelagic Ctenophora and Cnidaria by fish. Canadian Journal of Fisheries and Aquatic Sciences 60:825–9.

Bray RA. 2004. The bathymetric distribution of the digenean parasites of deep-sea fishes. Folia Parasitologica 51:268–74.

Bush O, Lafferty AD, Lotz JM, Shostak AW. 1997. Parasitology meets ecology on its own terms: Margolis et al. revisited. Journal of Parasitology 83:575–83.

Gaevskaya AV. 1989. Revision of the genus *Lecithophyllum* (Trematoda, Lecithasteridae). Zoologichesky Zhurnal 68:130–4.

Ho J, Kim I, Nagasawa K, Saruwatari T. 2003. *Paeonocanthus antarcticensis* (Hewitt, 1965): a rare copepod parasite of bathypelagic fish, *Bathylagus antarcticus* Günther, from the Antarctic Ocean. Zoological Science 20:1315–21.

Hogans WE. 1986. *Paeonocanthus antarcticensis* (Copepoda: Sphyriidae) parasitic on the bathypelagic fish *Bathylagus euryops* in the northwest Atlantic Ocean. Sarsia 71:305–7.

Hyslop EJ. 1980. Stomach content analysis – a review of methods and their application. Journal of Fish Biology 17:411–29.

Khalil LF, Jones A, Bray RA. 1994. Keys to the Cestode Parasites of Vertebrates. Wallingford (UK): CAB International. 751 p.

Klimpel S. 2005. Distribution of nematodes of the family Anisakidae in commercially important fish species from the central and northern North Sea. Bulletin of Fish Biology 7:161–8.

Klimpel S, Palm HW, Busch MW, Kellermanns E, Rückert S. 2006. Fish parasites in the Arctic deep-sea: poor diversity in pelagic fish species vs. heavy parasite load in a demersal fish. Deep-Sea Research I 53:1167–81.

Klimpel S, Palm HW, Rückert S, Piatkowski U. 2004. The life cycle of *Anisakis simplex* in the Norwegian Deep (northern North Sea). Parasitology Research 94:1–9.

Klimpel S, Seehagen A, Palm HW, Rosenthal H. 2001. Deep-water Metazoan Fish Parasites of the World. Berlin: Logos. 316 p.

Køie M, Karlsbakk E, Nylund A. 2002. A cystophorous cercaria and metacercaria in *Antalis entalis* (L.) (Mollusca, Scaphopoda) in Norwegian waters, the larval stage of *Lecithophyllum botryophorum* (Olsson, 1868) (Digenea, Lecithasteridae). Sarsia 87:302–11.

Kuchta R, Scholz T, Brabec J, Bray RA. 2008. Suppression of the tapeworm order Pseudophyllidea (Platyhelminthes: Eucestoda) and the proposal of two new orders, Bothriocephalidea and Diphyllobothriidea. International Journal of Parasitology 38:49–55.

Mauchline J, Gordon JDM. 1983a. Diets of sharks and chimaeroids of the Rockall Trough, northeastern Atlantic Ocean. Marine Biology 75:269–78.

Mauchline J, Gordon JDM. 1983b. Diets of clupeoid, stomiatoid and salmonoid fish of the Rockall Trough, northeastern Atlantic Ocean. Marine Biology 77:67–78.

Mauchline J, Gordon JDM. 1984. Incidence of parasitic worms in stomachs of pelagic and demersal fish of the Rockall Trough, northeastern Atlantic Ocean. Journal of Fish Biology 24:281–5.

Orias JD, Noble ER, Alderson GD. 1978. Parasitism in some atlantic bathypelagic fishes with a description of *Lecithophyllum irelandeum* sp. n. (Trematoda). Journal of Parasitology 64: 49–51.

Pinkas L, Oliphant MD, Iverson ILK. 1971. Food habits of albacore, bluefin tuna and bonito in Californian waters. California Fish and Game 152:1–105.

Scott JS. 1969. Trematode populations in the Atlantic argentine, *Argentina silus*, and their use as biological indicators. Journal of the Fisheries Research Board of Canada 26:879–91.

Skov H, Gunnlaugsson T, Budgell WP, Horne J, Nøttestad L, Olsen E, et al. 2008. Small-scale spatial variability of sperm and sei whales in relation to oceanographic and topographic features along the Mid-Atlantic Ridge. Deep-Sea Research II 55:254–68.

Sutton TT, Porteiro FM, Heino M, Byrkjedal I, Langhelle G, Anderson CIH, et al. 2008. Vertical structure and biomass of deep-pelagic fishes in relation to the Mid-Atlantic Ridge from Iceland to the Azores. Deep-Sea Research II 55:161–84.

Wenneck T de Lange, Falkenhaug T, Bergstad OA. 2008. Strategies, methods and technologies adopted on the RV G.O. Sars MAR-ECO expedition to the Mid-Atlantic Ridge in 2004. Deep-Sea Research II 56:6–28.

Editorial responsibility: Egil Karlsbakk