Available online at www.sciencedirect.com
ScienceDirect
Polar Science 5 (2011) 195–210
NiPR National Institute of Polar Research
http://ees.elsevier.com/polar/

Size distribution of meso- and bathypelagic fish in the Dumont d'Urville Sea (East Antarctica) during the CEAMARC surveys

Philippe Koubbi [a,b,*], Percy-Alexander Hulley [c], Patrice Pruvost [d], Pauline Henri [a,b], Jean-Philippe Labat [a,b], Victoria Wadley [e], Daisuke Hirano [f], Masato Moteki [f]

[a] *UPMC Université Paris 06, UMR 7093, Laboratoire d'Océanographie de Villefranche, BP28, 06234 Villefranche-sur-Mer, France*
[b] *CNRS, UMR 7093, LOV, BP 28, 06234 Villefranche-sur-Mer, France*
[c] *Iziko-South African Museum, P. O. Box 61, 8000 Cape Town, South Africa*
[d] *MNHN, DMPA-UMR 7208, 43 rue Cuvier, 75005 Paris, France*
[e] *Department of Sustainability, Environment, Water, Population and Communities, Australian Antarctic Division, 203 Channel Highway, Kingston, Tasmania 7050, Australia*
[f] *Faculty of Marine Science, Tokyo University of Marine Sciences and Technology, 4-5-7 Konan, Minato, Tokyo 108-8477, Japan*

Received 9 February 2011; revised 7 March 2011; accepted 8 March 2011
Available online 5 April 2011

Abstract

The pelagic fish community of the Dumont d'Urville Sea (East Antarctica) was investigated during the 2008 austral-summer using IYGPT (International Young Gadoid Pelagic Trawl) samples taken in different depth layers from the surface to 1000 m. The aim of this paper is to describe the mesopelagic fish community and its size distribution. The family Myctophidae dominated the mesopelagic ichthyofauna, while bathylagids were abundant in deeper hauls. Bathylagids, *Cyclothone* spp., *Gymnoscopelus opisthopterus, Electrona antarctica, Protomyctophum bolini,* and *Krefftichthys anderssoni* were the most abundant taxa in the samples and showed size stratification with depth. Community and size structuring appear to be influenced by the hydrology and by the proximity of the continental margin, as well as a relationship to the circulation of the Modified Circumpolar Deep Water.

Keywords: Mesopelagic; Bathypelagic; Southern Ocean; Myctophids; East Antarctica

1. Introduction

The mesopelagic zone relates to the water masses between the epipelagic zone (0–200 m depth) and the deep bathypelagic zone at 1000 m. Mesopelagic fish spend the day in the mesopelagic zone and most of them perform diel migration, coming to the epipelagic zone during the night (Gjosaeter and Kawaguchi, 1980). To the south of the Antarctic Polar Front, the majority of meso- and bathypelagic species have circumpolar distributions that are linked to specific water masses (Hulley, 1981; Koubbi et al., 2011). Here a few families dominate the ichthyofauna: Bathylagidae, Gonostomatidae, Myctophidae and Paralepididae (Kock, 1992; Kellermann, 1996). Of these, myctophids or lanternfishes are the most diverse and abundant family with more than thirty species (Hulley,

* Corresponding author. UPMC Université Paris 06, UMR 7093, Laboratoire d'Océanographie de Villefranche, BP28, 06234 Villefranche-sur-Mer, France. Tel.: +33 140793760.
E-mail address: koubbi@obs-vlfr.fr (P. Koubbi).

1873-9652/$ - see front matter © 2011 Elsevier B.V. and NIPR. All rights reserved.
doi:10.1016/j.polar.2011.03.003

1990 and Barrera-Oro, 2002) and a biomass (probably an underestimate) of 70–200 $\times$ 10^6 t (Lubimova et al., 1983). These micronektonic species represent a mid-trophic level between zooplankton (Pakhomov et al., 1996; Pusch et al., 2004; Flores et al., 2008; Van de Putte et al., 2010) and top predators (seabirds and marine mammals) (Chérel et al., 2010). Mesopelagic fish play an important role in the ecosystem since they allow for rapid exchange of production from the epipelagic zone to the deeper layers during their diel vertical migrations (Torres and Somero, 1988; Lancraft et al., 1989; Piatkowski et al., 1994; Duhamel, 1998; Pusch et al., 2004; Moteki et al., 2009). *Electrona antarctica* is one of the most abundant myctophids along the East Antarctica continental shelf (Hoddell et al., 2000; Moteki et al., 2009; Van de Putte et al., 2010; Koubbi et al., 2010), and the species has a broad distribution between the Antarctic Polar Front and the continental shelf (Hulley, 1990; Koubbi et al., 2011).

The shelf break represents a marked change between the oceanic and neritic species assemblages. Shelf assemblages are dominated by notothenioids, mainly Antarctic silverfish (*Pleuragramma antarcticum*), icefish and fish larvae (Hulley, 1992; Hoddell et al., 2000; Van de Putte et al., 2010; Koubbi et al., 2010, 2011). Oceanic assemblages are dominated by meso- and bathypelagic fish, while along the continental margin there is often a transitional assemblage, comprising oceanic species mixed with those notothenioids associated with Antarctic krill (*Euphausia superba*) swarms (Hoddell et al., 2000; Koubbi et al., 2010). Most of the studies near the continental shelf margin have employed RMT 1 + 8 nets to sample fish larvae, post larvae and juveniles, or bongo nets for fish larvae (Koubbi et al., 2011).

In the present study, a large pelagic trawl was used to sample macrozooplankton and micronekton, although an RMT 1 + 8 (Moteki et al., 2011) was also deployed along the transects. The CEAMARC surveys (Collaborative East Antarctic Marine Census), which form part of the Census of Antarctic Marine Life (CAML, IPY Project 53) were carried out during the Austral-summer 2008 in the Dumont d'Urville Sea, from Terre Adélie to the Mertz Glacier Tongue. The Japanese TRV *Umitaka Maru* was used to sample the pelagic realm from the coast and into the oceanic zone to as far north as 62°S. Previously and in our study area, a biological/oceanographic survey (BROKE-East) had been conducted in 1995/96, but at a much broader scale, and mainly in the oceanic zone (Nicol et al., 2000). Here, an RMT was used to study the micronekton (Hoddell et al., 2000). The ICO^{2}TA (Integrated Coastal Ocean Observations in Terre Adélie) surveys, commencing in 2004, sampled fish larvae from the shelf area (Koubbi et al., 2011), but with limited samples in the oceanic zone.

The continental shelf of the Dumont d'Urville Sea from Adélie Land to the Mertz Glacier Tongue is 120–130 km wide with a shelf break located at depths between 500 m and 550 m. The continental slope extends down to about 2000 m. It is characterized by alternating banks, shoaling to 200 m (Adélie and Mertz Banks), and troughs connected to submarine canyons. A complex network of submarine canyons is observed with the Jussieu and Cuvier canyons reaching the shelf break and innershelf depressions; others canyons are not connected to the shelf (Caburlotto et al., 2006; De Santis et al., 2007; Beaman, 2008; Post et al., 2011). The continental rise may be subdivided into two regions, a relatively steep region from 2000 to 3000 m and with deep-sea channels; and a gentler lower rise in areas exceeding 3000 m (Caburlotto et al., 2006).

The area has been identified as a source of Antarctic Bottom Waters (AABW), named ALBW (Adélie Land Bottom Water) (Gordon and Tchernia, 1972; Rintoul, 1998). Circumpolar Deep Water (CDW) is differentiated from the Modified Circumpolar Deep Water (MCDW) by being warmer, more saline and with lower dissolved oxygen; both are circumpolar (Orsi et al., 1999; Bindoff et al., 2000). MCDW corresponds to waters that have upwelled onto the outer continental slope at intermediate depths and includes Slope Water (Whitworth et al., 1998; Gordon and Tchernia, 1972; Bindoff et al., 2000). Major currents like the Antarctic Circumpolar Current (ACC) and the East Antarctic Current, are associated with gyral systems (Nicol et al., 2000). The southern boundary of the ACC corresponds to the southernmost edge of the Upper Circumpolar Deep Water (Orsi et al., 1995). It is recognized as being an important region for biological production (Tynan, 1998; Nicol et al., 2000). The Antarctic Slope Front (Jacobs, 1991) is bathymetrically locked to the edge of the continental shelf close to the 1000 m, where it separates the less dense Antarctic Surface Waters (AASW) from the denser MCDW (Bindoff et al., 2000).

In this article, meso- and bathypelagic fish spatial distributions are studied with reference to their diversity, abundance and size. Previously and in order to delineate ecoregions, Koubbi et al. (2010) have considered presence-absence data for the pelagic fish community investigations.