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African Journal of Marine Science
Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/tams20

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Available online: 08 Jan 2010

To cite this article: C. Sparks & M. J. Gibbons (2003): Hydromedusae Off the Orange River Mouth, Southern Africa, African Journal of Marine Science, 25:1, 373-376

To link to this article: http://dx.doi.org/10.2989/18142320309504023

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Afr. J. mar. Sci. 25: 373–376
2003

HYDROMEDUSAE OFF THE ORANGE RIVER MOUTH, SOUTHERN AFRICA

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A total of 242 zooplankton samples from the upper 100 m of the water column was collected discontinuously from March 1997 to January 1999 off the Orange River mouth on the west coast of southern Africa. Six species of hydromedusae were recovered at generally low abundance, of which *Euphysa aurata, Leuckartia octona* and *Proboscidactyla menoni* were dominant. *E. aurata* and *L. octona* showed evidence of seasonality in abundance. The low diversity of the fauna was remarkable and it is hypothesized that this might be attributable in part to sedimentation from the Orange River, and in part to locally weak circulation and the wide extent of the continental shelf.

Key words: Benguela upwelling ecosystem, diversity, hydromedusae

Studies on the distribution of gelatinous zooplankton in the Benguela upwelling ecosystem indicate a spatial pattern in diversity along longitudinal and latitudinal gradients (Pagès and Gili 1991a, Pagès *et al.* 1991, Pagès 1992, Buecher and Gibbons 2000). Assemblages over the continental shelf are generally of low diversity, whereas those of higher diversity occupy waters at and beyond the shelf break (Gibbons and Hutchings 1996). The richness of most epipelagic assemblages near the northern and southern boundaries of the Benguela ecosystem tend be high (Gibbons and Hutchings 1996), owing to a mixing of Benguela waters with those of the Angola and Agulhas currents respectively (Gibbons *et al.* 1995, Gibbons and Thibault-Botha 2002). Although the permanent upwelling cell at Lüderitz (26°S) acts as an internal boundary to the system (Agenbag and Shannon 1988, Largier and Boyd 2001), it is not considered to have a profound influence on the specific composition of regional zooplankton (Gibbons *et al.* 1995, Gibbons and Thibault-Botha 2002, but see Barange *et al*. 1992, Emanuel *et al*. 1992). Indeed, it has been suggested that there is a spatial homogeneity to the specific composition (and by inference, diversity) of the zooplankton within the Benguela upwelling region (Gibbons and Hutchings 1996). This may not always be apparent because micro- and mesoscale temporal events (Pagès *et al.* 1991, Pagès and Gili 1991b, Pagès 1992, Gibbons and Buecher 2001) are not distributed evenly in space, so creating a spatio-temporal mosaic of species distributions.

In this paper, the generality of the observation of Gibbons and Hutchings (1996) regarding regional diversity is examined by focusing on the composition of medusoid assemblages in the central Benguela ecosystem.

MATERIAL AND METHODS

The study was conducted in an area north-west (28°11´S, 17°15´E) of the Orange River mouth (28°30´S, 16°E) at a depth of approximately 150 m. Samples were collected daily from the offshore diamond mining vessel, M.V. *Grand Banks*, from March 1997 to January 1999, using a vertical Bongo net (57 cm mouth diameter, fitted with 200-µm mesh) that was lowered to 100 m and retrieved immediately at 1 m s^{-1}. The average volume of seawater filtered by the net was 25.52 m^3. All material was collected within two hours after sunrise, and samples were preserved in 5% buffered saline formalin. In the laboratory, all hydromedusae were counted from the entire sample, and zooplankton counts were standardized to numbers per m^3. Supplementary information on water temperature was recorded daily from 10 ℓ bucket samples collected at the sea surface (using a mercury thermometer accurate to better than 1°C), but these data are not discussed in any detail.

The position of the mining vessel varied little over the study period, but owing to operational difficulties, it was not possible to sample continuously. Sampling periods ranged from 15 March to 18 May 1997 (austral autumn), 4 September 1997 to 28 March 1998 (spring and summer) and 2 October 1998 to 11 January 1999 (spring and summer). There was no sampling during the austral winter.

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Manuscript received September 2002; accepted February 2003

Table I: Seasonal variations in mean sea surface temperature and mean density of the dominant hydromedusae off the Orange River mouth. The number of samples collected (*n*) is shown, and the number of times that each species was recorded in a sample is indicated in parentheses

Species	Spring			Summer			Autumn		
	Mean	*SD*	*n*	Mean	*SD*	*n*	Mean	*SD*	*n*
Temperature (°C)									
	14.44	1.13	110	15.63	1.44	61	14.85	2.11	42
Density (number m^{-3}*)*									
L. octona	0.020	0.040	128 (31)	0	0	61 (0)	0.005	0.017	53 (4)
E. aurata	0.012	0.034	128 (18)	0.003	0.014	61 (3)	0.102	0.144	53(28)
P. menoni	0.009	0.031	128 (15)	0.008	0.024	61 (7)	0.009	0.026	53 (7)

Seasonal changes in medusoid abundance were analysed by Kruskal-Wallis tests, using Statistica software.

RESULTS AND DISCUSSION

In all, 242 zooplankton samples were collected; they contained just six species of hydromedusae. Three (dominant) species were recovered on more than 20 occasions each – *Euphysa aurata* and *Leuckartia octona* (anthomedusae) and *Proboscidactyla menoni* (limnomedusa; Table I). The three other species, *Bougainvillia macloviana* and *Sarsia* sp. (anthomedusa) and *Aequorea* sp. (leptomedusa) were all recorded on fewer than five occasions each. All these hydromedusae are meroplanktic and are among the commonest eurytypic species (Buecher and Gibbons 2000) in the Benguela system, where they are indicative of coastal and shelf water (Pagès *et al.* 1991, Pagès 1992).

The densities of hydromedusae observed were low, but they are in the range of previous estimates (Pagès *et al.* 1991, Buecher and Gibbons 2000). Whereas the generally low frequency at which any species of medusa was seen precludes detailed analyses, of the three dominant species collected, only *P. menoni* failed to show any seasonal change in abundance following consolidation of the data (Kruskal Wallis, $p > 0.05$). *E. aurata* was significantly ($p < 0.05$) more common in autumn (0.102 m^{-3}) than spring (0.012 m^{-3}) or summer (0.003 m^{-3}), and *L. octona* was more abundant in spring (0.02 m^{-3}) than summer or autumn (0.005 m^{-3}; Table I). Although it is tempting to try and interpret the seasonal changes in abundance with respect to sea surface temperature, such analyses would be ambiguous given the betho-pelagic nature of the collected taxa, and the lack of temperature data from deeper water.

Two features of the results are particularly noteworthy; the very low diversity of the assemblages and the persistent nature of this low diversity. These contrast with the features of assemblages observed farther north (Pagès and Gili 1991a) and south (Buecher and Gibbons 2000). Although sampling effort was high (albeit inconsistent) during the study, the volume of water filtered during each tow was relatively low and rare species of hydromedusae might not have been caught. Despite this, both the diversity and abundance of hydromedusae caught off the Orange River mouth are still lower than observed elsewhere using similar gear. For example, Buecher and Gibbons (2000) recorded a total of 50 hydromedusae using similar gear from 243 Bongo net collections in St Helena Bay (31°50´S).

The low diversity of the assemblage here may be surprising, but similar observations can be deduced from previous work. For example, in their analysis of pelagic cnidarians from 11 cruises in the Benguela, Pagès *et al.* (1992) recorded only one species (*L. octona*) from the four samples collected off the Orange River mouth (nine specimens in 1983 and three in 1984). Further, Sparks (unpublished data) only collected two species (*E. aurata* and *L. octona*) in the same region from four samples collected in 1999.

Two hypotheses are advanced to explain the unusual results. First, the continental shelf is wide and local circulation generally sluggish (Hart and Currie 1960), being dominated by inertial motion (Largier and Boyd 2001). Northward, alongshore flows are weak offshore, but strengthen where the topography steepens, and onshore, southward flows dominate nearshore (Largier and Boyd 2001, Iita *et al.* 2001). Upwelling wind stress in the region is neither pronounced nor markedly seasonal (Boyd 1987), and the site is distant from advective centres. As a consequence, the residence time of water nearshore may span weeks (Largier and Boyd 2001), and "new" water with "new species" is not regularly introduced into the area. This means that locally poor diversity is not supplemented.

Second, the paucity of species observed may be caused by sedimentation from the run-off of the Orange River. The Orange is classified as one of the world's major rivers (Rogers and Bremner 1991). It is 2 173 km long and has a simulated mean annual run-off of 11.64×10^9 m^3 (Swart *et al*. 1990). Its catchment is prone to drought and flooding, and it is subject to intensive agriculture. It is a variable river in terms of flow (Swart *et al*. 1990) and, given the sandy nature of the catchment (Bremner *et al.* 1990), it carries large quantities of sedimentary material considerable distances offshore (Shillington *et al.* 1990). Indeed, the area of seabed influenced by sedimentation from the Orange River extends from north of the river mouth (mostly sand) to St Helena Bay (finer muds; Rogers and Bremner 1991), and it is referred to as the Orange River, or Namaqualand, mudbelt (Rogers and Bremner 1991, Mabote *et al.* 1997). Not only is the smothering of the seabed likely to have a negative impact on benthic communities (Moore 1977, Meadows *et al.* 1997; including the polyp-stages of medusae), but the very variability of the impact will influence the evolution of resilient polyps (Kikinger 1992). This could happen to an extent, perhaps, that the diversity of downstream assemblages of pelagic organisms relying on upstream seed populations of benthic life-history stages is reduced.

In proposing this latter hypothesis, three others must be considered. First, although it can be argued that the river's run-off will also reduce salinity, any impacts at the seabed (the polyp environment) will be limited to the area immediately around the Orange River mouth (P. Huizinga, CSIR, pers. comm.). Although salinity can have an impact on medusa release by polyps (Purcell *et al*. 1999), any influence on the medusoid assemblages recovered here would imply that shelf-wide populations are maintained only from polyps localized near the river mouth. This is unlikely. Second, whereas salinity at the sea surface might have been reduced near the sampling station at some stage during the course of the study, such changes would have been small (Shillington *et al.* 1990), especially given that salinity in the region of the Orange River is generally at its minimum during winter (Swart *et al.* 1990), the one season that was not sampled. Moreover, any reductions in salinity would not have persisted through time, so that if richness was attributable to freshwater run-off *per se*, changes in diversity should have become apparent over the course of the study. They were not. Finally, the mining activities of the platform itself might have a negative impact on the medusoid assemblages observed. Although this hypothesis cannot be discounted, samples were consistently collected on the side of the vessel upstream from the tailings plume. The mining platform would have a negligible impact on water flow in the immediate area, because the draught of the vessel is 6.48 m, and the drill string, which is lowered through the centre of the vessel, is only 500 mm in diameter.

In conclusion, it is clear that the composition of the zooplankton is not homogeneous throughout the Benguela. It is difficult to ascertain whether the patterns observed for hydromedusae off the Orange River mouth are similarly reflected by other components of the zooplankton, but if so, then this region of the Benguela shelf is quite different from the rest of the shelf region.

ACKNOWLEDGEMENTS

We thank Dr P. A. Wickens (De Beers Marine, Cape Town) and the staff of the MV *Grand Banks* for their enthusiastic support for the collection of samples, and Dr E. Buecher (University of the Western Cape) for assistance in the identification of medusae. Thanks are also due to Dr A. J. Boyd (Marine & Coastal Management [MCM]) for discussions about surface circulation over the Orange River cone, and to Ms L. van Niekerk and Mr P. Huizinga (CSIR, Stellenbosch) for discussions on flow of the Orange River. Dr J. Rogers (University of Cape Town) and Dr I. McMillan (De Beers Marine, Cape Town) contributed useful comments on sedimentology off the Orange River. Dr L. Hutchings (MCM), Dr M. Graham (Dauphin Island Sea Laboratory) and two anonymous referees are thanked for their comments on the manuscript. Finally, we thank De Beers Marine (Pty) Ltd, The Royal Society (London) and South Africa's National Research Foundation for financial support.

LITERATURE CITED

AGENBAG, J. J. and L. V. SHANNON 1988 — A suggested physical explanation for the existence of a biological boundary at 24°30´S in the Benguela system. *S. Afr. J. mar. Sci*. **6**: 119–132.

BARANGE, M., PILLAR, S. C. and L. HUTCHINGS 1992 — Major pelagic borders of the Benguela upwelling system according to euphausiid species distribution. In *Benguela Trophic Functioning*. Payne, A. I. L., Brink, K. H., Mann, K. H. and R. Hilborn (Eds). *S. Afr. J. mar. Sci*. **12**: 3–17.

BOYD, A. J. 1987 — The oceanography of the Namibian shelf. Ph.D. thesis, University of Cape Town: [xv] + 190 pp. + [i].

BREMNER, J. M., ROGERS, J. and J. P. WILLIS 1990 — Sedimentological aspects of the 1988 Orange River floods. *Trans. R. Soc. S. Afr.* **47**(3): 247–294.

BUECHER, E. and M. J. GIBBONS 2000 — Interannual variation in the composition of the assemblages of medusae and ctenophores in St Helena Bay, southern Benguela ecosystem. *Scientia mar., Barcelona* **64**(suppl. 1): 123–134.

EMANUEL, B. P., BUSTAMANTE, R. H., BRANCH, G. M., EEKHOUT, S. and F. J. ODENDAAL 1992 — A zoogeographic and functional approach to the selection of marine reserves on the west coast of South Africa. In *Benguela Trophic Functioning*. Payne, A. I. L., Brink, K. H., Mann, K. H. and R. Hilborn (Eds). *S. Afr. J. mar. Sci.* **12**: 341–354.

GIBBONS, M. J., BARANGE, M. and L. HUTCHINGS 1995 — The zoogeography and diversity of euphausiids around southern Africa. *Mar. Biol.* **123**: 257–268.

GIBBONS, M. J. and E. BUECHER 2001 — Short-term variability in the assemblage of medusae and ctenophores following upwelling events in the southern Benguela ecosystem. *Mar. Ecol. Prog. Ser.* **220**: 169–177.

GIBBONS, M. J. and L. HUTCHINGS 1996 — Zooplankton diversity and community structure around southern Africa, with special attention to the Benguela upwelling system. *S. Afr. J. Sci.* **92**: 63–76.

GIBBONS, M. J. and D. THIBAULT-BOTHA 2002 — The match between ocean circulation and zoogeography of epipelagic siphonophores around southern Africa. *J. mar. biol. Ass. U.K.* **82**: 801–810.

HART, T. J. and R. I. CURRIE 1960 — The Benguela Current. *"Discovery" Rep.* **31**: 123–297.

IITA, A., BOYD, A. J. and C. H. BARTHOLOMAE 2001 — A snapshot of the circulation and hydrology of the southern and central shelf regions of the Benguela Current in winter 1999. *S. Afr. J. Sci.* **97**: 213–217.

KIKINGER, R. 1992 — *Cotylorhiza tuberculata* (Cnidaria: Scyphozoa) – life history of a stationary population. *Mar. Ecol.* **13**: 333–362.

LARGIER, J. and A. J. BOYD 2001 — Drifter observations of surface water transport in the Benguela Current during winter 1999. *S. Afr. J. Sci.* **97**: 223–229.

MABOTE, M. E., ROGERS, J. and M. E. MEADOWS 1997 — Sedimentology of terrigenous mud from the Orange River Delta and the inner shelf off Namaqualand, South Africa. (Spec. Ed.). *S. Afr. Geogr. J.*: 108–114.

MEADOWS, M. E., DINGLE, R. V., ROGERS, J. and E. G. MILLS 1997 — Radiocarbon chronology of Namaqualand mudbelt sediments: problems and prospects. *S. Afr. J. Sci.* **93**: 321–327.

MOORE, P. G. 1977 — Inorganic particulate suspensions in the sea and their effects on marine animals. In *Oceanography and Marine Biology. An Annual Review* **15**. Barnes, H. (Ed.). Aberdeen; University Press: 225–363.

PAGÈS, F. 1992 — Mesoscale coupling between planktonic cnidarian distribution and water masses during a temporal transition between active upwelling and abatement in the northern Benguela system. In *Benguela Trophic Functioning*. Payne, A. I. L., Brink, K. H., Mann, K. H. and R. Hilborn (Eds). *S. Afr. J. mar. Sci.* **12**: 41–52.

PAGÈS, F. and J-M. GILI 1991a — Effects of large-scale advective processes on gelatinous zooplankton populations in the northern Benguela ecosystem. *Mar. Ecol. Prog. Ser.* **75**: 205–215.

PAGÈS, F. and J-M. GILI 1991b — Vertical distribution of epipelagic siphonophores at the confluence between Benguela waters and the Angola Current over 48 hours. In *Coelenterate Biology: Recent Research on Cnidaria and Ctenophora.* Williams, R. B., Cornelius, P. F. S., Hughes, R. G. and E. A. Robson (Eds). *Hydrobiologia* **216/217**: 355–362.

PAGÈS, F., GILI, J-M. and J. BOUILLON 1992 — Medusae (Hydrozoa, Scyphozoa, Cubozoa) of the Benguela Current South eastern Atlantic. *Scientia Mar., Barcelona* **56**: 1–64.

PAGÈS, F., VERHEYE, H. M., GILI, J-M. and J. FLOS 1991 — Short-term effects of coastal upwelling and wind reversals on epiplanktonic cnidarians in the southern Benguela ecosystem. *S. Afr. J. mar. Sci.* **10**: 203–211.

PURCELL, J. E., WHITE, J. R., NEMAZIE, D. A. and D. A. WRIGHT 1999 — Temperature, salinity and food effects on sexual reproduction and abundance of the scyphozoan *Chrysaora quinquecirrha. Mar. Ecol. Prog. Ser.* **180**: 87–196.

ROGERS, J. and J. M. BREMNER 1991 — The Benguela ecosystem. 7. Marine geological aspects. In *Oceanography and Marine Biology. An Annual Review* **29**. Barnes, M. (Ed.). Aberdeen; University Press: 1–85.

SHILLINGTON, F. A., BRUNDRIT, G. B., LUTJEHARMS, J. R. E., BOYD, A. J., AGENBAG, J. J. and L. V. SHANNON 1990 — The coastal current circulation during the Orange River flood 1988. *Trans. R. Soc. S. Afr.* **47**: 307–330.

STANDER, G. H. 1964 — The Benguela Current off South West Africa. *Investl Rep. mar. Res. Lab. S.W. Afr.* **12**: 43 pp. + Plates 5–81.

SWART, D. H., CROWLEY, J. B., MÖLLER, J. P. and A. DE WET 1990 — Nature and behaviour of the flood at the river mouth. *Trans. R. Soc. S. Afr.* **47**: 217–245.