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CHARACTERIZATION OF MACRO- AND MEIOBENTHOS AT THE INP-MOORING SITE IN THE OYSTER GROUNDS AND SURROUNDING AREAS

Contribution nr. 2 by RWS-DNZ to:
BEON Project INP-MOORING 94-96:
Eutrophication and natural variations at the INP-Mooring station in the Oyster Grounds;
(NIOZ, RWS-DNZ, RWS-RIKZ and MAFF)

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1. Introduction

The BEON project NIOZ 95 E 01 forms a part of the joint INP-Mooring Project (Integrated North Sea Mooring Programme) of NIOZ, RWS-DNZ, RWS-RIKZ, and MAFF (Lowestoft, UK). The aims of the INP-Mooring project are fully described in the BEON project plan, and are shortly summarized below:

a. to provide insight in the effects of physical induced changes in vertical transports in the watercolumn and water-bottom exchange on
   (i) phytoplankton growth, and
   (ii) higher trophic levels (benthos),
   in the summer-stratified sedimentation area Oyster Grounds;
b. to assess the usefulness of a mooring station in such an area as the Oyster Grounds for incorporation in the RWS-monitoring programme performed by ships.

This paper (RWS-DNZ contribution nr. 2) focuses on the possible eutrophication effects on the availability of food for benthos in a summer stratified sedimentation area, linked to the additional nutrient supply arising from fluxes from sediments, deeper water layers and increased phytoplankton growth (Van Raaphorst et al., 1991). From the late '70s up to 1991, an increase in densities of species like *Amphiura filiformis* has been observed in the Oysterground area. This species is considered an indicator of food-enriched (eutrophicated) areas (Kúnitzer et al., 1992; Holtmann & Groenewold, 1992).

In this paper attention is paid to spatial trends (and not temperal trends) in the benthos communities in the Oyster Grounds and its surrounding areas (Dutch Continental Shelf, DCS). We also emphasize the representativeness of the INP-Mooring site in the Oysterground area with respect to benthos communities. Species selected for presentation are: dominant macrobenthic species (including (possible) indicators for eutrophication), main macro- and meiobenthic taxa, characteristic macrobenthic species, and species sensitive for bottom disturbing activities.

The results presented here will form a part of the final report to BEON.

2. Material & Methods

2.1. Data

The data used to produce the distribution maps were collected during several sampling cruises executed from 1985 to 1993 (Table 1) and compiled in one large database. Figures 1a-1f show the locations sampled during the different sampling programmes. At each station at least one sample for macrobenthos and one for meiobenthos were taken, preferably with a Reineck-boxcore (0.068 m^2). The meiobenthos boxcore was subsequently subsampled. For a more detailed description of the methods used we refer to the publications mentioned in Table 1.
All samples were taken in spring - begin summer, between the April 1st and the July 22nd. The different ICES-cruises were all part of the North Sea Benthos Survey and were all executed between the April 1st and the May 20th. The number of stations sampled on the Oyster Grounds and subsequently sorted amounts to 67 for the macrobenthos and 55 for the meiobenthos. The area here depicted as the Oyster Grounds is the area defined as the MANS-area of the same name (see figures 1a-f). Unfortunately it was not possible to incorporate data of the Cleaver Bank, the only large gravel area on the DCS (Dutch Continental Shelf). For a description of the bottom fauna of this area we refer to van Moorsel (1994).
The Atlas of the zoobenthos of the Dutch Continental Shelf (Asjes, in prep.) treats the distribution of over 65 macrobenthic species and over 15 meiobenthic taxa on the DCS and is based on the same data.

Table 1. List of cruises.

Description cruise	Region	Number of stations	Publications
Voordelta 1985	North Sea Dutch coast Voordelta	172	Seip & Brand, 1987
Ices Middelburg 1986	North Sea English coast	17	
Ices Gent 1986	Southern North Sea lower then 53 lat	19	
Ices NIOZ 1986	North Sea between 53 lat and 55 lat	70	Heip *et al.*, 1992;
Ices Helgoland 1986	North Sea between 6 long and 8 long	21	Künitzer *et al.*, 1992
Ices Bremerhaven 1986	North Sea middle part 56-57 lat 0-6 long	44	
Ices Wilhelmshaven 1986	North Sea middle part 55-56 lat 0-6 long	28	
Ices Wimereux 1986	North Sea English coast	28	
MILZON 1988	North Sea Dutch Continental Shelf	177	van Scheppingen &
MILZON 1989	North Sea Dutch Continental Shelf	157	Groenewold, 1990
MMP Netherlands 1990	North Sea Dutch coast	7	-
MILZON II 1991	The Oyster Ground, Frisian Front, Vlieland Ground and Terschelling Bank	78	Holtmann & Groenewold, 1992
EXP*BMN 1991 [Biomon]	North Sea Dutch Continental Shelf	25	Duineveld, 1992
EXP*BMN 1992 [Biomon]	North Sea Dutch Continental Shelf	24	Duineveld & Belgers, 1993
MILZON II 1992	The Broad Fourteens and Brown Bank	53	Holtmann &
MILZON II 1993	The Western Frisian Front	29	Groenewold, 1994
EXP*BMN 1993 [Biomon]	North Sea Dutch Continental Shelf	25	Duineveld & Belgers, 1994
Doggersbank 1986	Doggersbank	14	-
Doggersbank 1987	Doggersbank	14	-

The sediment composition data used were provided by the Dutch 'Rijksgeologische Dienst' and are compiled is the MANS-database.
The INP-Mooring location at 4°00'E 54°30'N was sampled during the ICES NIOZ 1986 cruise, the MILZON II 1991 cruise and the three EXP*BMN cruises of 1991, 1992 and 1993.

2.2. *Species selection*

To get an impression of the benthic community of the Oyster Grounds the density distribution of several species and taxonomic groups will be presented. The selected species and taxa had to conform to the one or more of the following criteria.

1. Dominant species: The five most widespread species on the basis of the number of stations on which they were found.

2. Main macrobenthic taxa: The four main macrobenthic taxa represented on the Oyster Grounds.

3. Main meiobenthic taxa: The four most widespread taxa on the basis of the number of stations on which they were found.

4. Characteristic species: Macrobenthic species found to be indicator species for the TWINSPAN-clusters characteristic for the Oyster Grounds (Holtmann & Groenewold, 1992).

5. Sensitive species: Species sensitive for bottom disturbing activities. Those macrobenthic species with an estimated mortality of 50% or more due to beamtrawl fishery. Selection on the basis of figures presented by the ICES Benthic Ecology Working Group (ICES, 1994).

Using these criteria resulted in the selection of fourteen macrobenthic species, four macrobenthic higher taxa and four meiobenthic taxa (Table 2).

Table 2: List of selected macrobenthic species and higher benthic taxa (see text). Ann = Annelid, Arth = Arthropod, Ech = Echinoderm, Moll = Mollusc.

Criteria	Species/taxa selected	Criteria	Species/taxa selected
Main macrobenthic taxa	Annelida	**Characteristic species**	*Eudorellopsis deformis* (Arth)
	Arthropoda		*Glycera rouxii* (Ann)
	Echinodermata		*Harpinia antennaria* (Arth)
	Mollusca		*Scoloplos armiger* (Ann)
Main meiobenthic taxa	Copepoda	**Sensitive species**	*Abra alba* (Moll)
	Nematoda		*Echinocardium cordatum* (Ech)
	Polychaeta		*Pectinaria* spp. (Ann)
	Turbellaria		*Psammechinus miliaris* (Ech)
Dominant species	*Amphiura filiformis* (Ech)		*Spisula subtruncata* (Moll)
	Callianassa subterranea (Arth)		*Tellimya ferruginosa* (Moll)
	Harpinia antennaria (Arth)		
	Mysella bidentata (Moll)		
	Nephtys hombergii (Ann)		

In addition to the density distribution of these twenty two species and taxa total macrobenthic density and biomass and total meiobenthic density will be shown.

2.3. *Distribution maps*

The distribution of each of the selected species and taxa is presented in two maps, one to show the situation on the Oyster Grounds in relation to the rest of the DCS and one to give a more detailed view of the distribution on the Oyster Grounds itself.
To produce contours the values were interpolated between the sample locations using krigging. Duplicate values for a location were averaged. Contourlevels were then established so that the

areas covered per range of densities (excluding the zero class) were approximately of the same size. For a more complete account of the method used we refer to Asjes (in prep.).

3. Results

3.1. *Sediment*

All kinds of sediment present on the DCS, from silt (median grain size <63μ) to coarse sand (>500μ) and gravel, can be found on the Oyster Grounds (figure 2). The Oyster Grounds are characterised, as compared to the rest of the DCS, by the dominance of very fine sand (between 63 and 125μ) and the presence of large areas of silt. Throughout the area patches of fine sand (between 125 and 250μ) can be found. In the south-western corner coarser sediments (>250μ to gravel) occur.

3.2. *Total macrobenthic density and biomass*

Figures 3 and 5 show the distribution of total macrobenthic density and biomass, respectively. Total density on the Oyster Grounds is high compared to the southern part of the DCS and the Dogger Bank, and in part equals that of the Frisian Front. Especially the northern part reveals a high total density. Only in the central Oyster Grounds an area can be detected with lower density levels. Highest macrobenthic densities are found outside the Oyster Grounds, in the area north of the Wadden Sea and on the Frisian Front.

Looking at the Oyster Grounds in more detail (figure 4), two large areas with high densities varying between 2529 and 5697 individuals per m^2 can be found around 5°E 55°N and 3°30'E 54°30'N, respectively. In the south-central, eastern and western part lower densities up to 1594 individuals per m^2 are found.

Total macrobenthic biomass shows peaks in several areas on the DCS. On the eastern Frisian Front a large area with high biomass can be found, extending into the Oyster Grounds. Also along the Dutch coast and in some areas offshore high macrobenthic biomass can be detected. The area with high total macrobenthic density encountered around 3°30'E 54°30'N does not support a high macrobenthic biomass.

Total macrobenthic biomass at the sample locations on the Oyster Grounds (figure 6) is at its maximum only one fourth that of the area north of the Wadden Sea (111 versus 428 gAFDW per m^2). On the Oyster Grounds highest biomasses are found in an area running from the Frisian Front border to the north in the east of the area. The annelid *Chaetopterus variopedatus*, the echinoderms *Amphiura filiformis* and *Echinocardium cordatum* and the arthropod *Callianassa subterranea* are the main contributors to these high values. Macrobenthic biomass is relatively low in the east, the north and the central-south.

3.3. *Total meiobenthic density*

The distribution of total meiobenthic density (figure 7) broadly resembles that of the macrobenthic density, showing high values on the Oyster Grounds relative to the southern part of the DCS and the Dogger Bank, and in part equalling those encountered on the Frisian Front. However, highest values are found outside the Oyster Grounds (up to 9592 individuals per 10 cm^2 on the Frisian Front).

On the Oyster Grounds itself highest densities (2527-4366 individuals per 10 cm^2; figure 8) are, just as with the macrobenthic density, found in two large areas centred around 5°E 55°N and 3°30'E 54°30'N, respectively. Complementary to these two areas, patches with high densities are located on the southern edges of the Oyster Grounds. Relatively low densities (<1615 individuals per 10 cm^2) are found in the centre and at the west, north and north-east borders of the area.

3.4. Main macrobenthic taxa

3.4.1. Annelida

On the DCS the annelids are mostly concentrated in the eastern part, north of the Wadden Sea (densities up to 9540 individuals per 10 cm^2; figure 9). The Oyster Grounds are not extremely rich in annelids, nor poor.
Looking at the Oyster Grounds separately, it can be seen that the two areas with high total macrobenthic density are also rich in annelids (densities up to 6840 individuals per 10 cm^2; figure 10). Furthermore, in the south several areas can be found with relatively high densities. In the eastern part a large area with relatively low numbers can be detected.
The most abundant annelids on the Oyster Grounds are members of the order Phyllodocida, with *Pholoe minuta* (Sigalionidae) as the most abundant species.

3.4.2. Arthropoda

Arthropods are most abundant in the shallower part of the DCS, with areas of high abundance in the coastal region, offshore at 53° latitude and around the 30m isobath in the northern part of the DCS (figure 11). The larger part of the Oyster Grounds in contrast is poor in arthropods
The arthropods of the Oyster Grounds, mainly consisting of representatives of the order of Amphipoda (especially *Harpinia antennaria* (Phoxocephalidae) and *Bathyporeia* spp. (Haustoriidae)), reach highest numbers in the east (figure 12). Relatively low numbers are found roughly between 30 and 40 m deep in the western part of the area and in the north-east.

3.4.3. Echinodermata

On the DCS echinoderms reach their highest abundance north of the Wadden Sea, on the Frisian Front and the Oyster Ground, with densities over 5000 individuals per m^2 north of the Wadden Sea (figure 13). Almost the entire Oyster Grounds area falls within the highest class distinguished here.
A more detailed look at the echinoderms of the Oyster Grounds is given in figure 14. Two large areas can be made out, one in the western part of the area and one in the central-eastern part, corresponding with the two areas with high total macrobenthos densities. The high numbers of echinoderms on the Oyster Grounds are about entirely made up of *Amphiura filiformis* (see figure 25).

3.4.4. Mollusca

Molluscs reach relatively high numbers in the Dutch coastal area, the Frisian Front and the peripheral parts of the Oyster Grounds (figure 15). Highest densities are found along the Dutch coast (up to 8208 individuals per m^2).
The pattern of distribution on the Oyster Grounds coincides with the general pattern of distribution of the total macrobenthic density in the area (figure 16), with high densities in the western and central-eastern part and low densities in the central part. The molluscs of the Oyster Grounds mainly consist of *Mysella bidentata* (Montacutidae), *Tellina fabula* (Tellinidae), *Corbula gibba* (Erodonidae) and members of the Nuculidae

3.5. Main meiobenthic taxa

3.5.1. Copepoda

High densities of copepods are found in the sandy bottoms of the southern DCS and in the central part of the Oyster Grounds (figure 17). The maximum density on the Oyster Grounds however, equals about one third of the maximum reached in the southern DCS. The copepods of the southern DCS are mainly interstitial whereas those of the Oyster Grounds are, due to the fine structure of the sediment, essentially non-interstitial.
On the Oyster Grounds itself maximum numbers are found in the central part of the area and in the south-west (figure 18). The copepods found in high numbers here are mainly members of the Diosaccidae and Ectinosomatidae, with the exception of *Longipedia helgolandica* (Longipediidae).

3.5.2. Nematoda

When numbers are considered nematodes are the most important meiobenthic taxon on the DCS. They reach densities of over 9000 individuals per 10 cm^2. Especially on the Frisian Front and the Oyster Grounds, and to some extent in the coastal area, numbers are very high (figure 19).
On the Oyster Grounds high densities of nematodes are found at the border on the Frisian Front, in the central part and in the south-east (figure 20). Relatively low densities are found in the north-east, north and south-west.

3.5.3. Polychaeta

The meiobenthic members of the annelid class of polychaetes can be found in relatively high numbers in the coastal region of the DCS and in the northern part of the area (figure 21).
The polychaetes of the Oyster Grounds nowhere reach densities over 14 individuals per 10 cm^2. Concentrations of polychaetes can be found in the northern and western parts of the area (figure 22). The centre is relatively poor in polychaetes (only up to 3 individuals per 10 cm^2).

3.5.4. Turbellaria

In area of distribution the turbellarians rank second after the nematodes. As compared to the shallower part of the DCS the Oyster Grounds are poor in turbellarians with densities less than 42 individuals per 10 cm^2 (up to 234 in the southern DCS; figure 23).
On the Oyster Grounds turbellarians are most frequently encountered at the northern periphery, densities in the central part not reaching above 7 individuals per 10 cm^2 (figure 24).

3.6. Dominant species

3.6.1. *Amphiura filiformis*

Amphiura filiformis is a typical species of the deeper, northern part of the DCS, reaching its highest densities on the Frisian Front (figure 25). Also on the Oyster Grounds areas with relatively high numbers of this species can be found. It is absent from the southern part of the DCS.

The distribution of *Amphiura filiformis* on the Oyster Grounds is comparable to that of the total macrobenthic density, showing two areas with high densities and lower densities in the central, eastern and western parts (figure 26).

3.6.2. *Callianassa subterranea*

Callianassa subterranea is, like *Amphiura filiformis*, a species characteristic of the northern part of the DCS. Highest densities are found on the Frisian Front, with two small areas within the Oyster Ground with equally high numbers (figure 27). It also is absent from the southern part of the DCS.
On the Oyster Grounds the highest densities are found in the southern part, bordering on the Frisian Front and a small area around 5° E and 55°N (figure 28).

3.6.3. *Harpinia antennaria*

Harpinia antennaria is found in the part of the DCS north of the 30m isobath (figure 29). Highest densities are reached in a small area on the Frisian Front. A large area of high densities is situated in the eastern part of the Oyster Ground, being the most important area for *Harpinia antennaria*.
Harpinia antennaria is absent from the southern DCS and the outmost south-western and north-eastern parts of the Oyster Grounds. On the Oyster Grounds itself highest densities are concentrated in a horseshoe shaped area running from the south via the east to the north-west (figure 30).

3.6.4. *Mysella bidentata*

Mysella bidentata appears on most of the DCS, although in the southern region it is less abundant and in large parts even absent (figure 31). Highest numbers are found on the Frisian Front and the Oyster Grounds.
On the Oyster Grounds two areas can be discovered with high numbers of *Mysella bidentata* (figure 32). These areas are situated at the same place as the centres of high density of *Amphiura filiformis*. In two small areas in the south-central Oyster Grounds the occurrence of *Mysella bidentata* could not be demonstrated.

3.6.5. *Nephtys hombergii*

Nephtys hombergii is a species found in highest numbers along the coast and in the north of the Oyster Grounds (figure 33). Highest densities (up to 294 individuals per m^2) are reached along the coast in shallow waters. In the offshore southern DCS *Nephtys hombergii* is absent.
On the Oyster Grounds *Nephtys hombergii* is most numerous in the northern part with densities between 42 and 82 individuals per m^2 (figure 34). In the south-east a large area with relatively low densities can be found.

3.7. Characteristic species[1]

3.7.1. *Glycera rouxii*

Glycera rouxii is present on the DCS between depths of 30 to 50 m. It is thus found on the Oyster Grounds and on the Frisian Front and is absent from the southern DCS and the Dogger bank (figure 35).

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[1] *Harpinia antennaria* is dealt with in paragraph 3.6 - Dominant species.

On the Oyster Grounds *Glycera rouxii* is most abundant in the central part and absent from the northern and eastern periphery (figure 36). Its area of distribution extents from the Oyster Grounds into the Frisian Front.

3.7.2. *Scoloplos armiger*

Scoloplos armiger is one of the most abundant macrobenthic polychaet species on the DCS, reaching densities of over 1000 individuals per m^2 in the southern part (figure 37). On the Oyster Grounds it is found in high abundance in the northern part bordering the 40m isobath and in two smaller areas in the central east (figure 38). It is absent from the central southern part of the area, which is an area with a silty bottom.

3.7.3. *Eudorellopsis deformis*

Eudorellopsis deformis is a species characteristic for the deeper parts of the DCS, being almost entirely absent from the areas with a depth of less than 30m (figure 39). On the Oyster Grounds it can be found in the areas with fine to very fine sand and is absent from the area with a silty bottom (figure 40). Highest numbers are found in the north-west.

3.8. Sensitive species

3.8.1. *Abra alba*

On the DCS *Abra alba* has a very patchy distribution, with high densities on the Frisian Front, in the south-western part of the Oyster Grounds and some small areas along the Dutch coast (figure 41). It is absent from large parts of the DCS.
On the Oyster Grounds *Abra alba* is found in the eastern part and three areas in the south and west (figure 42). High densities are only found in the south-eastern corner of the area. The highest class shown in the map is caused by one sample location where an exceptionally high density was found (980 individuals per m^2). Leaving this station out of consideration densities on the Oyster Grounds nowhere reach over 85 individuals per m^2.

3.8.2. *Echinocardium cordatum*

Echinocardium cordatum is one of the main representatives of the echinoderms on the DCS. It is found in high densities in the coastal area north of the Wadden Sea. and in some parts along the southern coast (figure 43).
On the Oyster Ground *Echinocardium cordatum* reaches densities of up to 91 individuals per m^2. It is most abundant in the part south of 55° latitude (figure 44). In a few small areas in the north and the central Oyster Grounds it was not encountered during the several cruises.

3.8.3. *Pectinaria* spp.

Pectinaria spp. occur throughout the DCS, but are common only in the deeper parts, especially on the Frisian Front and the Oyster Grounds (figure 45). An additional area with high densities was found offshore the island of Texel. *Pectinaria* spp. are absent from most parts of the southern DCS.
Pectinaria spp. reach their highest numbers in the central part of the Oyster Grounds and some areas in the east (figure 46). In a few areas in the south of the area *Pectinaria* spp. could not be detected.

3.8.4. *Psammechinus miliaris* & *Spisula subtruncata*

Psammechinus miliaris and *Spisula subtruncata* (figures 48) are almost completely absent from the Oyster Grounds. Due to the very low number of stations on which it has been encountered, it was not possible to produce a distribution map of *Psammechinus miliaris*. *Spisula subtruncata* was found only at two stations at the border of the Oyster Ground area. As can be seen in figure 47 *Spisula subtruncata* is mainly a coastal species and its absence from the Oyster Grounds thus can not be contributed to its sensitivity to bottom disturbing activities on the Oyster Grounds.
The fact that *Psammechinus miliaris* was not found at the Oyster Grounds is probably due to the inefficiency of the boxcore in sampling large epibenthic species.

3.8.5. *Tellimya ferruginosa*

Tellimya ferruginosa has a patchy distribution on the DCS, occurring in low densities in the larger part of the area (figure 49). Everywhere on the DCS patches can be found where *Tellimya* could not be detected.
The distribution of *Tellimya ferruginosa* on the Oyster Grounds also shows a patchy pattern (figure 50). Highest densities, up to 37 individuals per m^2 are found in the south-east. Along the borders of the Oyster Grounds several areas can be found that are void of *Tellimya ferruginosa*.

4. Discussion and Conclusions

The Oyster Grounds are generally richer in macro- and meiobenthos than the shallower southern part of the DCS. However highest densities, not only for the total macro- and meiobenthos, but also for most of the other taxa dealt with, are found either in the Frisian Front area or in the part of the DCS north of the Wadden Sea. The Oyster Grounds are an especially important area of distribution for echinoderms, molluscs and nematodes. The turbellarians are the only higher taxon for which the Oyster Grounds reveal relatively low densities.
Four of the six selected sensitive species are found on the Oyster Grounds, of which *Pectinaria* spp. in relatively high numbers. The other two species, *Psammechinus miliaris* and *Spisula subruncata* were scarcely found in the area, the first probably due to the inefficiency of the sampling methods in catching large epibenthic species, the later because of its restriction to the coastal region. Since the dominant taxa were selected as being characteristic for the Oyster Grounds, a comparison with the rest of the DCS for these species is not justifiable.

With respect to macro- as well as meiobenthos the Oyster Ground area reveals to be heterogeneous. Centres of distribution differ per species or higher taxa and no single area can be detected containing high numbers or biomasses for all taxa dealt with. Nevertheless some areas seem to house relatively large benthos stocks. These areas are located around 5°E 55°N and 3°30'E 54°30'N. The relatively low macrobenthic biomass in the area around 3°30'E 54°30'N, constrasting with the high densities found, is caused by the large number of small species encountered in this area. The high abundance of copepods in the south-central part of the area, which is relatively poor in the other taxa dealt with in this report, is remarkable.
Furthermore, the high values frequently found on the southern border of the Oyster Grounds for some part seem to be extensions of the Frisian Front benthic fauna.

Due to the heterogeneousity of the area the INP-Mooring station in the centre of the area cannot be seen as representative of the Oyster Grounds. Compared to the rest of the Oyster Grounds the INP-Mooring station is rich in total macro- and meiobenthos, echinoderms (mainly *Amphiura filiformis*, which is an indicator for eutrophicated areas), molluscs (mainly *Mysella bidentata*), copepods, nematodes, *Nephtys hombergii*, *Eudorellopsis deformis* and *Pectinaria* spp. It is relatively poor in polychaetes, turbellarians and *Abra alba*.

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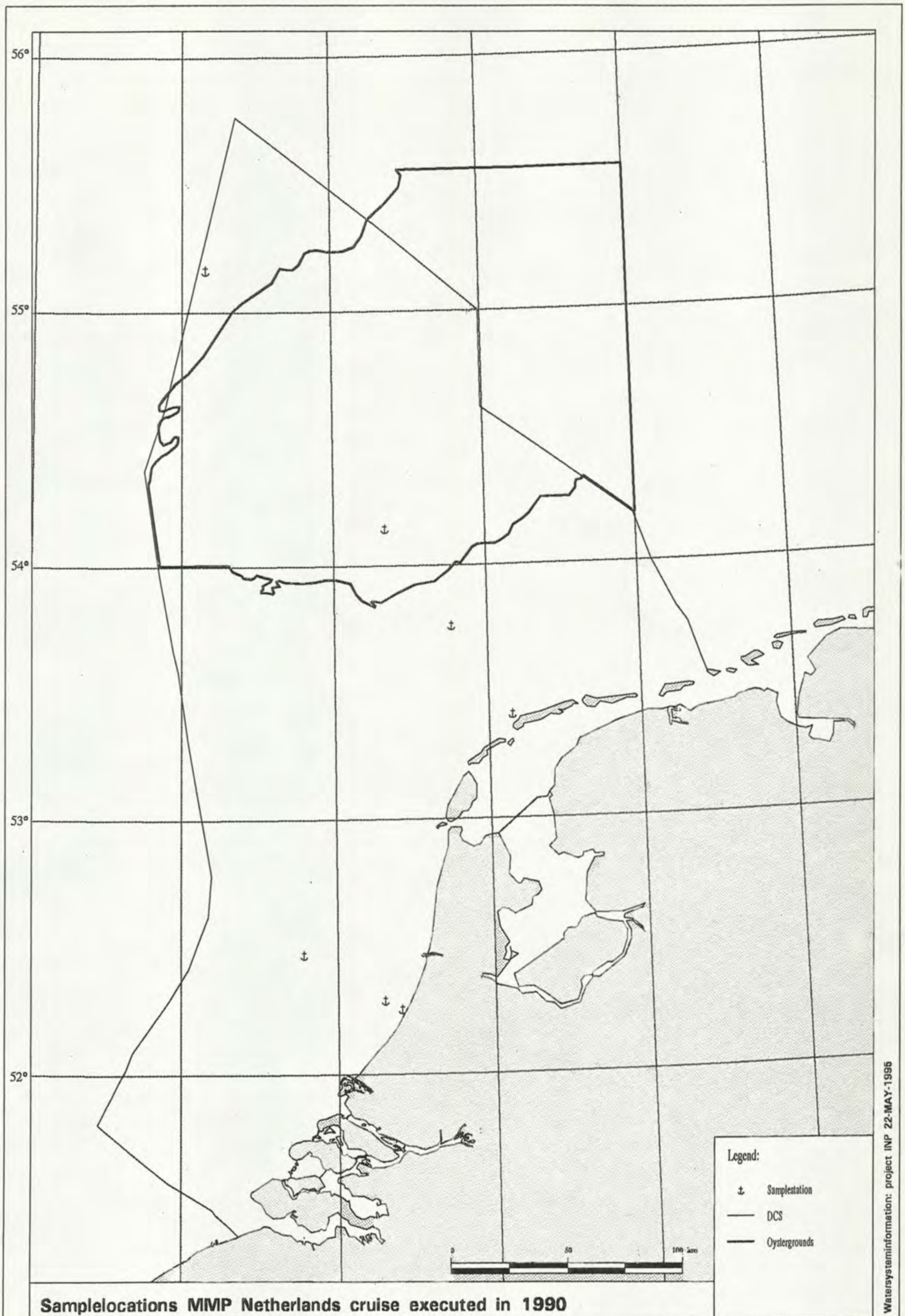
Seip, P.A. & R. Brand, 1987. Inventarisatie van macrozoöbenthos in de Voordelta. -- NIOZ-rapport 1987-1.

Figure 1a

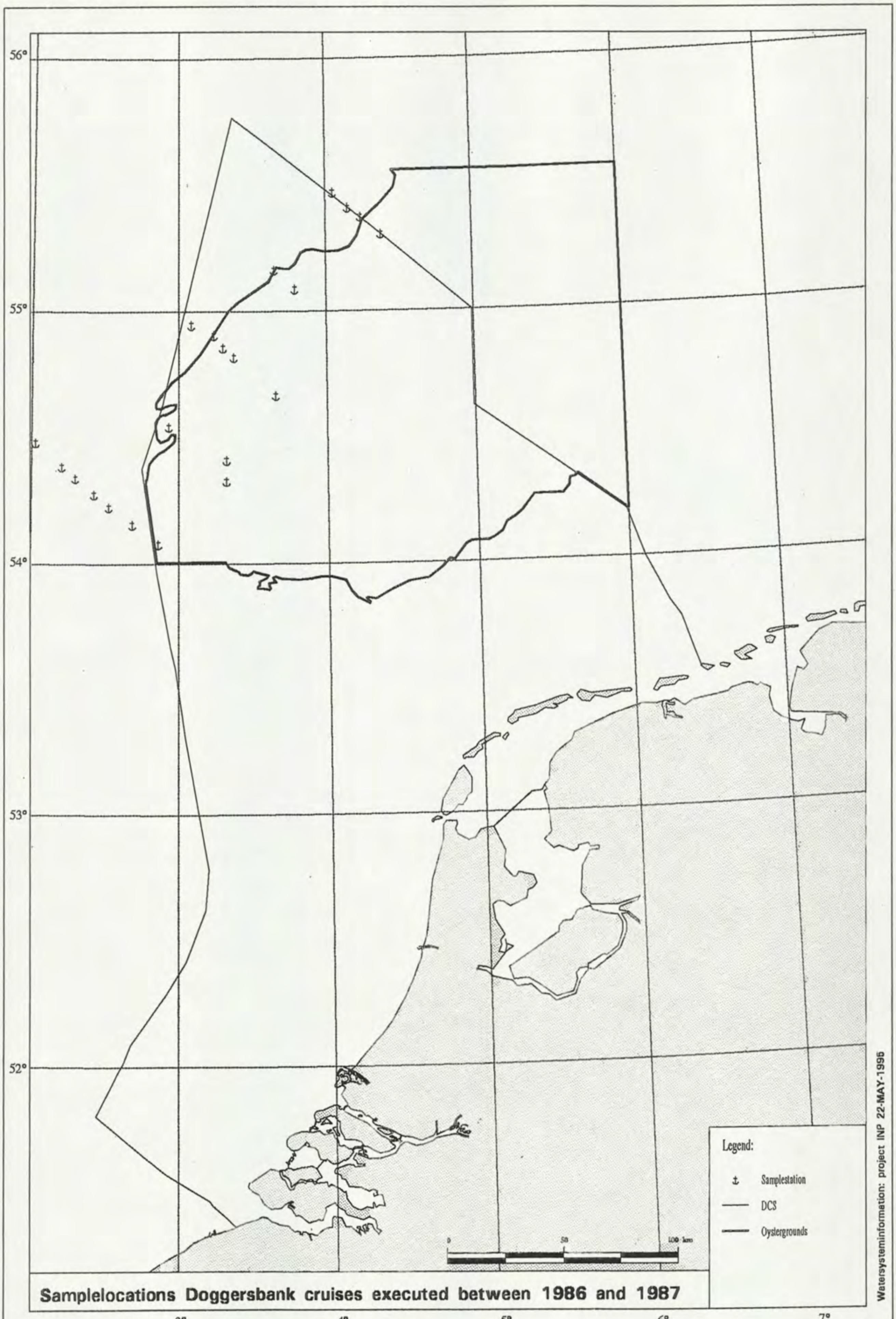
Samplelocations Voordelta cruise executed in 1985

Figure 1b



Samplelocations MMP Netherlands cruise executed in 1990

Figure 1c



Samplelocations Doggersbank cruises executed between 1986 and 1987

Figure 1d

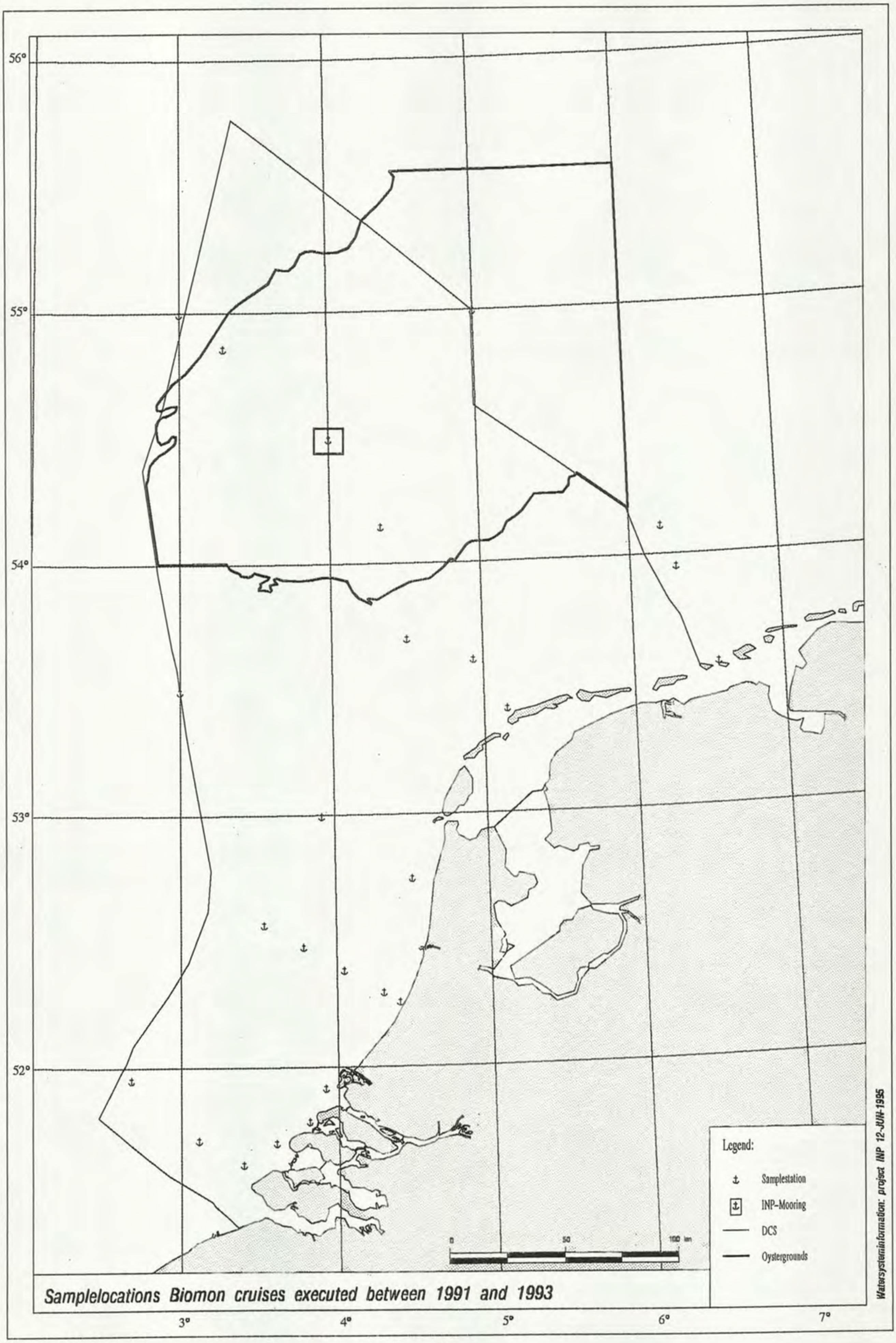
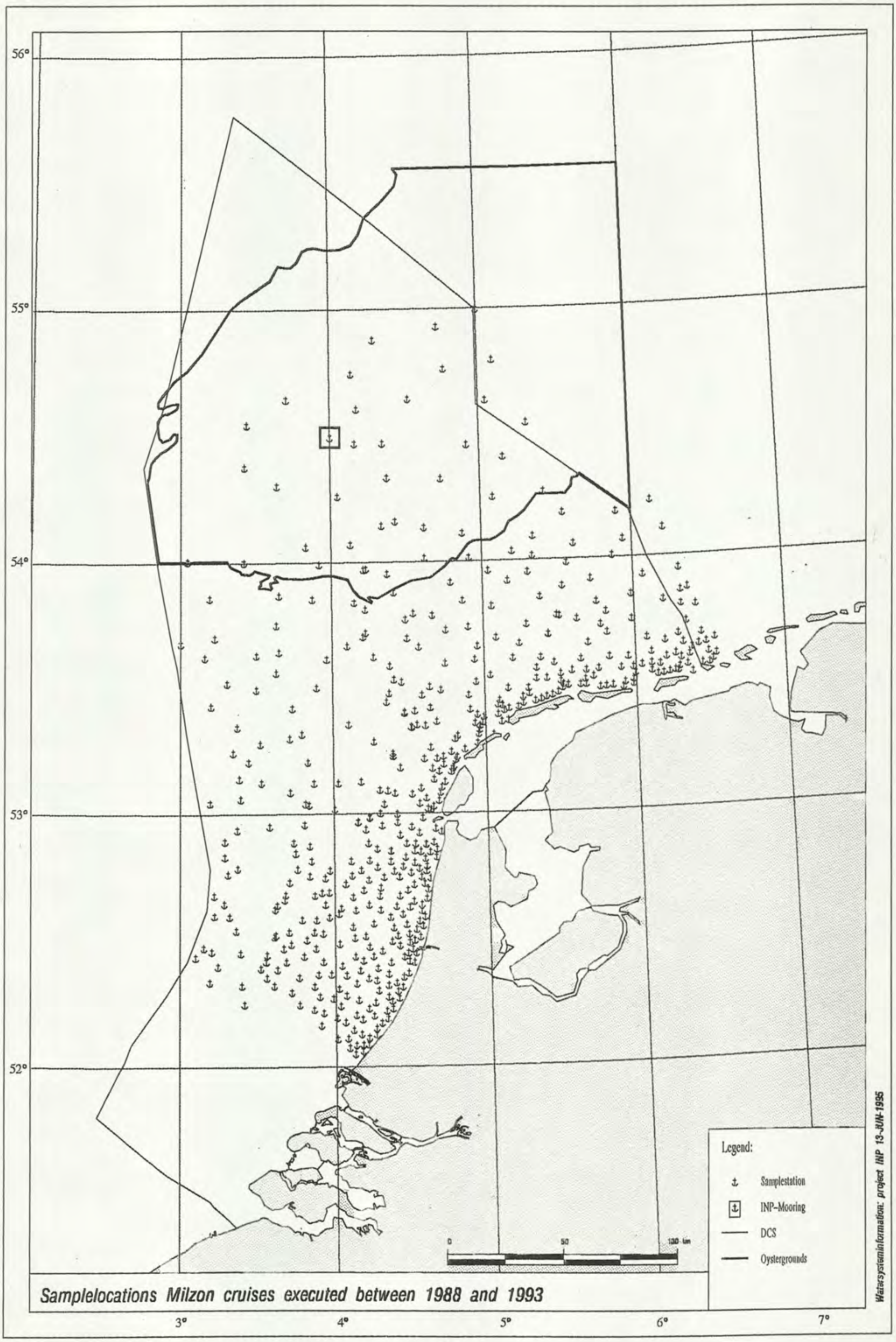

56°
55°
54°
53°
52°
3°
4°
5°
6°
7°
0
50
100 km
Legend:
Samplestation
INP-Mooring
DCS
Oystergrounds
Samplelocations Biomon cruises executed between 1991 and 1993
Watersysteminformation: project INP 12-JUN-1995

Figure 1e



Samplelocations Milzon cruises executed between 1988 and 1993

Figure 1f

Samplelocations ICES cruises executed in 1986

Figure 2

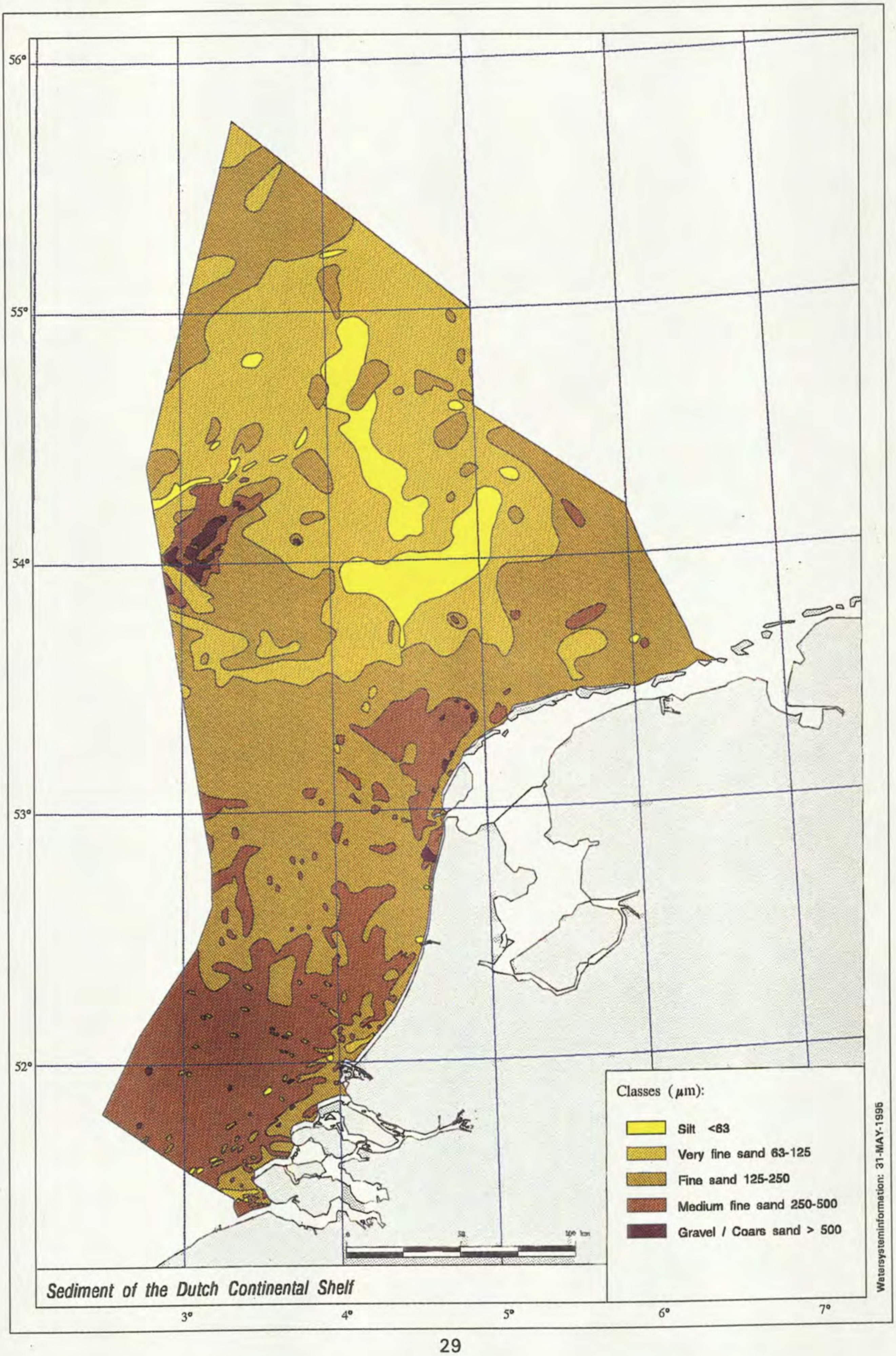
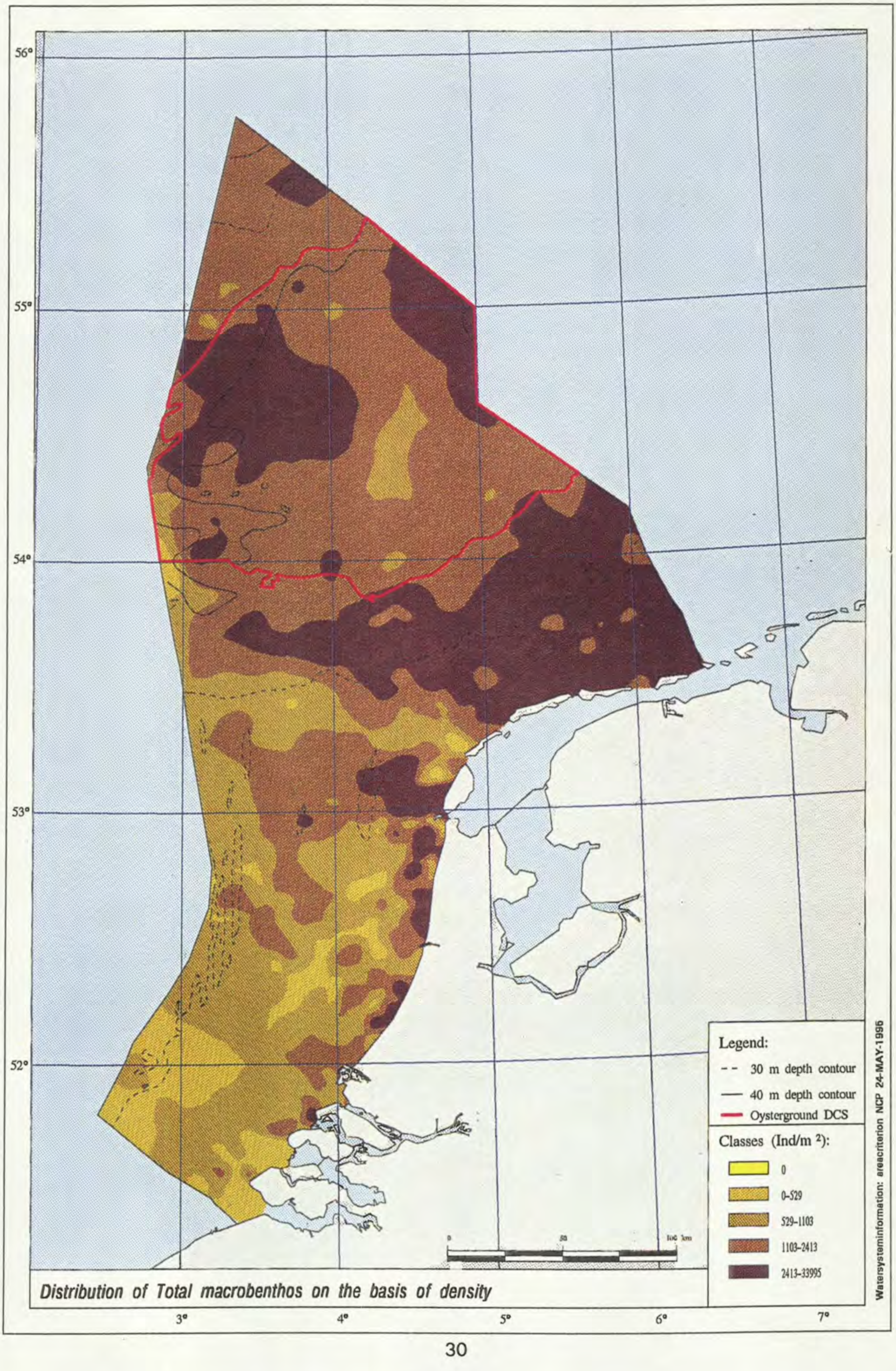
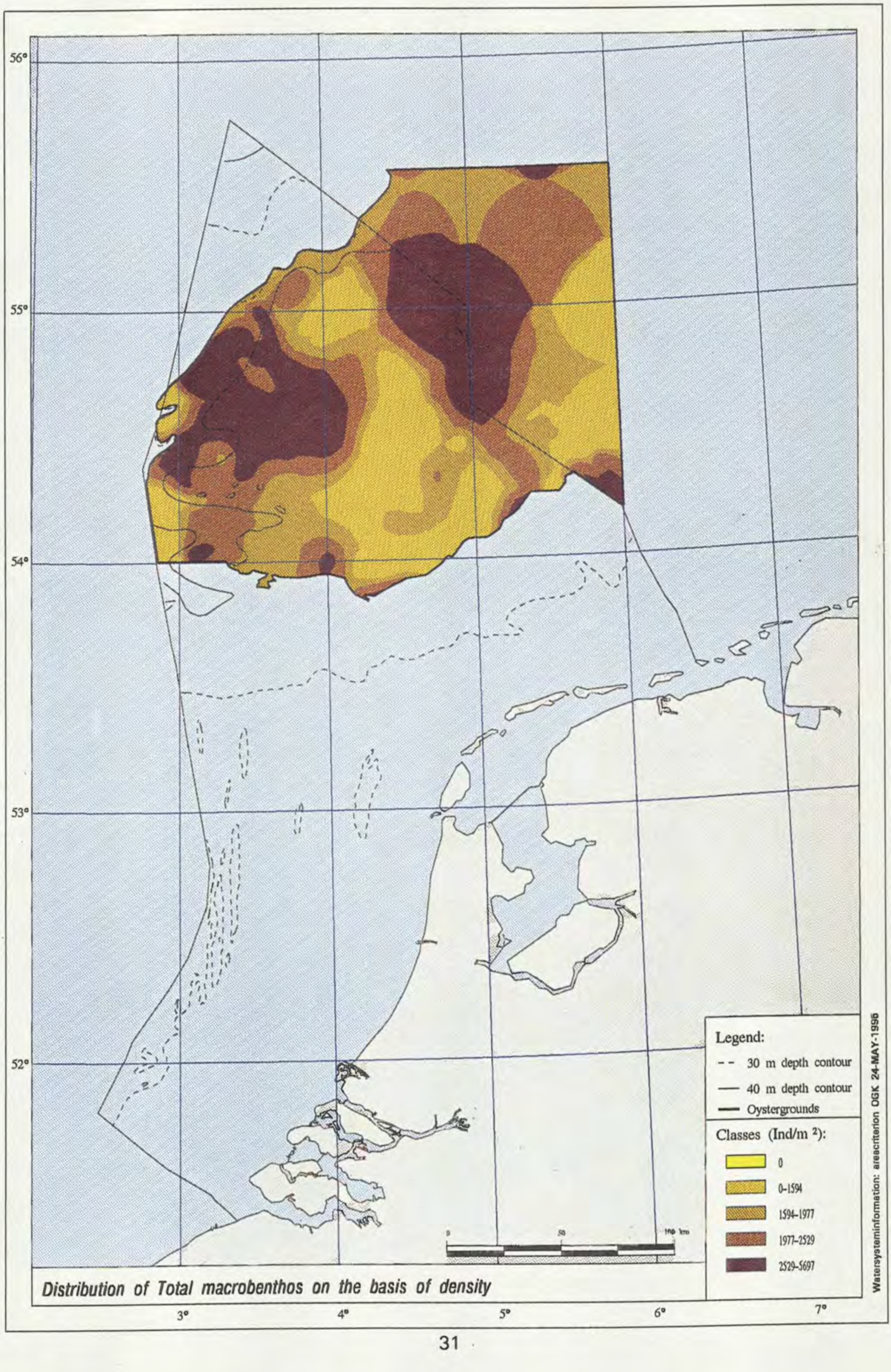

56°
55°
54°
53°
52°
3°
4°
5°
6°
7°
Classes (μm):
Silt <63
Very fine sand 63-125
Fine sand 125-250
Medium fine sand 250-500
Gravel / Coars sand > 500
Sediment of the Dutch Continental Shelf
Watersysteminformation: 31-MAY-1995

Figure 3



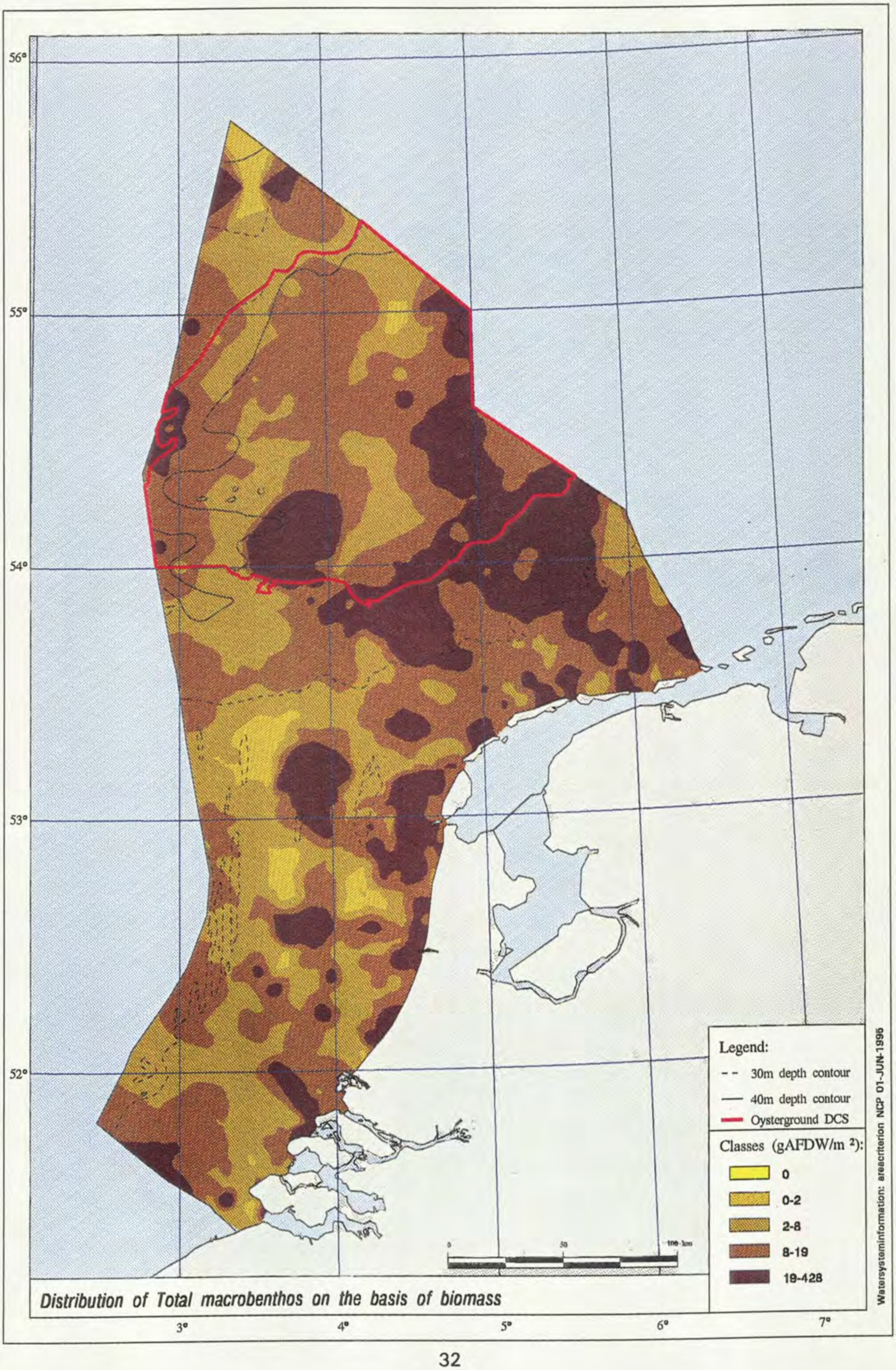
Distribution of Total macrobenthos on the basis of density

Figure 4



Distribution of Total macrobenthos on the basis of density

Figure 5



56°
55°
54°
53°
52°
3°
4°
5°
6°
7°
Legend:
30m depth contour
40m depth contour
Oysterground DCS
Classes (gAFDW/m ²):
0
0-2
2-8
8-19
19-428
Distribution of Total macrobenthos on the basis of biomass
Watersysteminformation: areacriterion NCP 01-JUN-1995

Figure 6

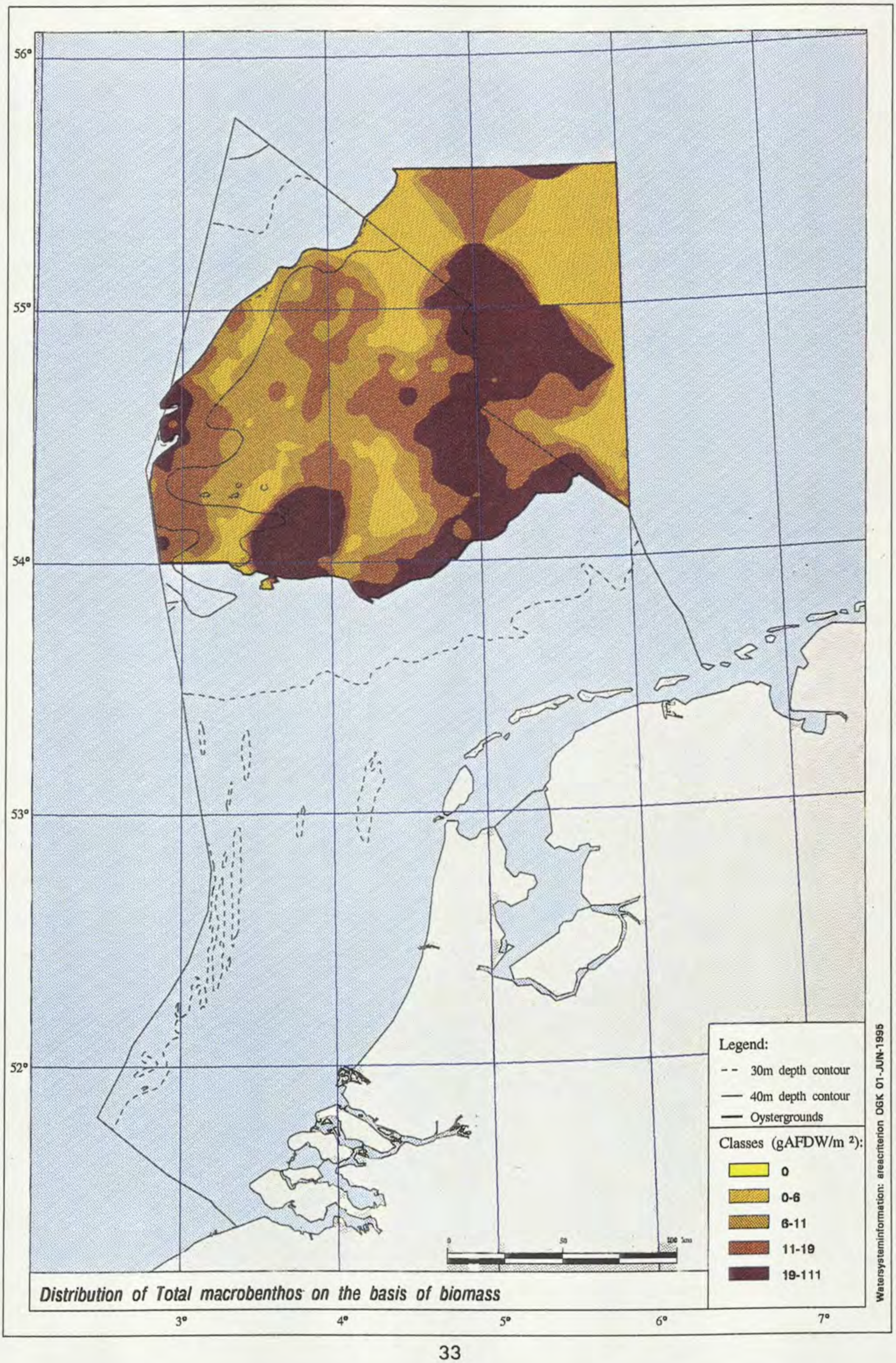
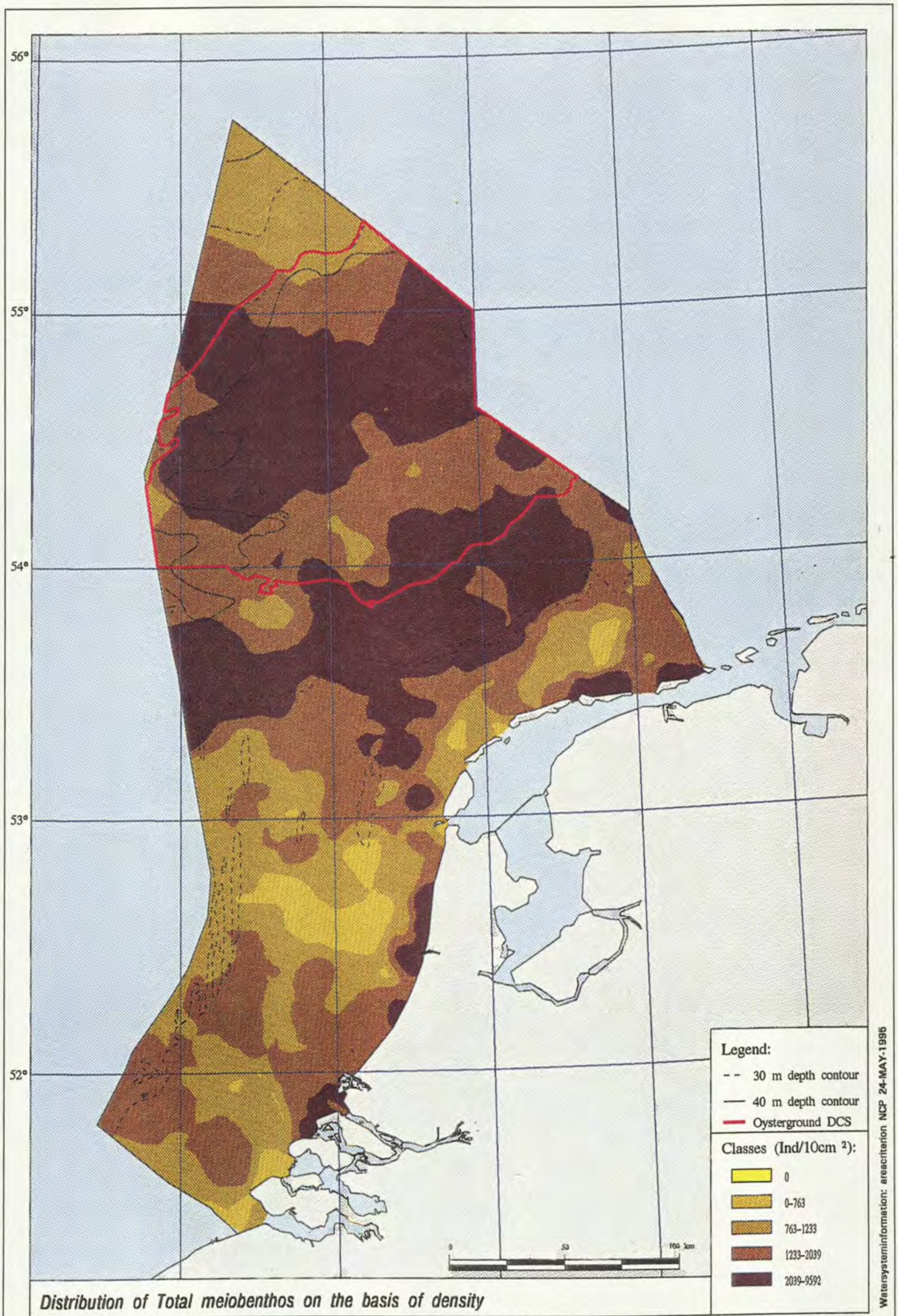
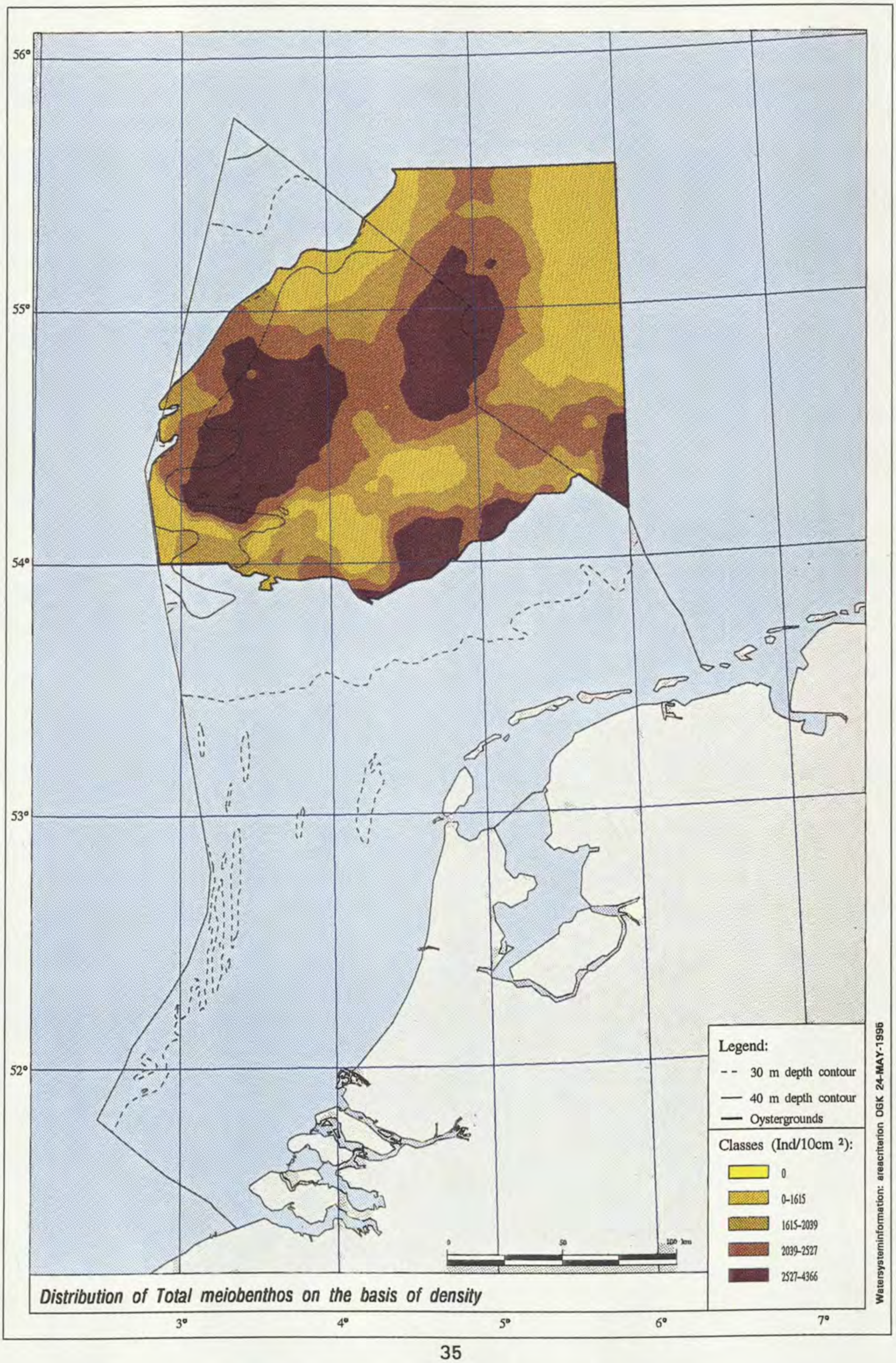

56°
55°
54°
53°
52°
3°
4°
5°
6°
7°
Legend:
30m depth contour
40m depth contour
Oystergrounds
Classes (gAFDW/m ²):
0
0-6
6-11
11-19
19-111
Distribution of Total macrobenthos on the basis of biomass
Watersysteminformation: areacriterion DGK 01-JUN-1995

Figure 7



Distribution of Total meiobenthos on the basis of density

Figure 8



Distribution of Total meiobenthos on the basis of density

Figure 9

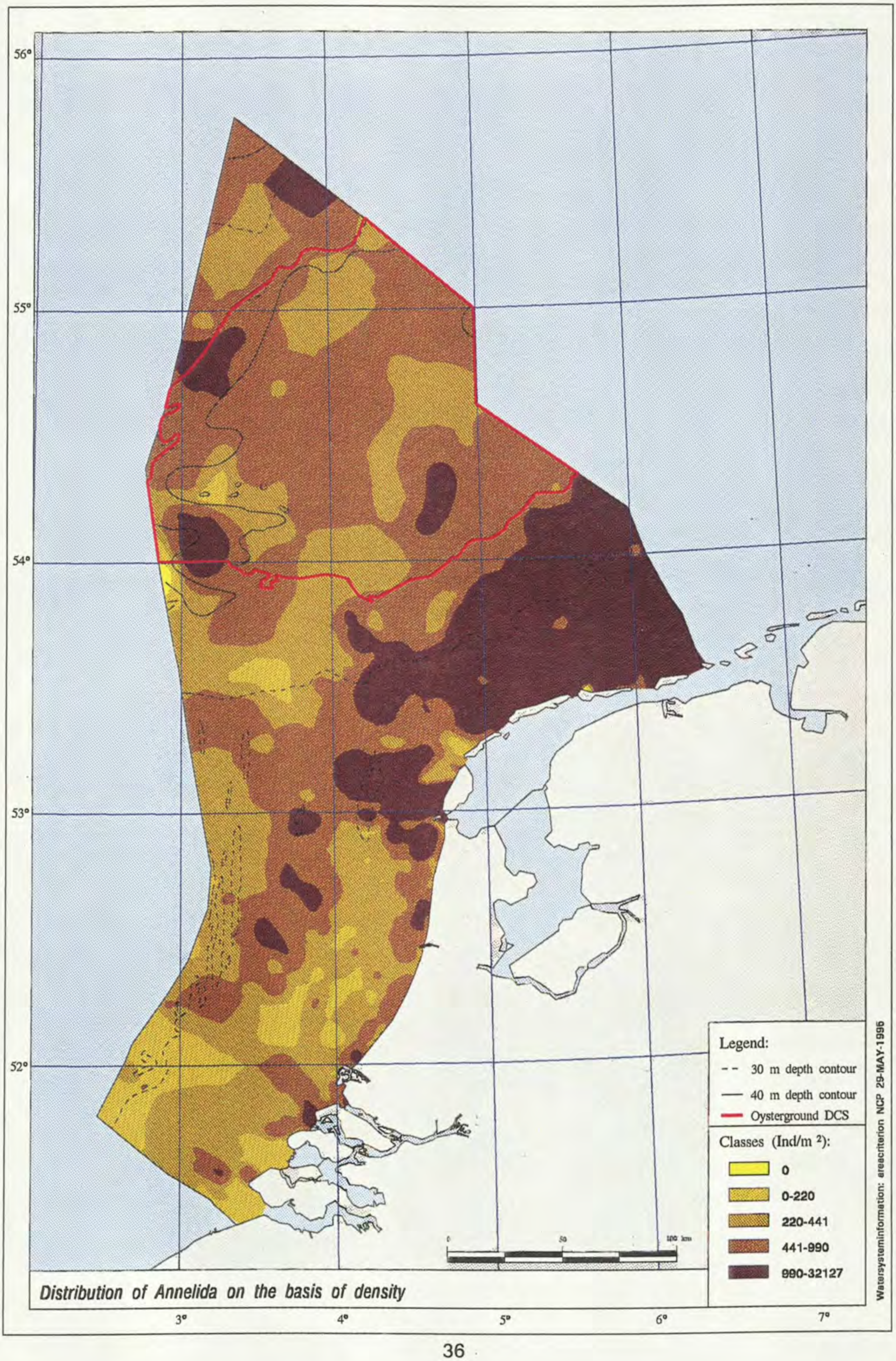
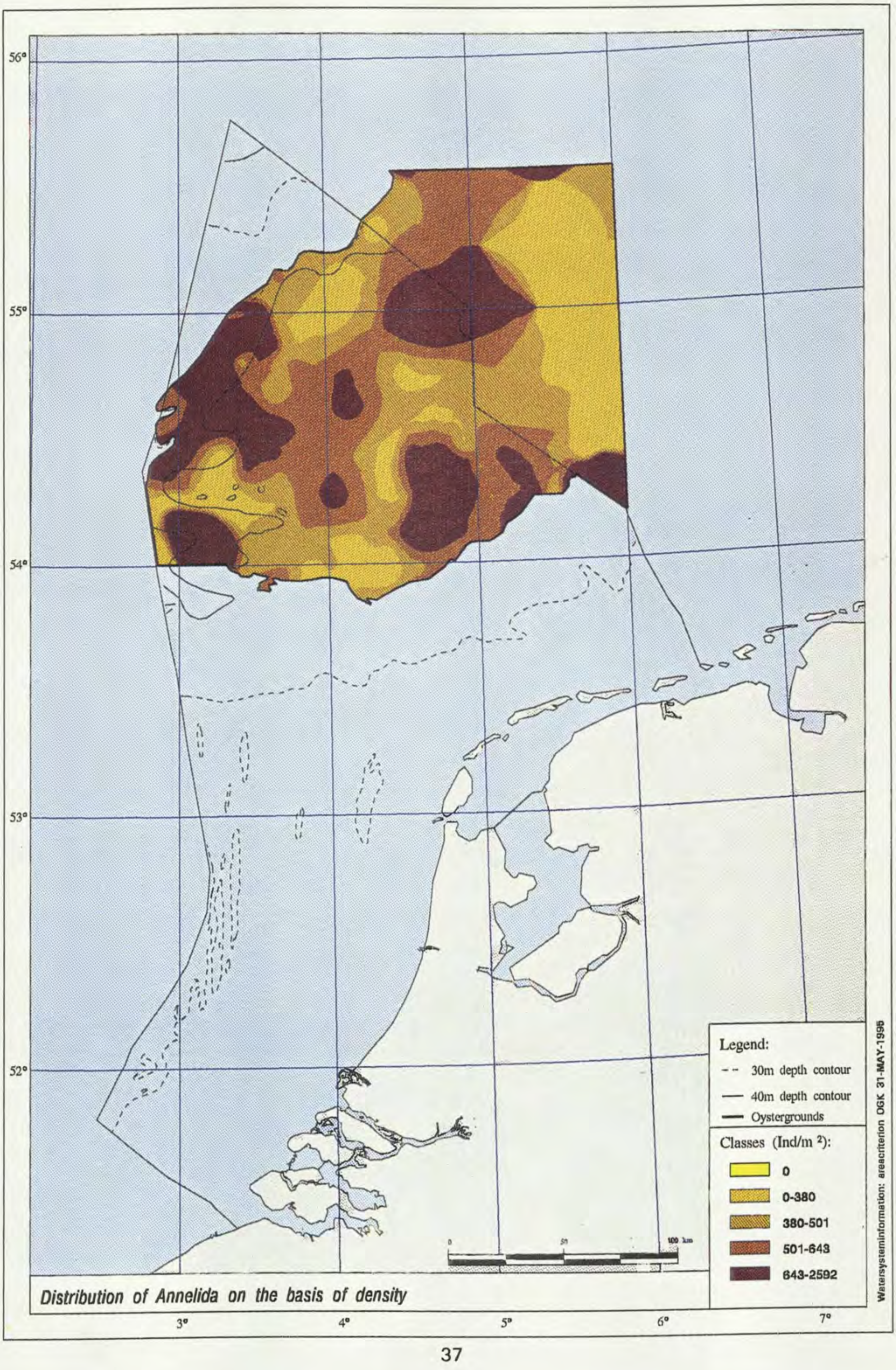
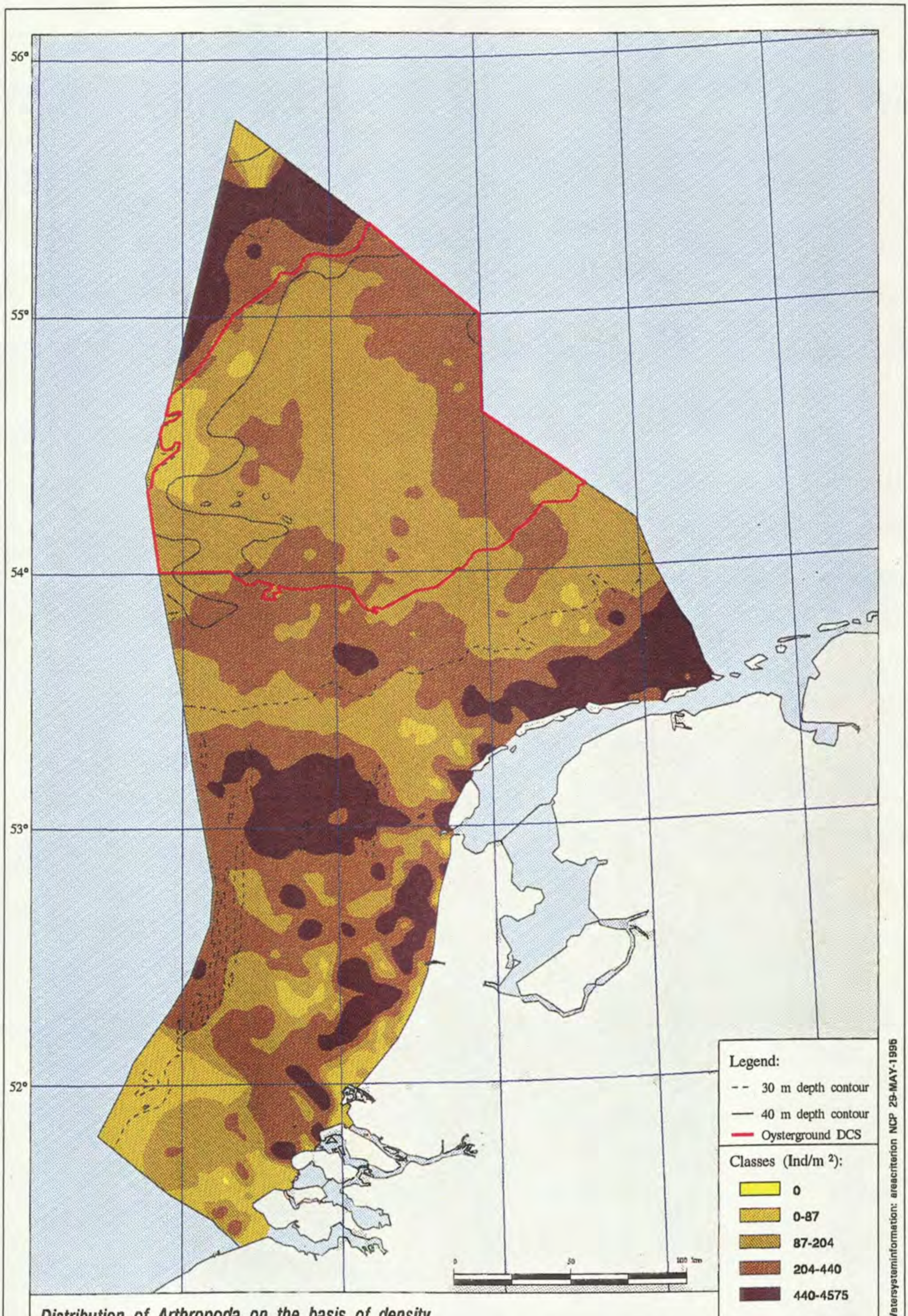

56°
55°
54°
53°
52°
3°
4°
5°
6°
7°
Legend:
30 m depth contour
40 m depth contour
Oysterground DCS
Classes (Ind/m ²):
0
0-220
220-441
441-990
990-32127
0
50
100 km
Distribution of Annelida on the basis of density
Watersysteminformation: areacriterion NCP 29-MAY-1995

Figure 10



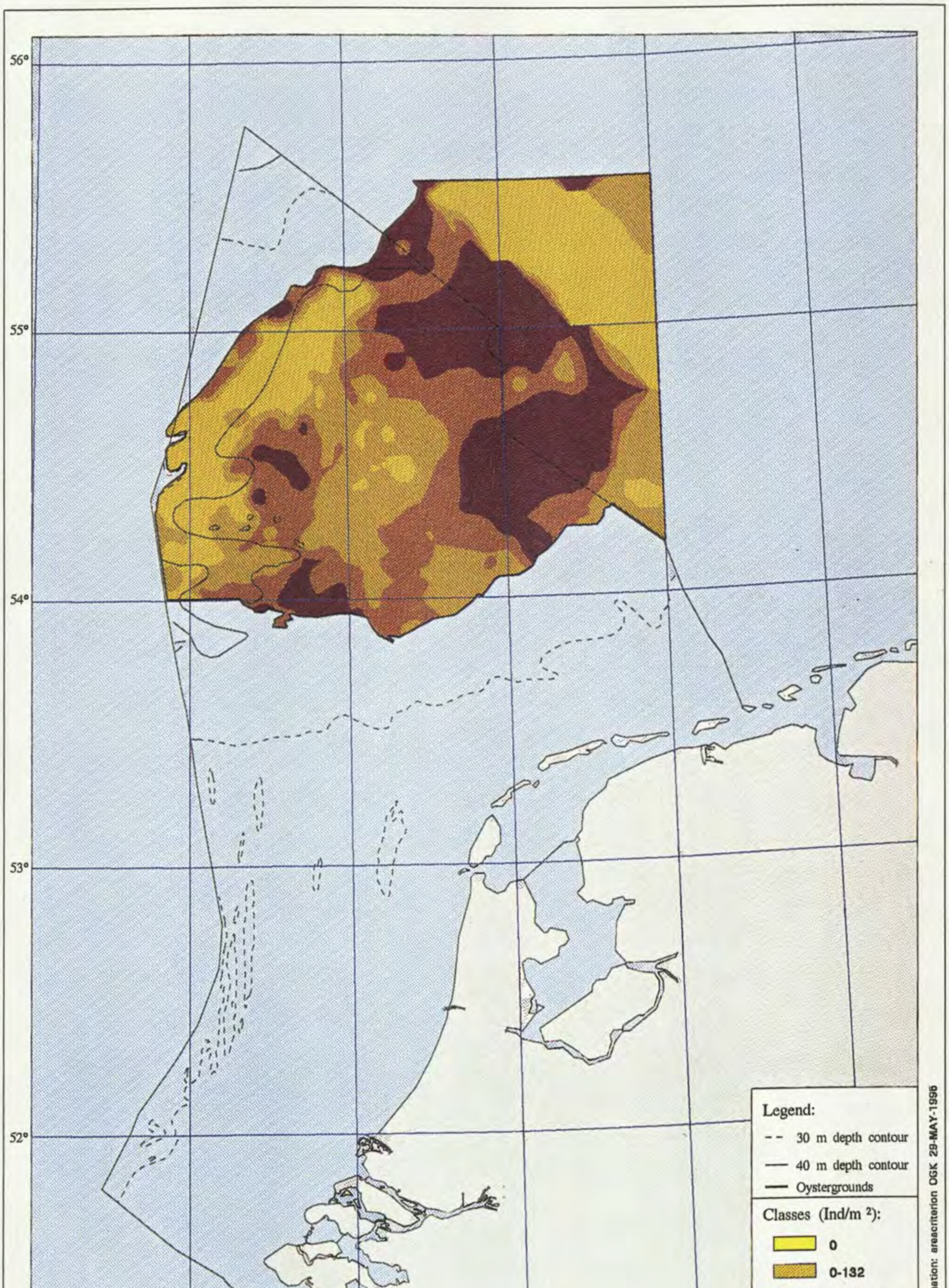
Distribution of Annelida on the basis of density

Figure 11



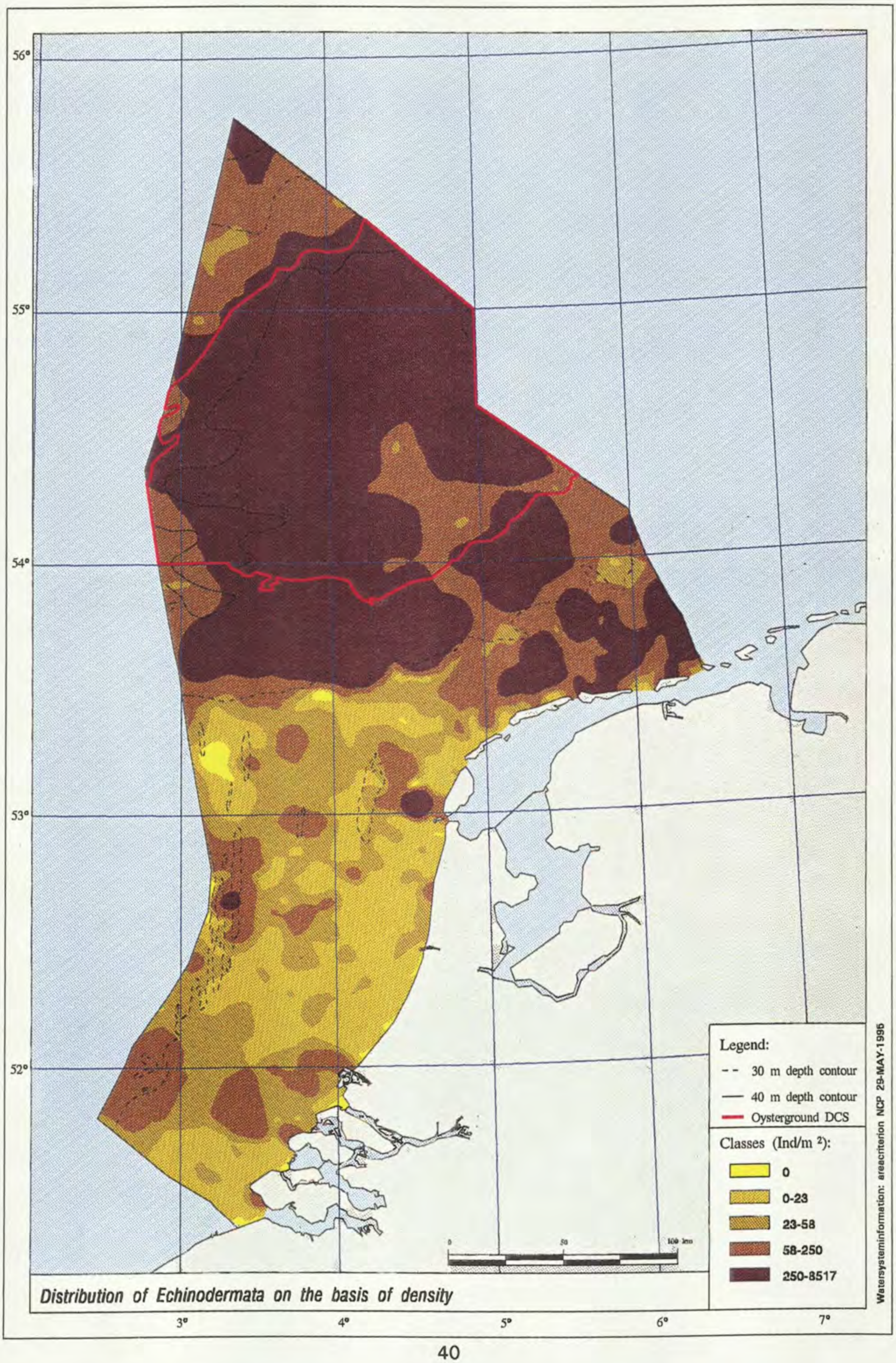
Distribution of Arthropoda on the basis of density

Figure 12



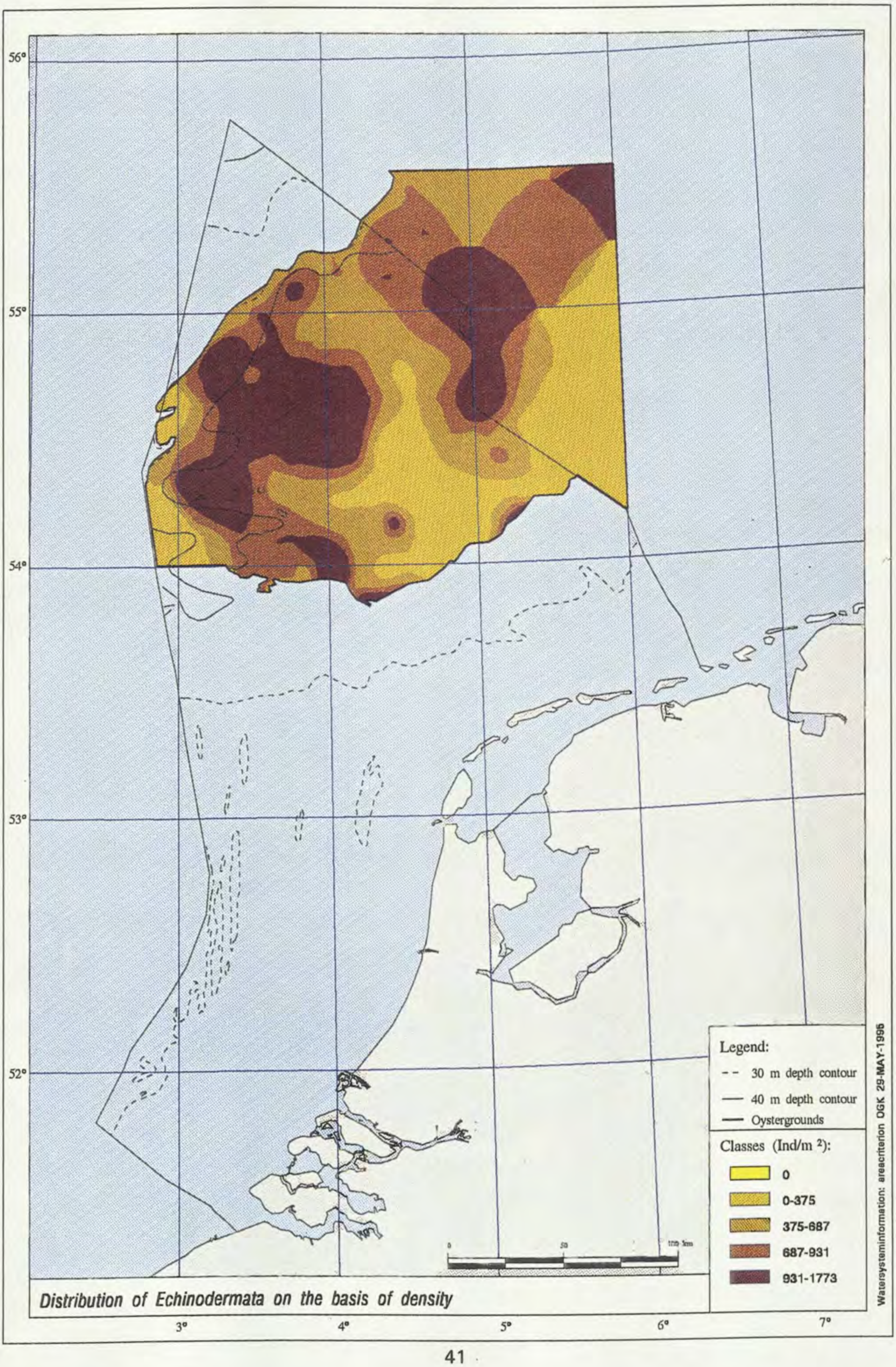
Distribution of Arthropoda on the basis of density

Figure 13



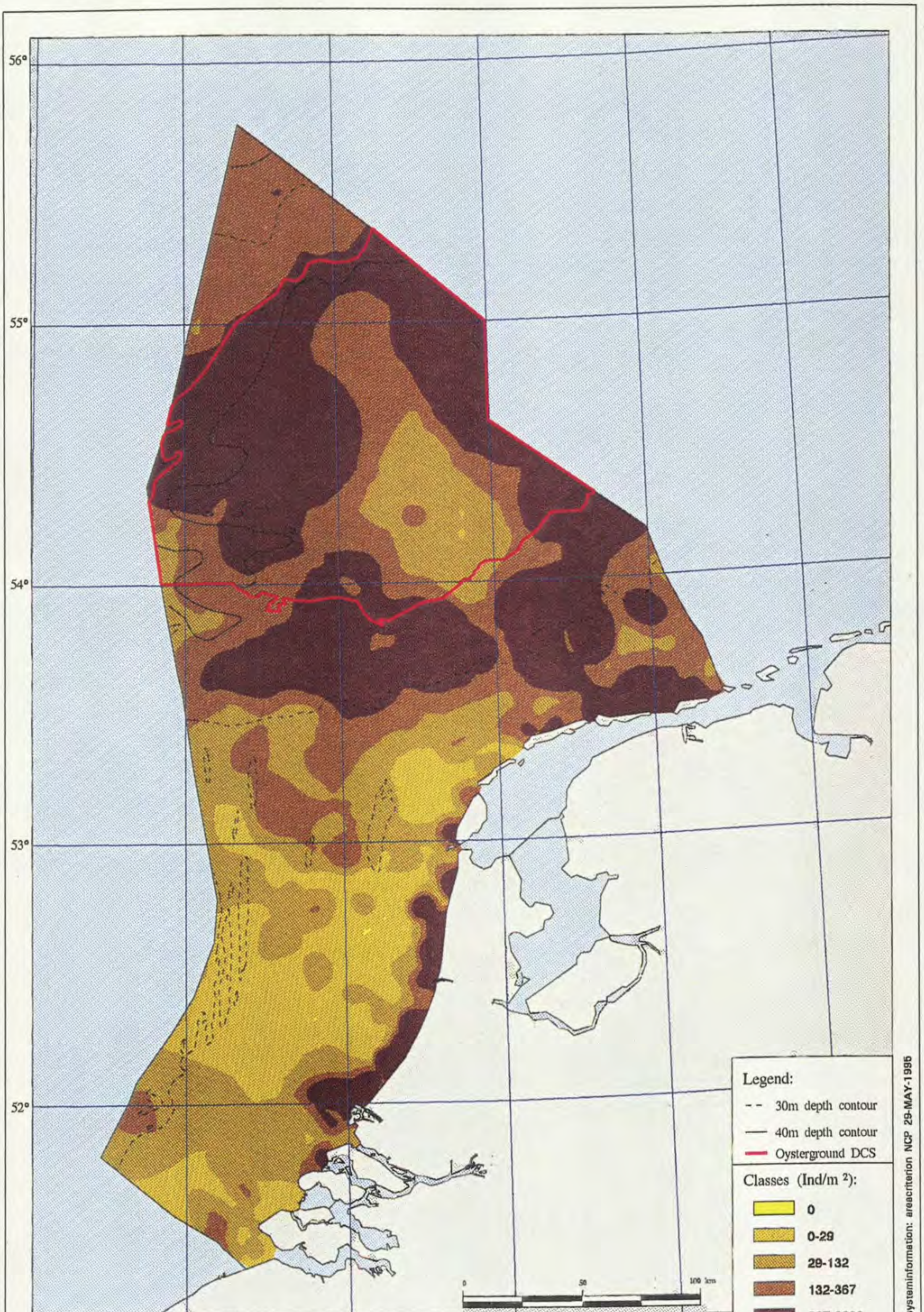
Distribution of Echinodermata on the basis of density

Figure 14



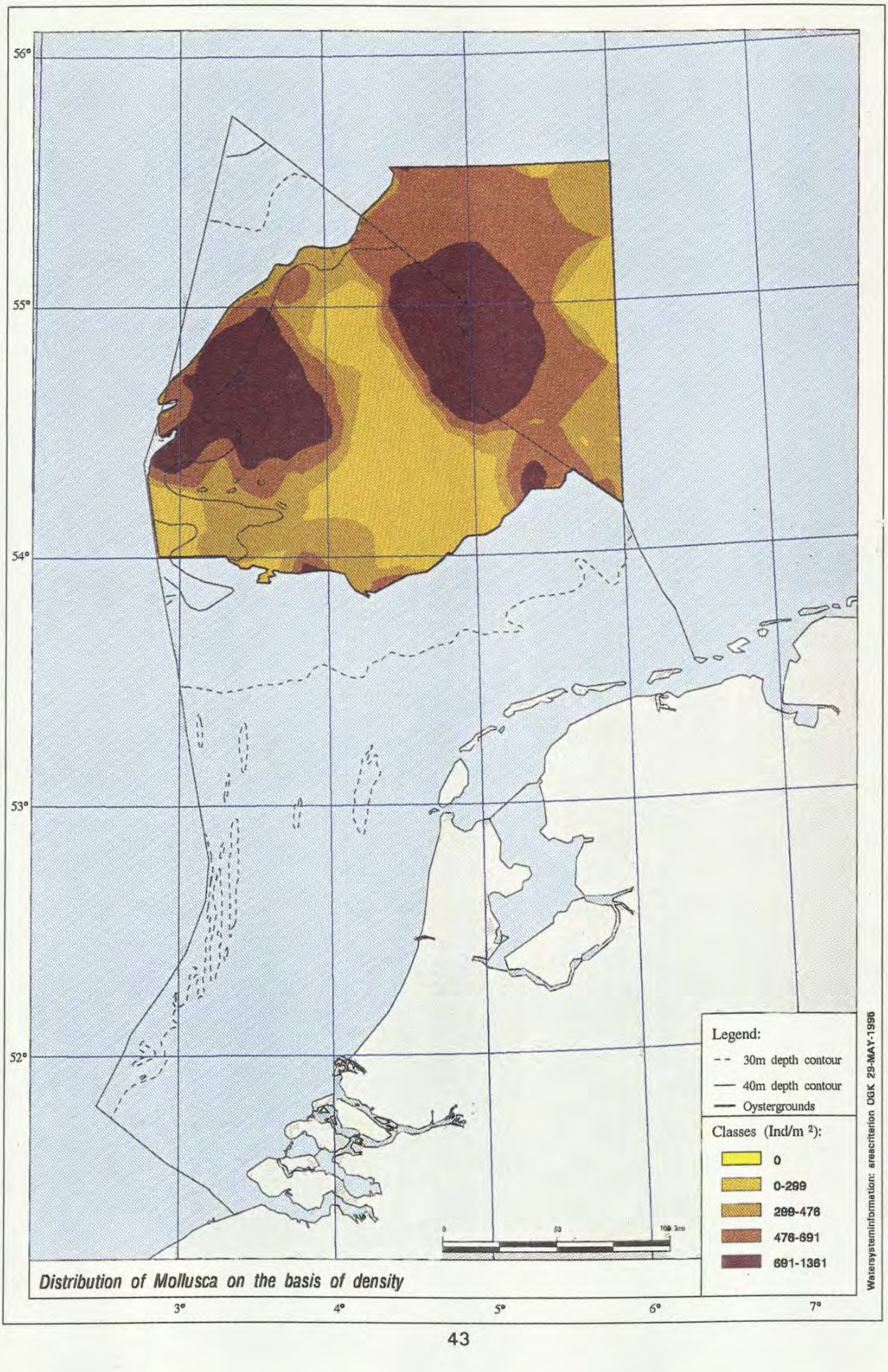
Distribution of Echinodermata on the basis of density

Figure 15



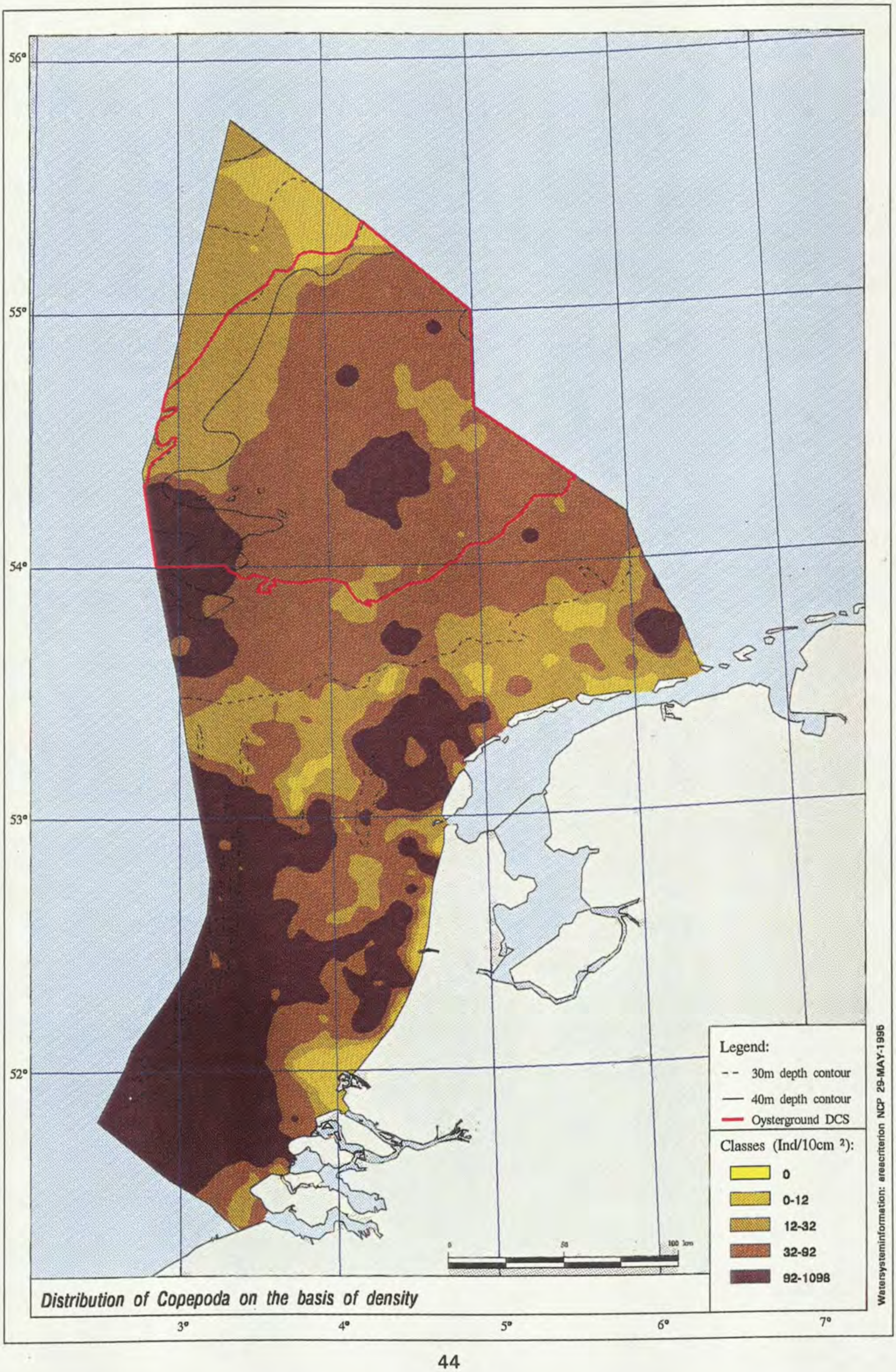
Distribution of Mollusca on the basis of density

Figure 16



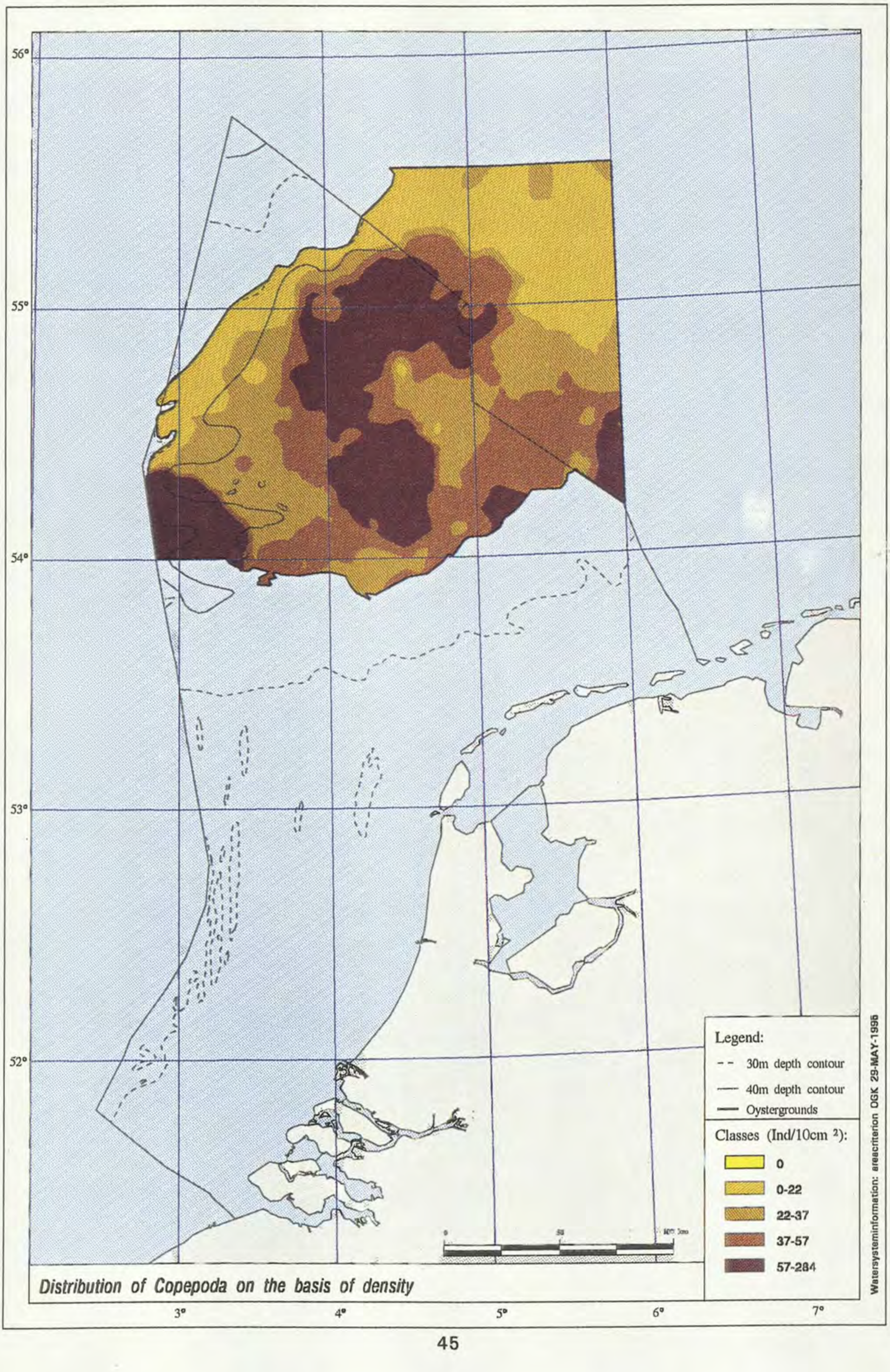
Distribution of Mollusca on the basis of density

Figure 17



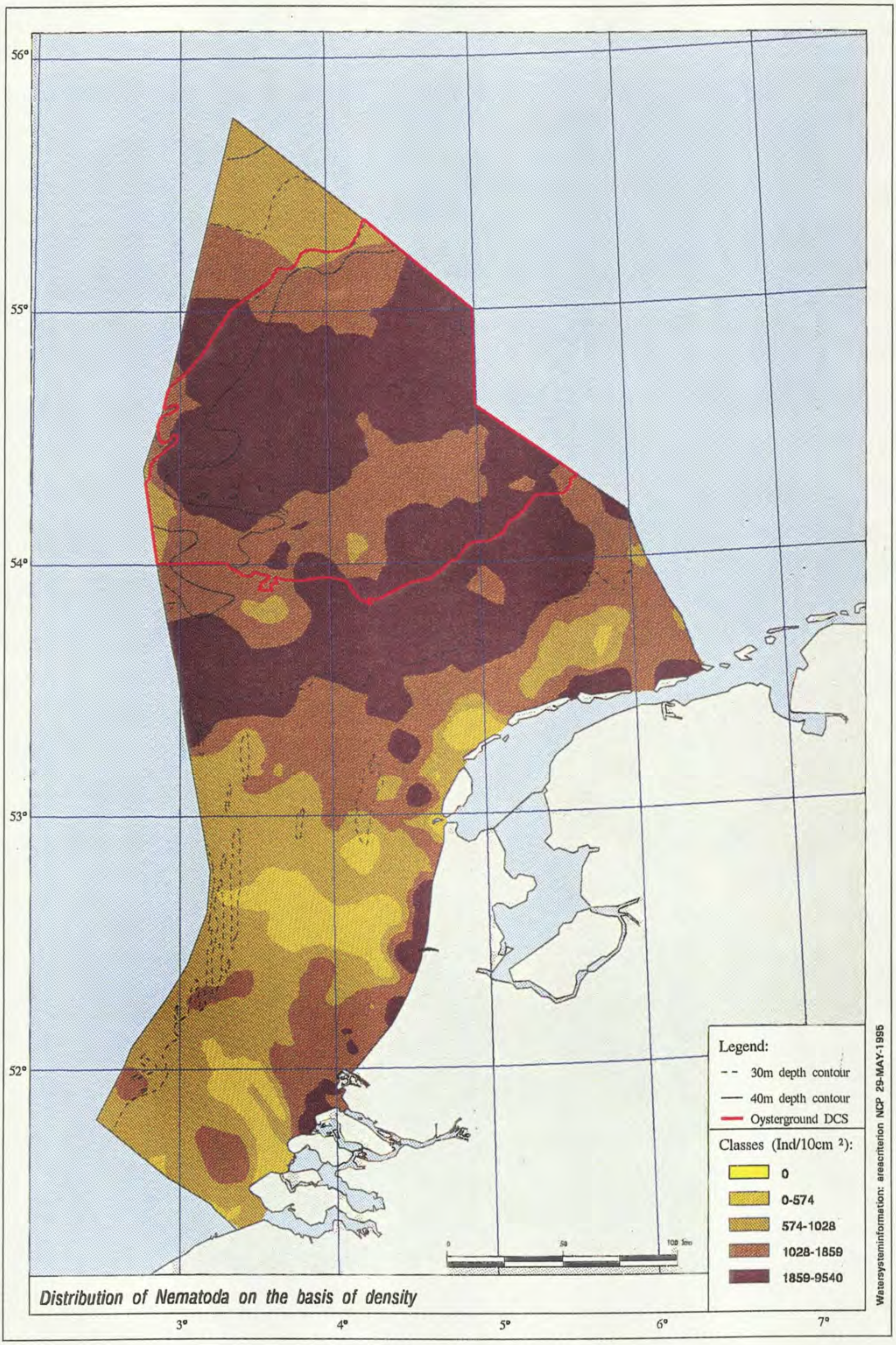
Distribution of Copepoda on the basis of density

Figure 18



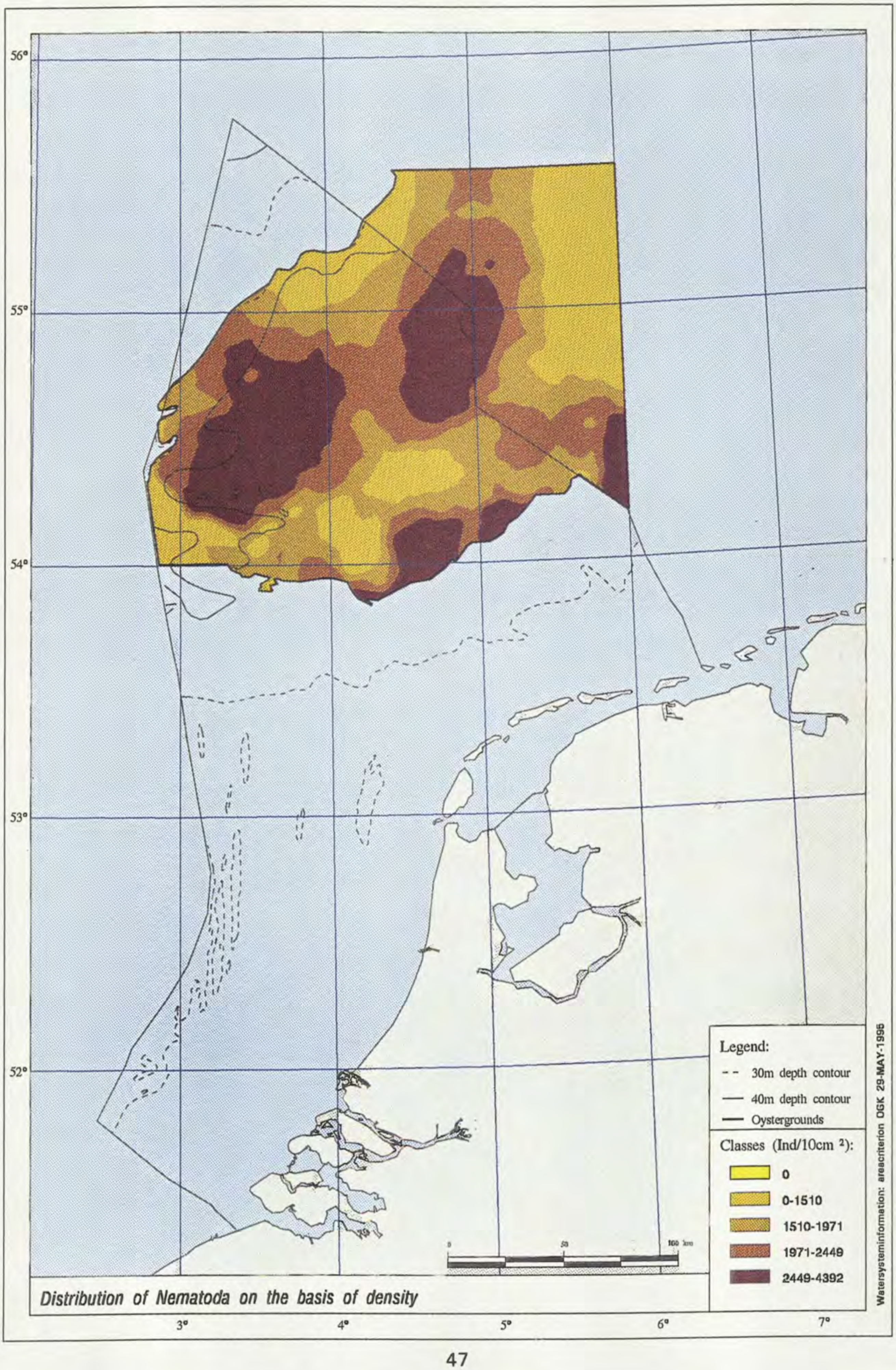
Distribution of Copepoda on the basis of density

Figure 19



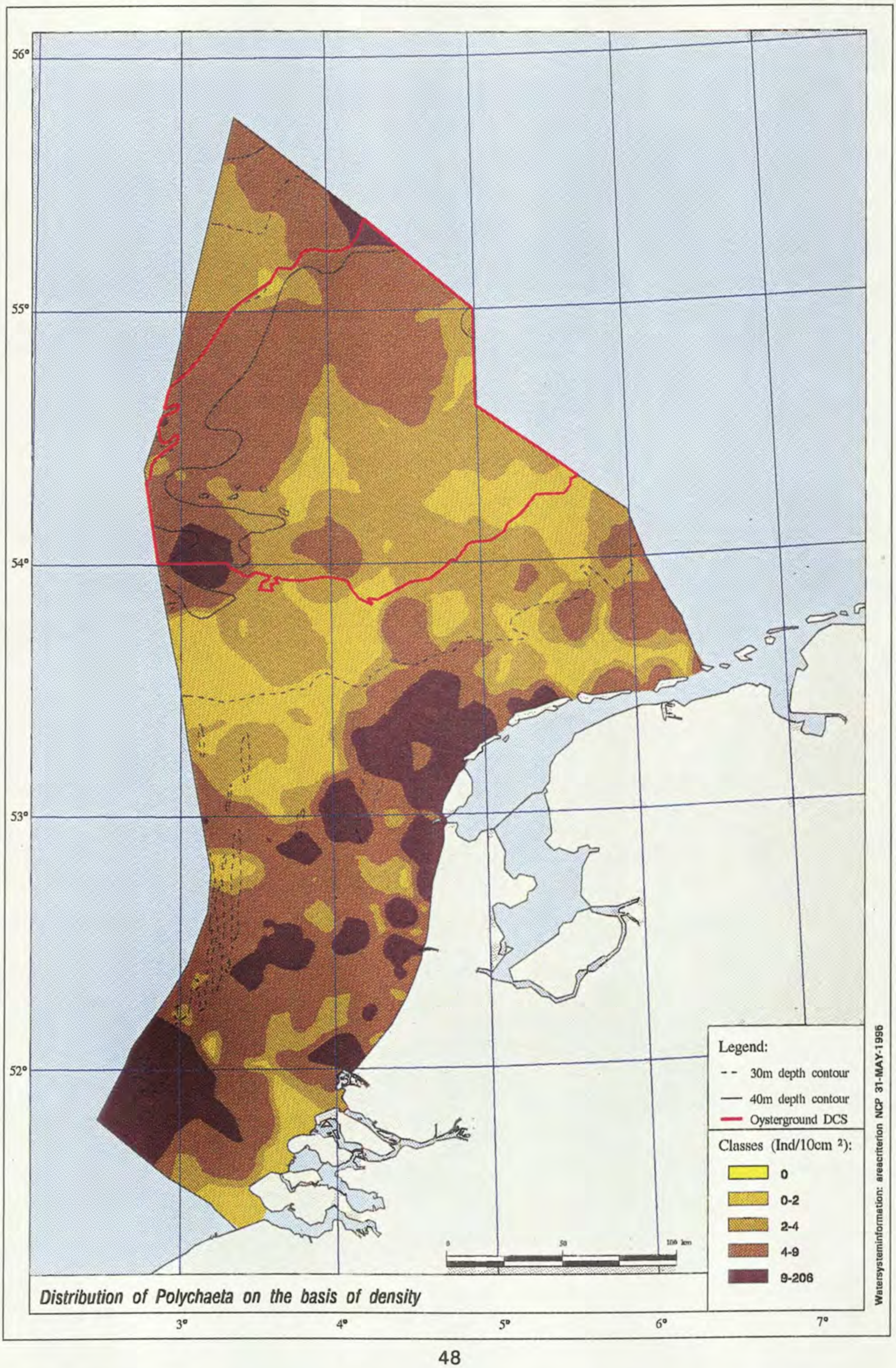
Distribution of Nematoda on the basis of density

Figure 20



Distribution of Nematoda on the basis of density

Figure 21



Distribution of Polychaeta on the basis of density

Figure 22

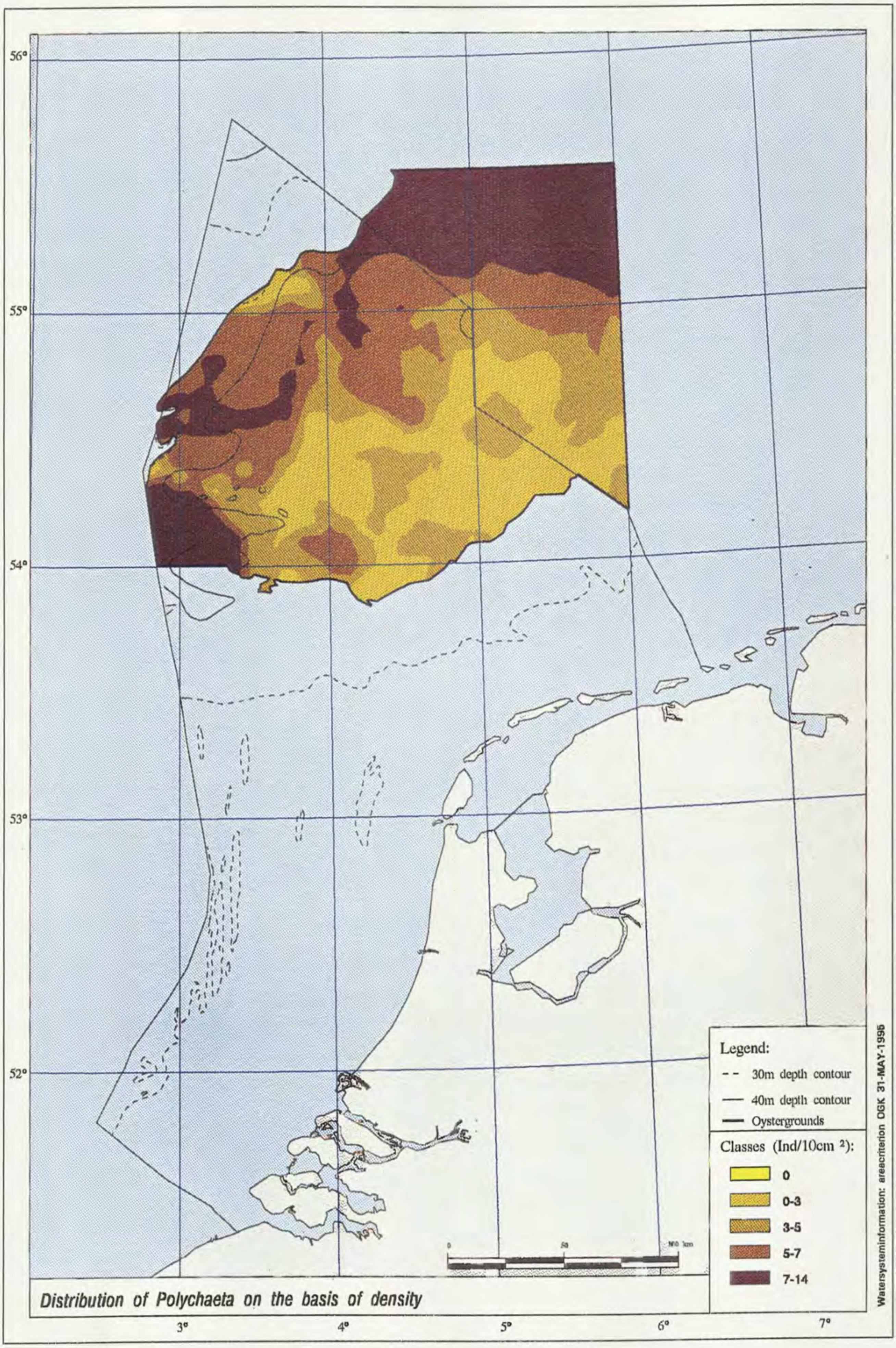
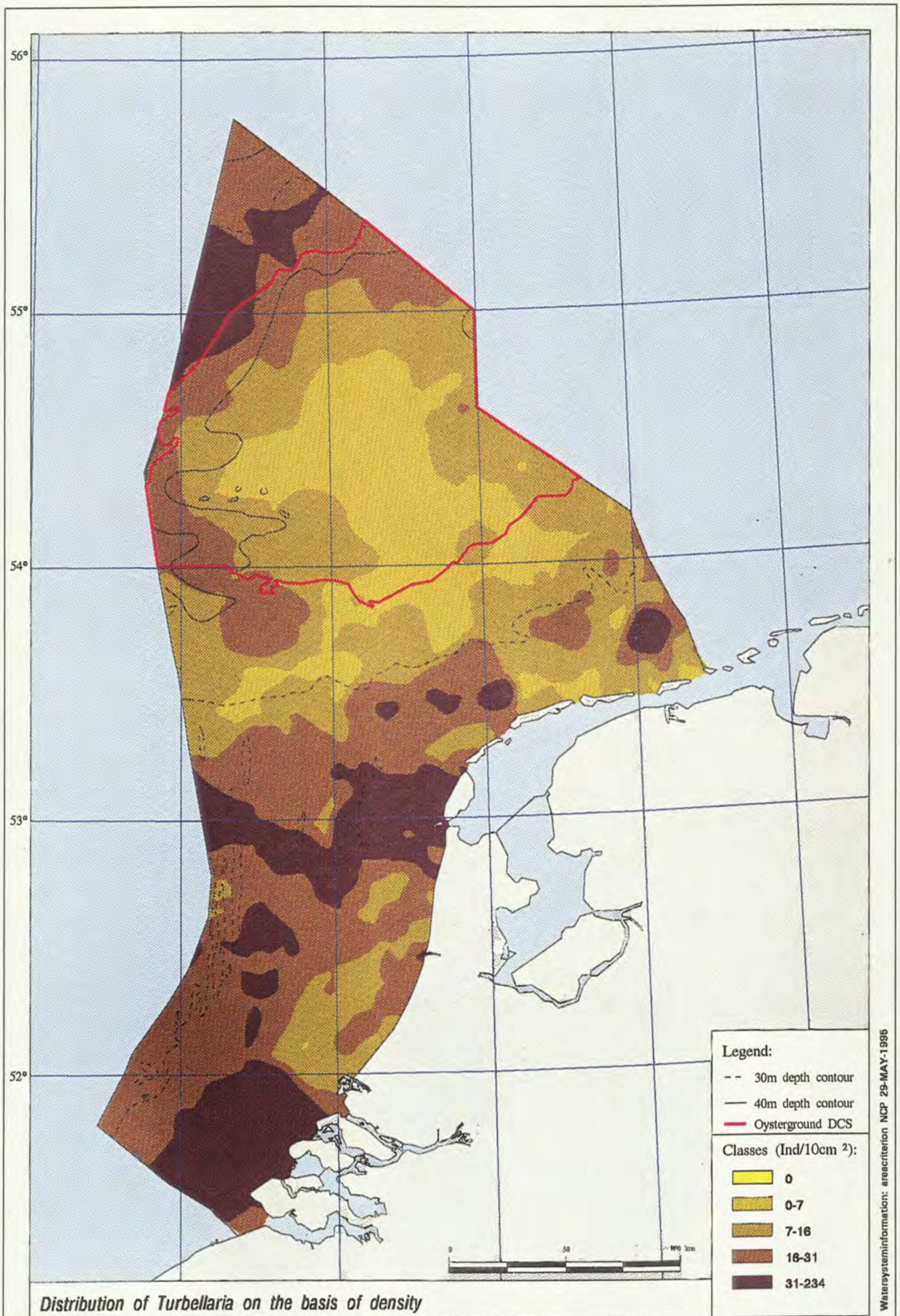
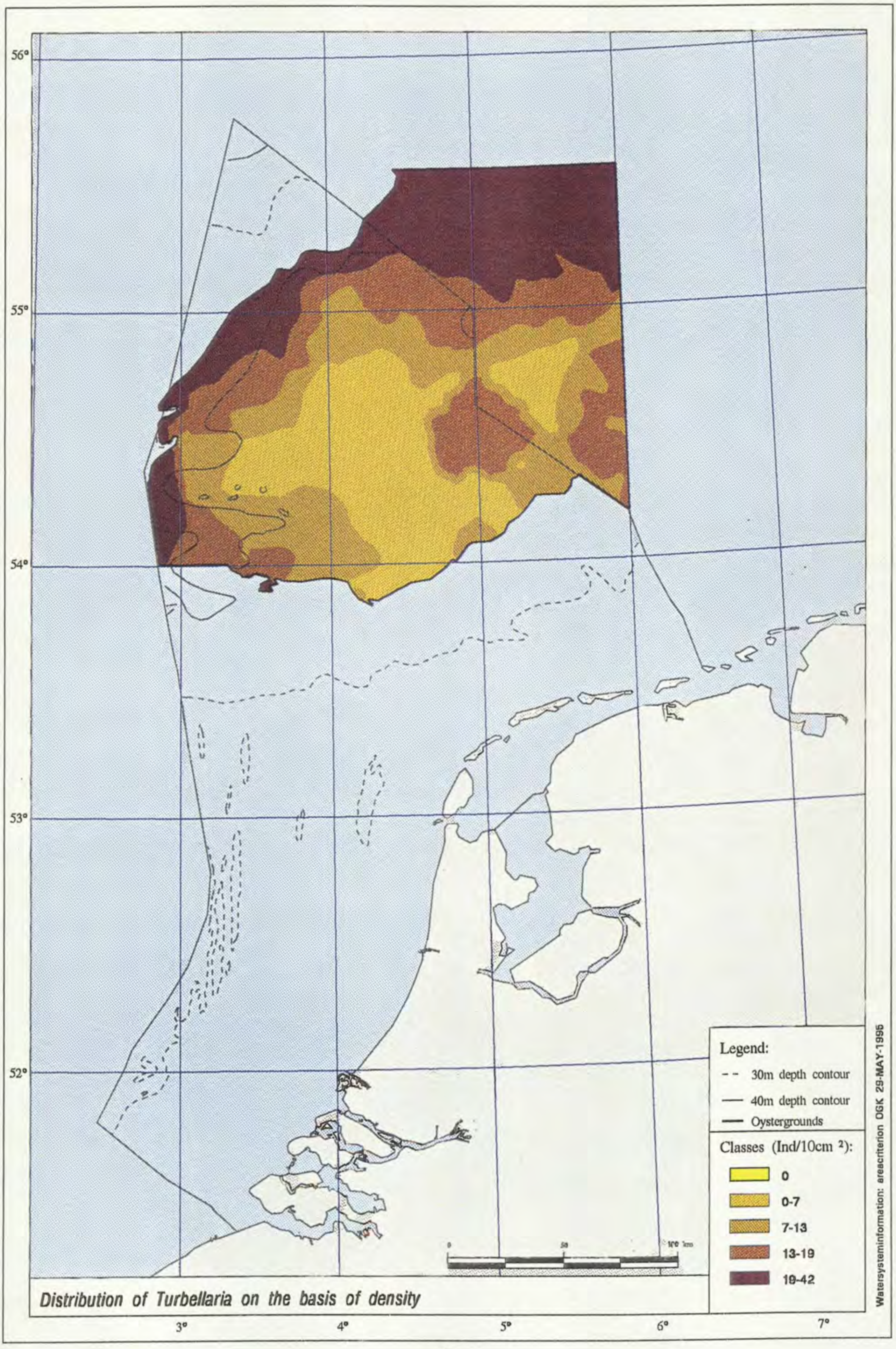

56°
55°
54°
53°
52°
3°
4°
5°
6°
7°
Legend:
30m depth contour
40m depth contour
Oysterground
Classes (Ind/10cm ²):
0
0-3
3-5
5-7
7-14
0
50
100 km
Distribution of Polychaeta on the basis of density
Watersysteminformation: areacriterion OGK 31-MAY-1995

Figure 23



Distribution of Turbellaria on the basis of density

Figure 24



Distribution of Turbellaria on the basis of density

Figure 25

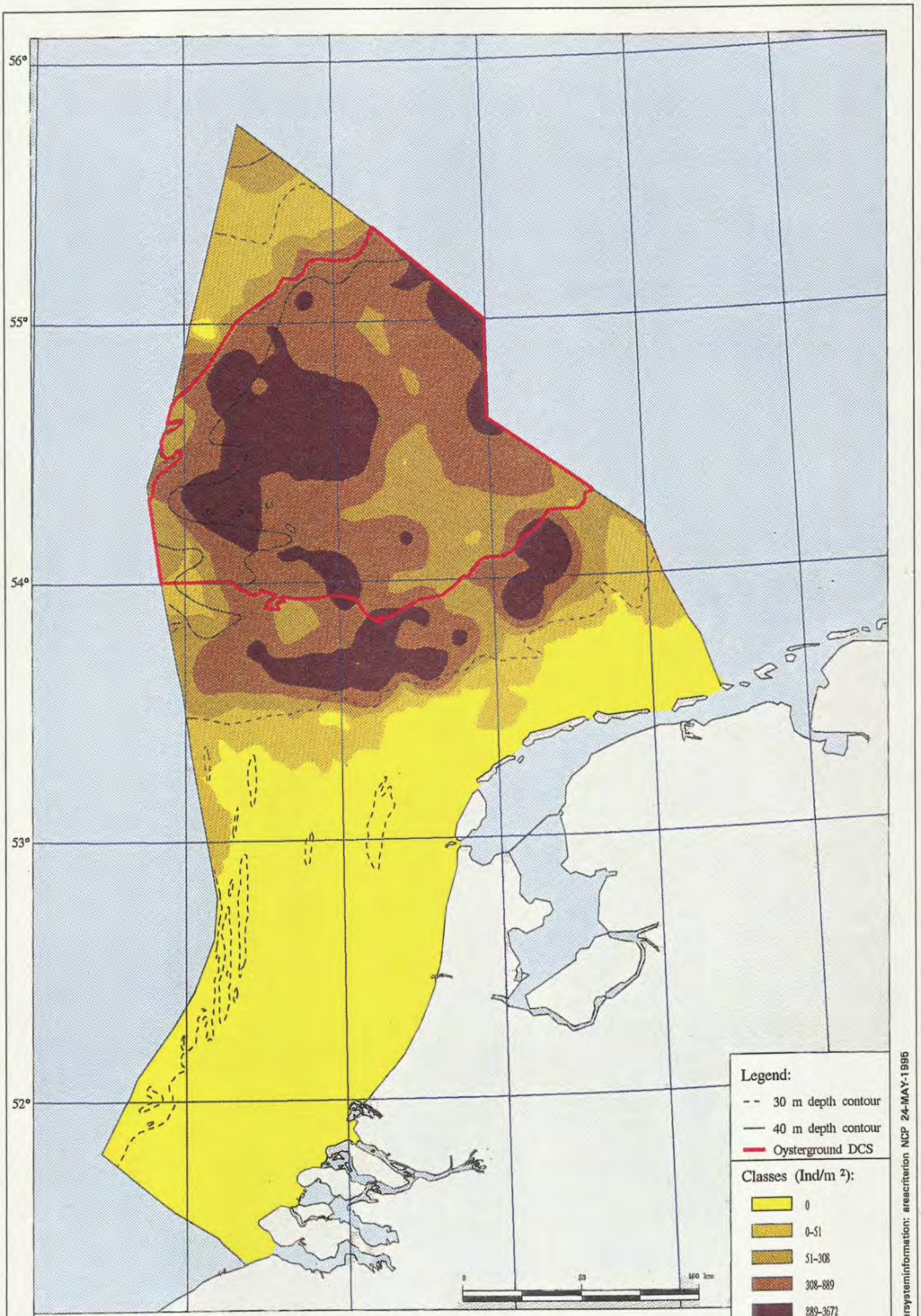
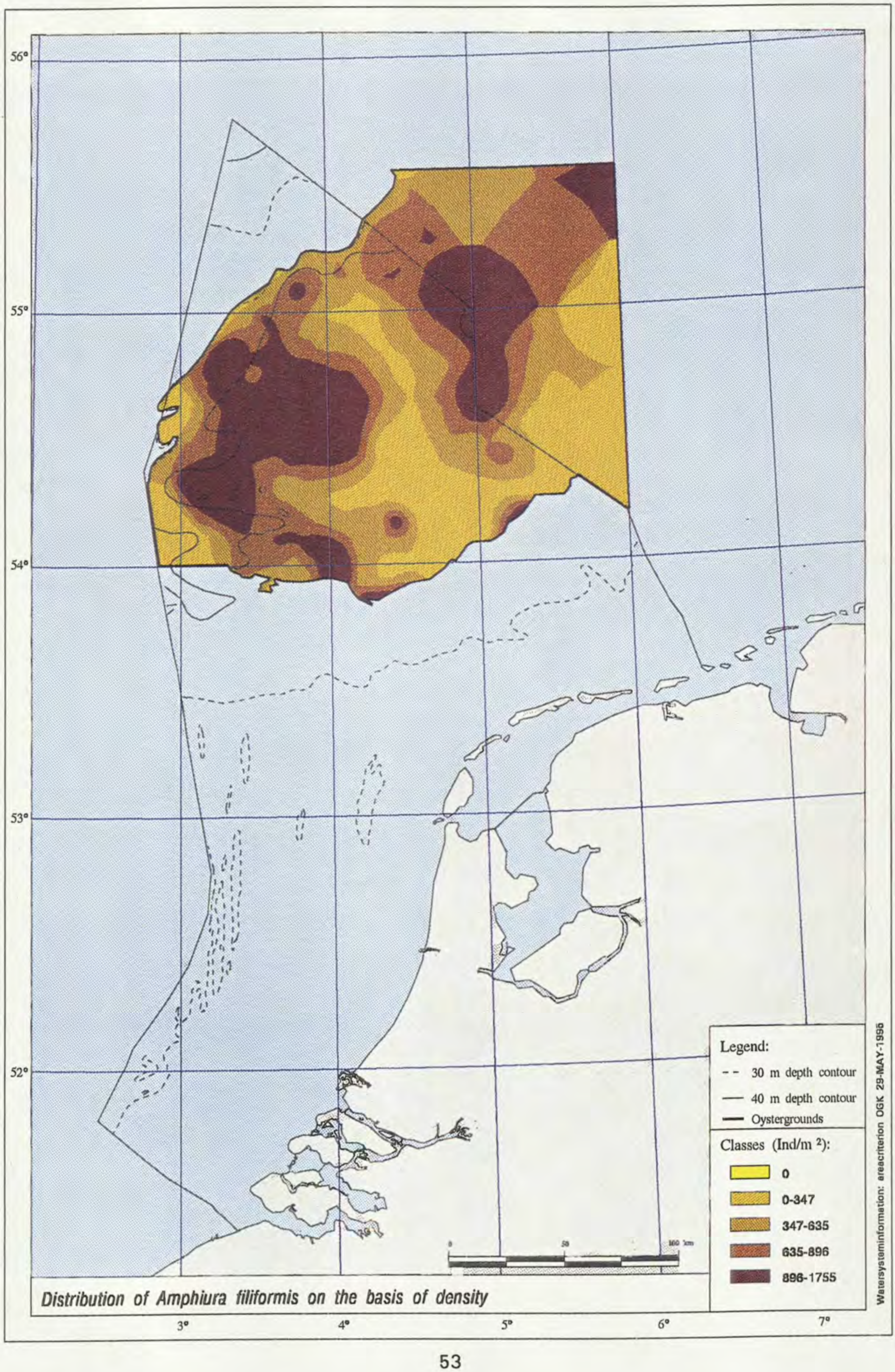
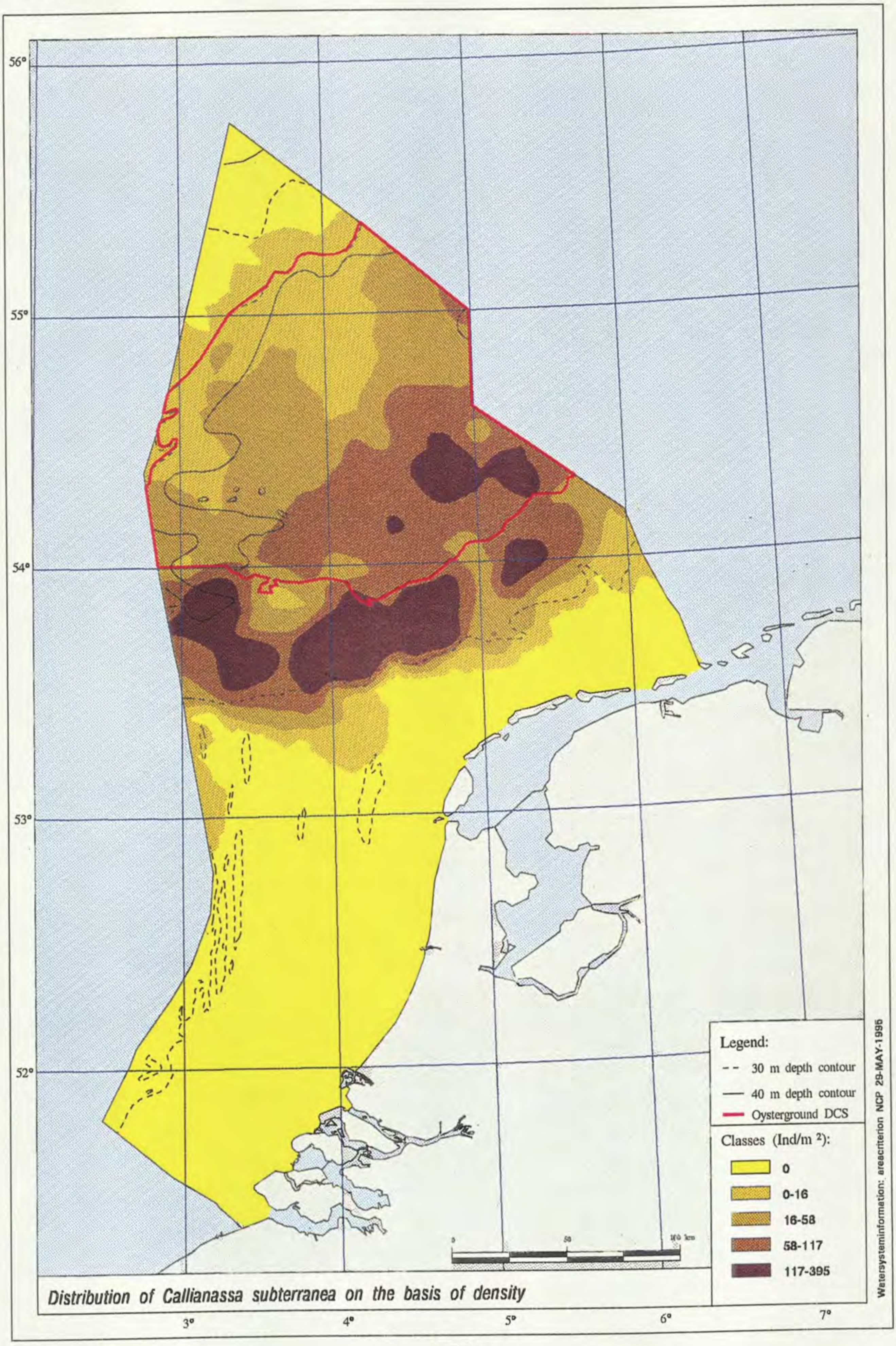

56°
55°
54°
53°
52°
3°
4°
5°
6°
7°
Legend:
30 m depth contour
40 m depth contour
Oysterground DCS
Classes (Ind/m ²):
0
0-51
51-308
308-889
889-3672
Distribution of Amphiura filiformis on the basis of density
Watersysteminformation: areacriterion NCP 24-MAY-1995

Figure 26



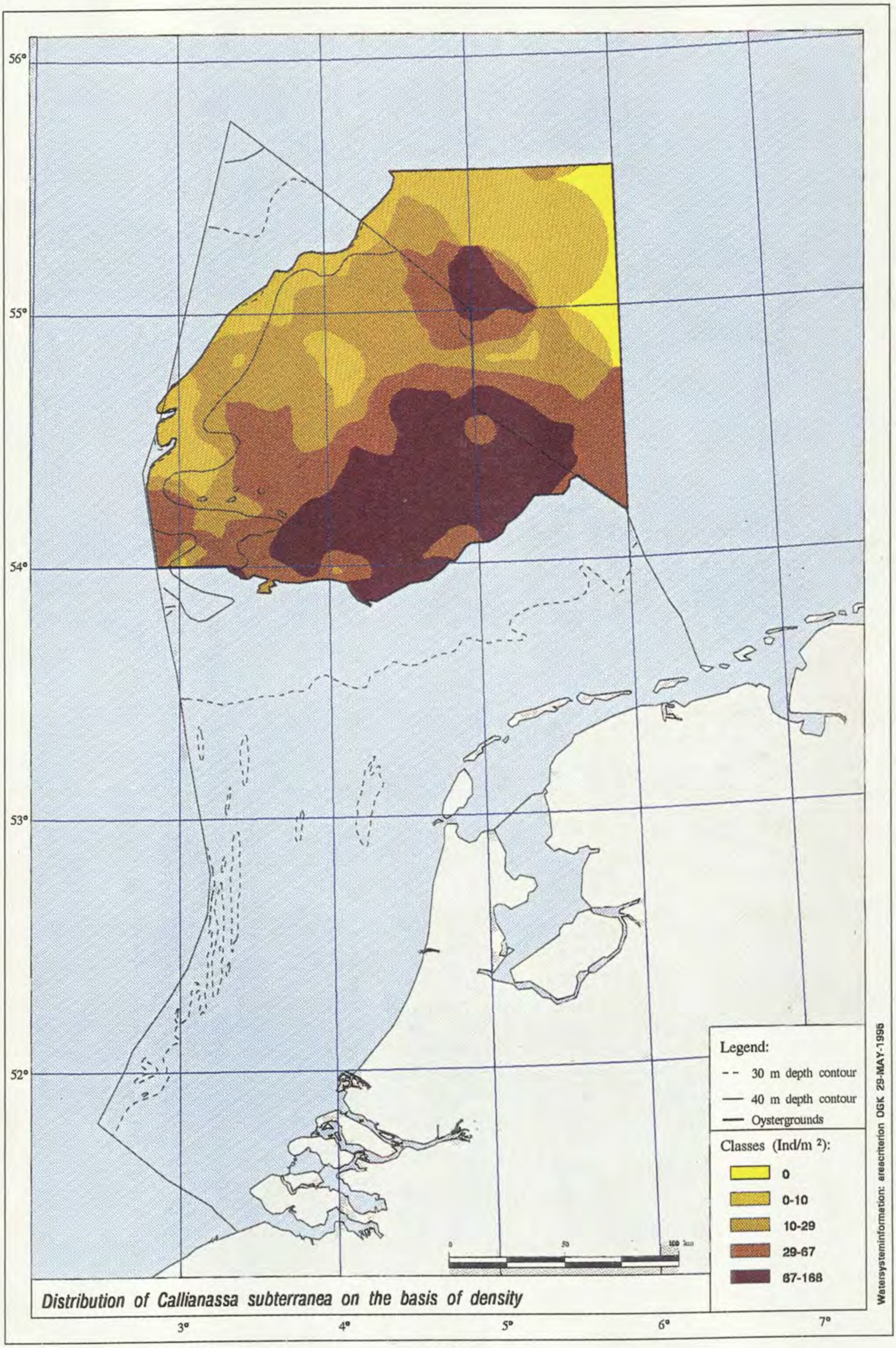
Distribution of Amphiura filiformis on the basis of density

Figure 27



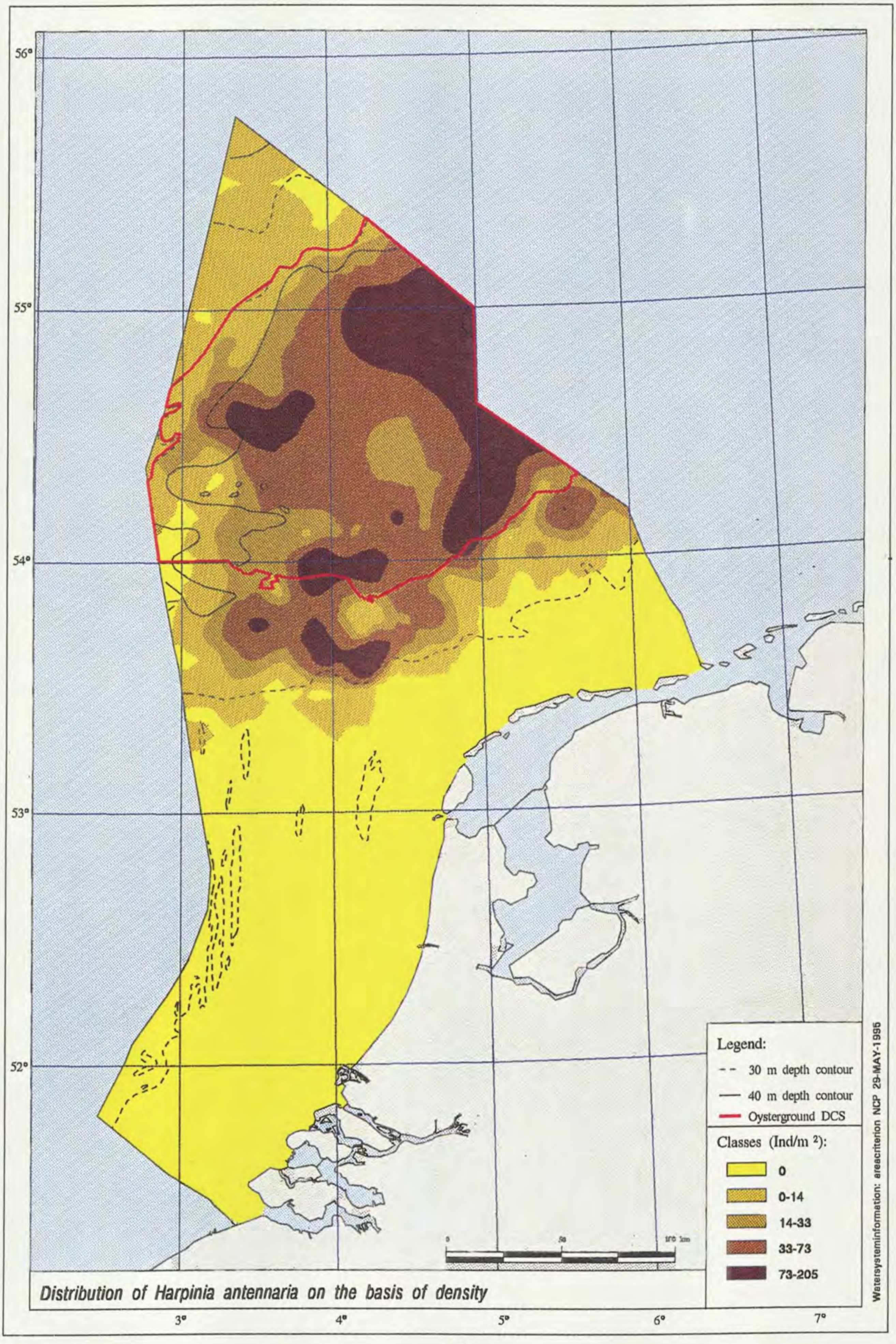
Distribution of Callianassa subterranea on the basis of density

Figure 28



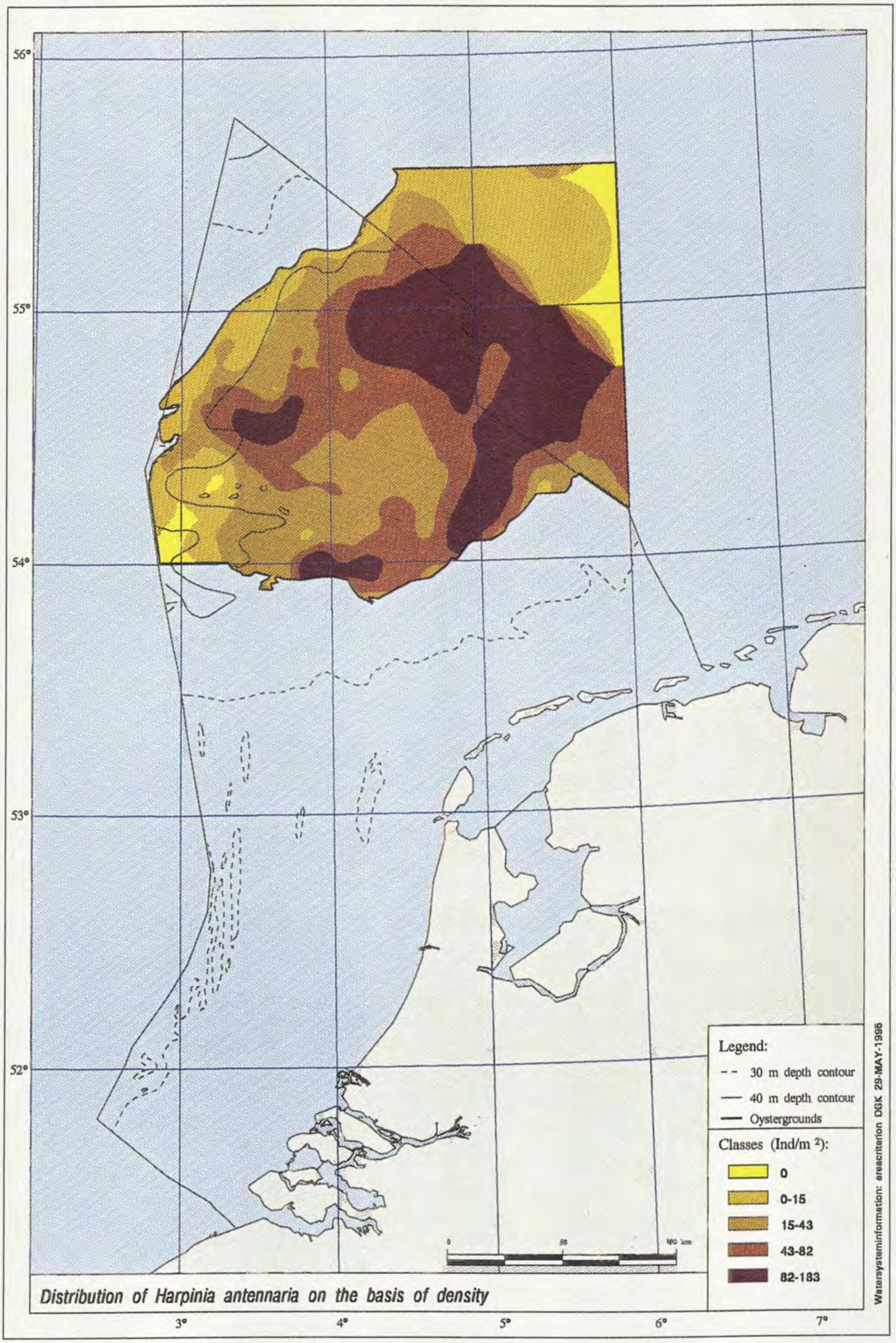
Distribution of Callianassa subterranea on the basis of density

Figure 29



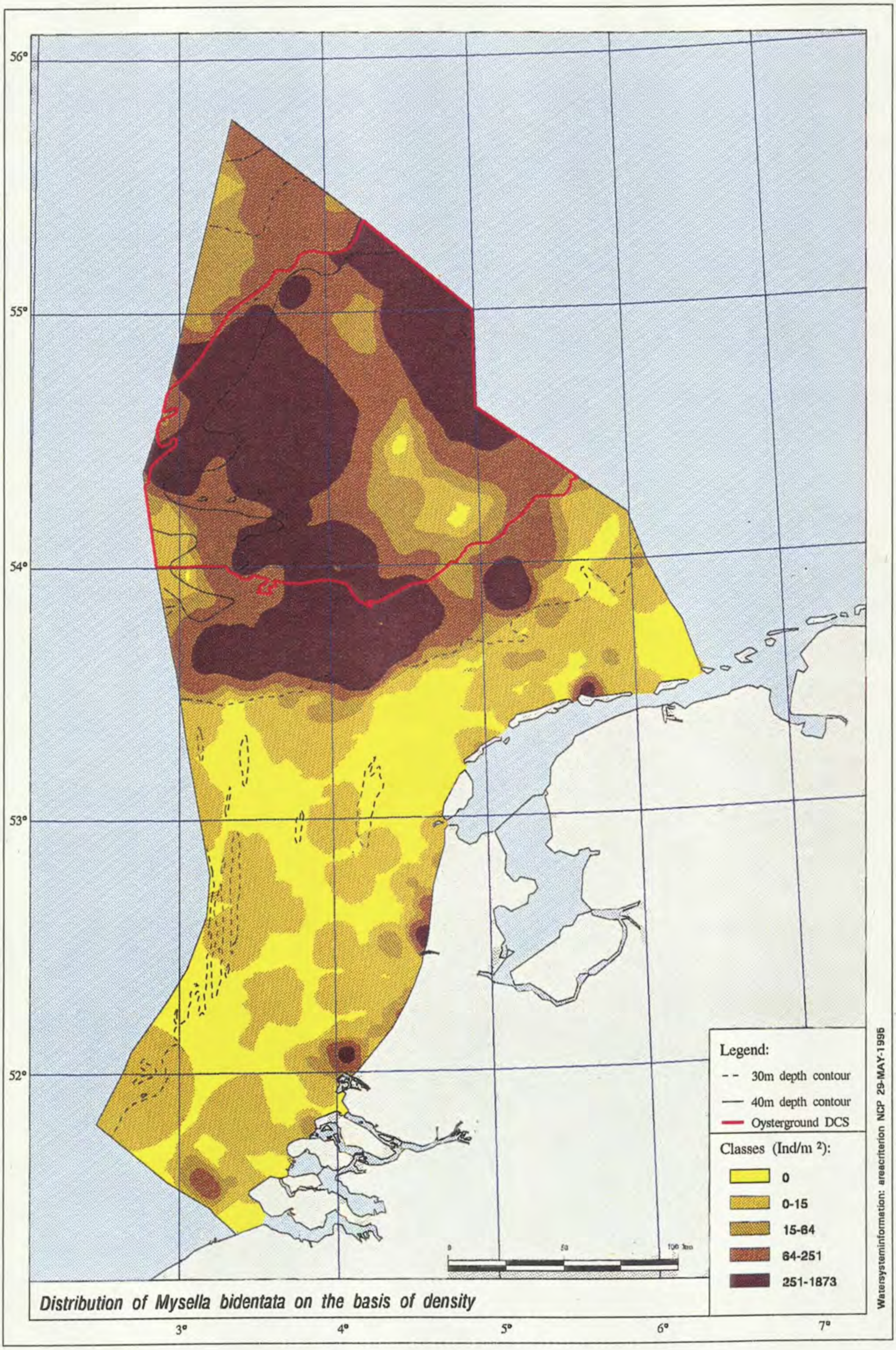
Distribution of Harpinia antennaria on the basis of density

Figure 30



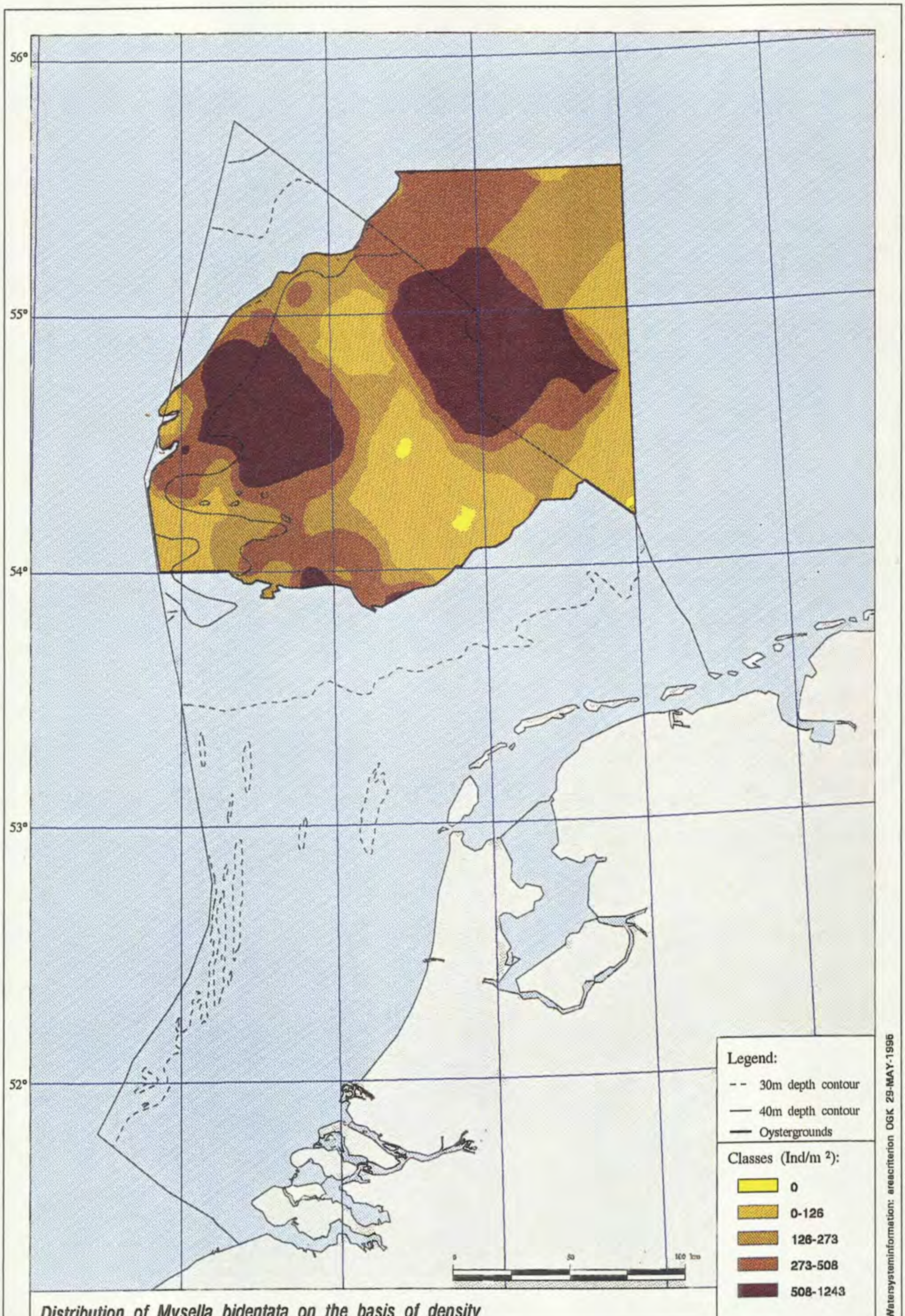
Distribution of Harpinia antennaria on the basis of density

Figure 31



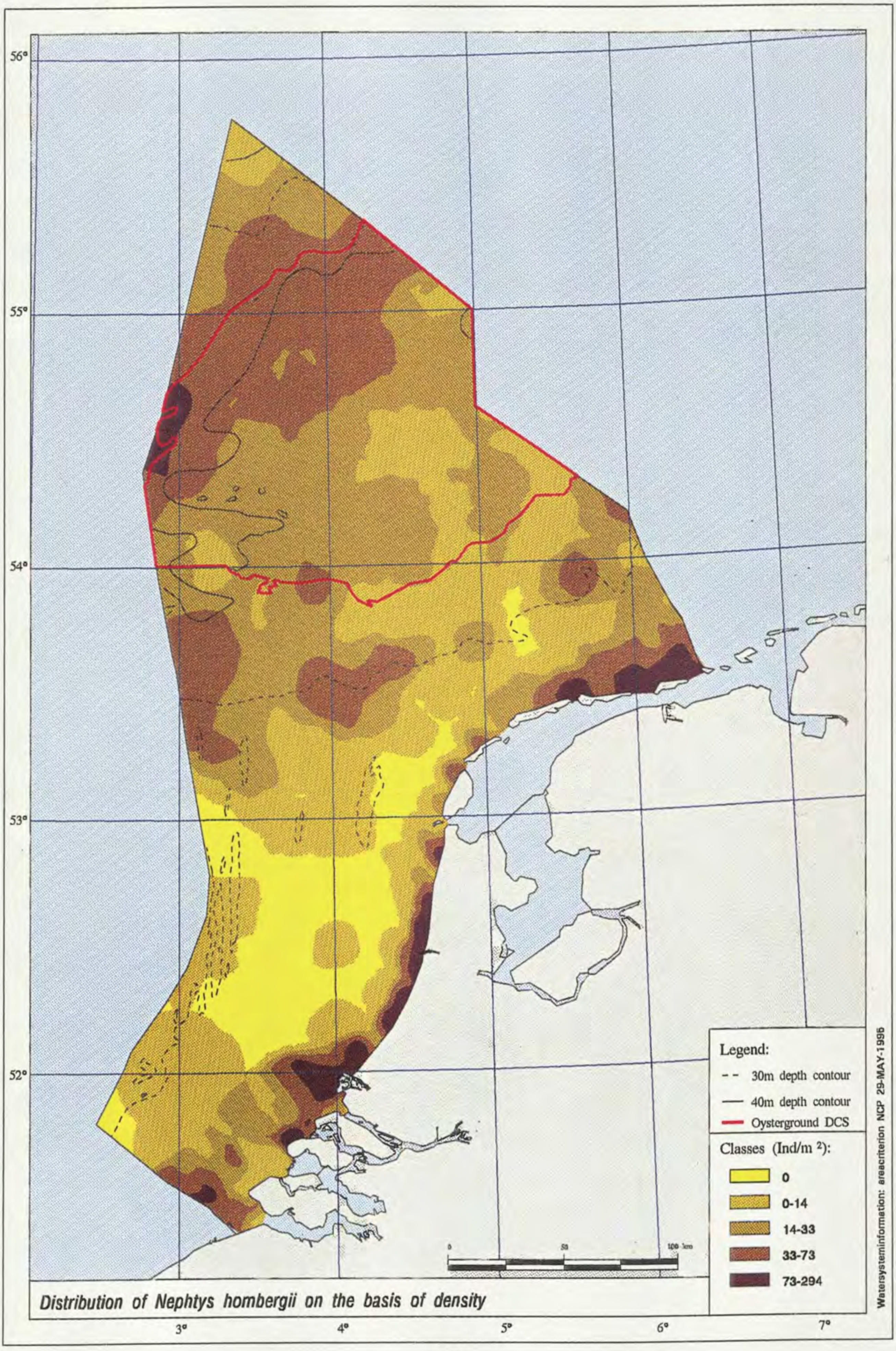
Distribution of Mysella bidentata on the basis of density

Figure 32



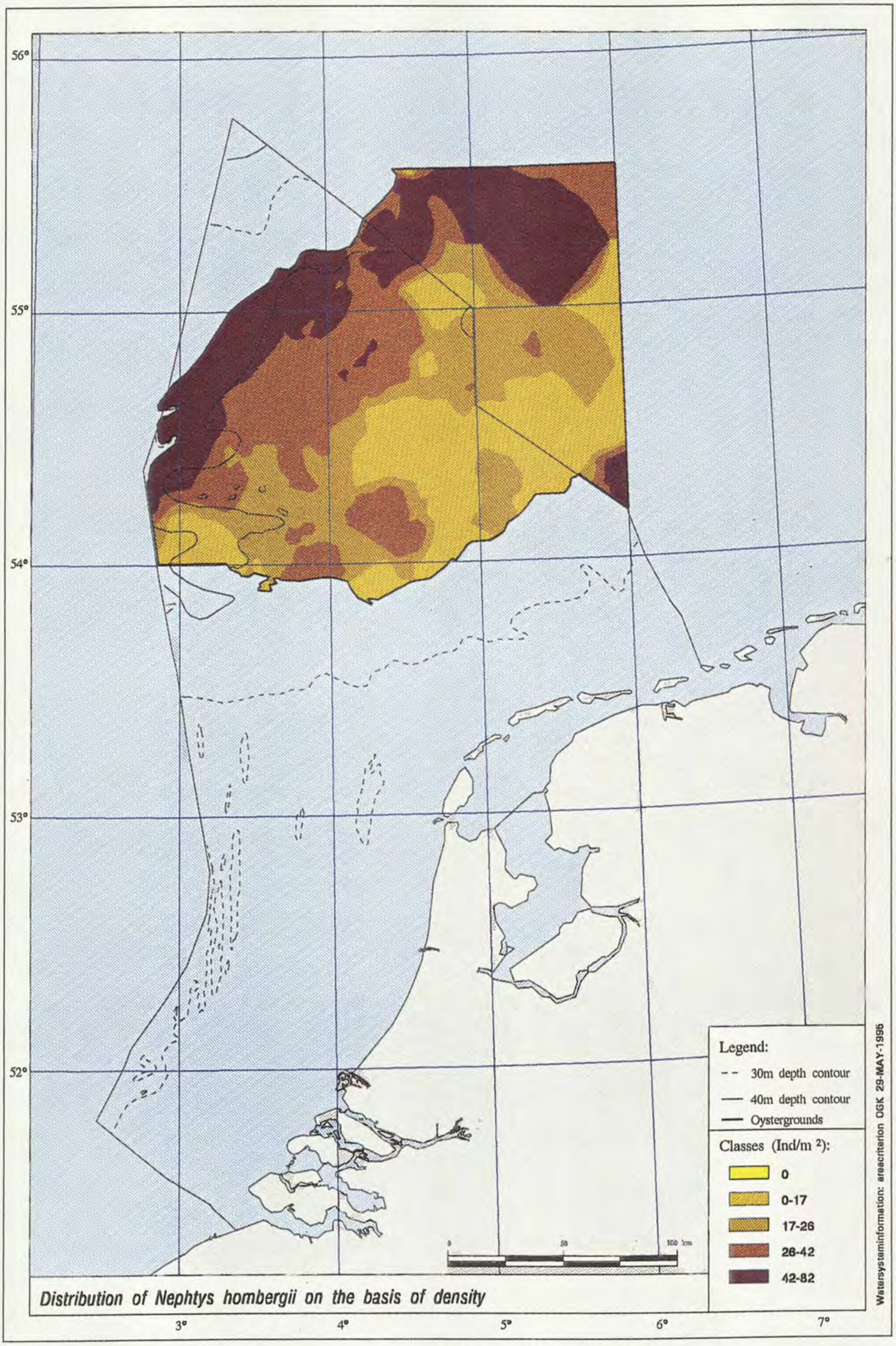
Distribution of Mysella bidentata on the basis of density

Figure 33



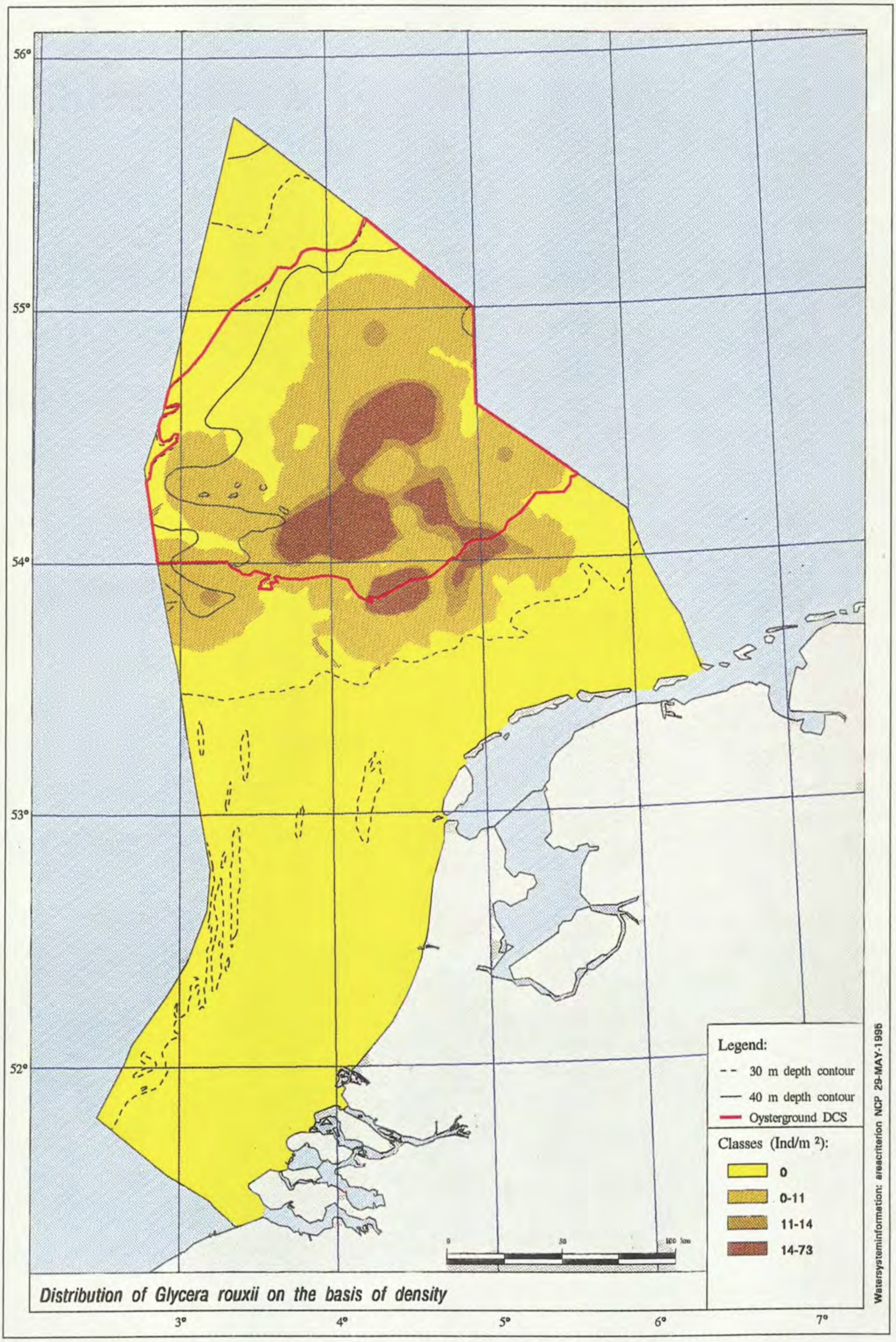
Distribution of Nephtys hombergii on the basis of density

Figure 34



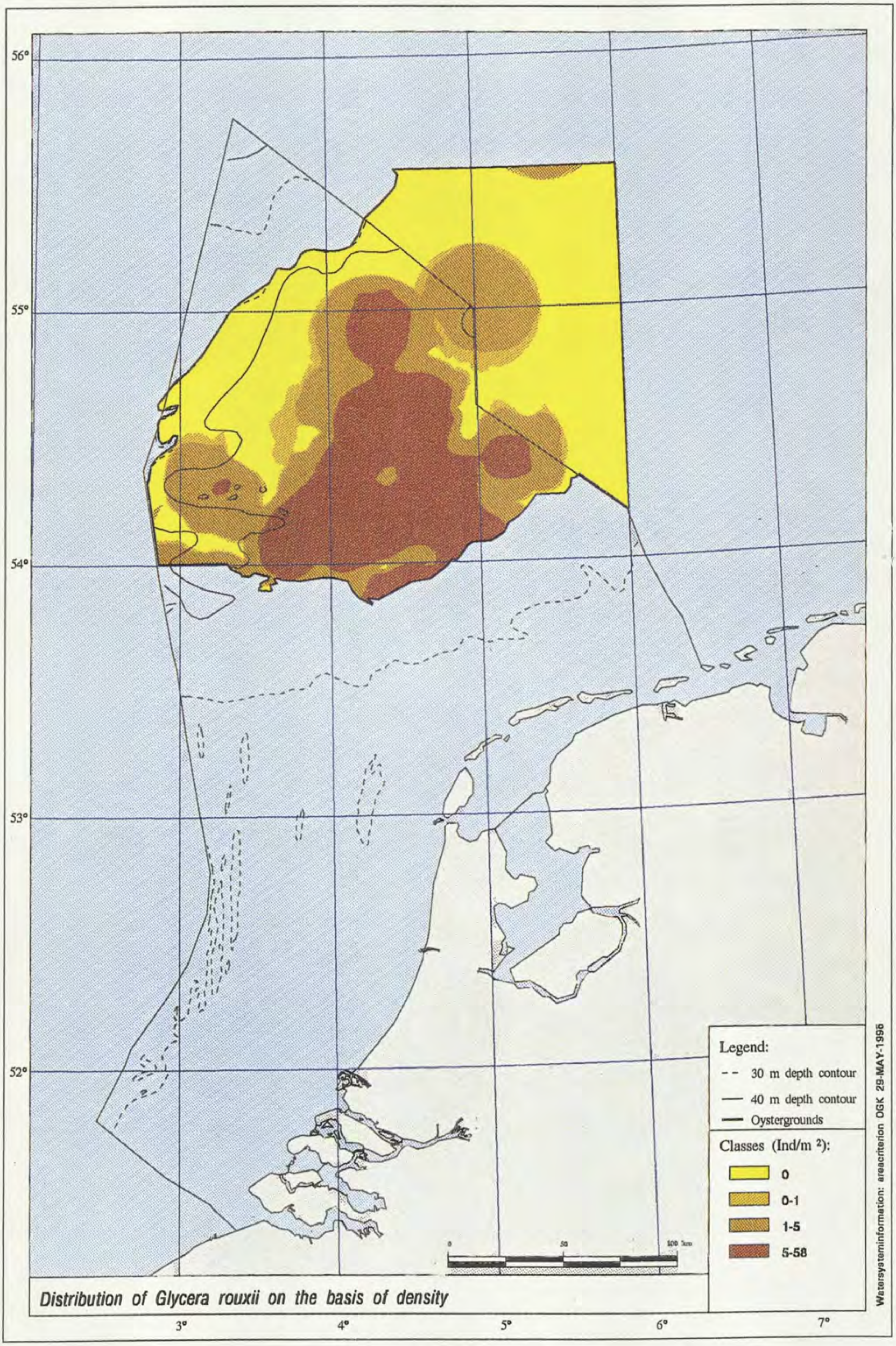
Distribution of Nephtys hombergii on the basis of density

Figure 35



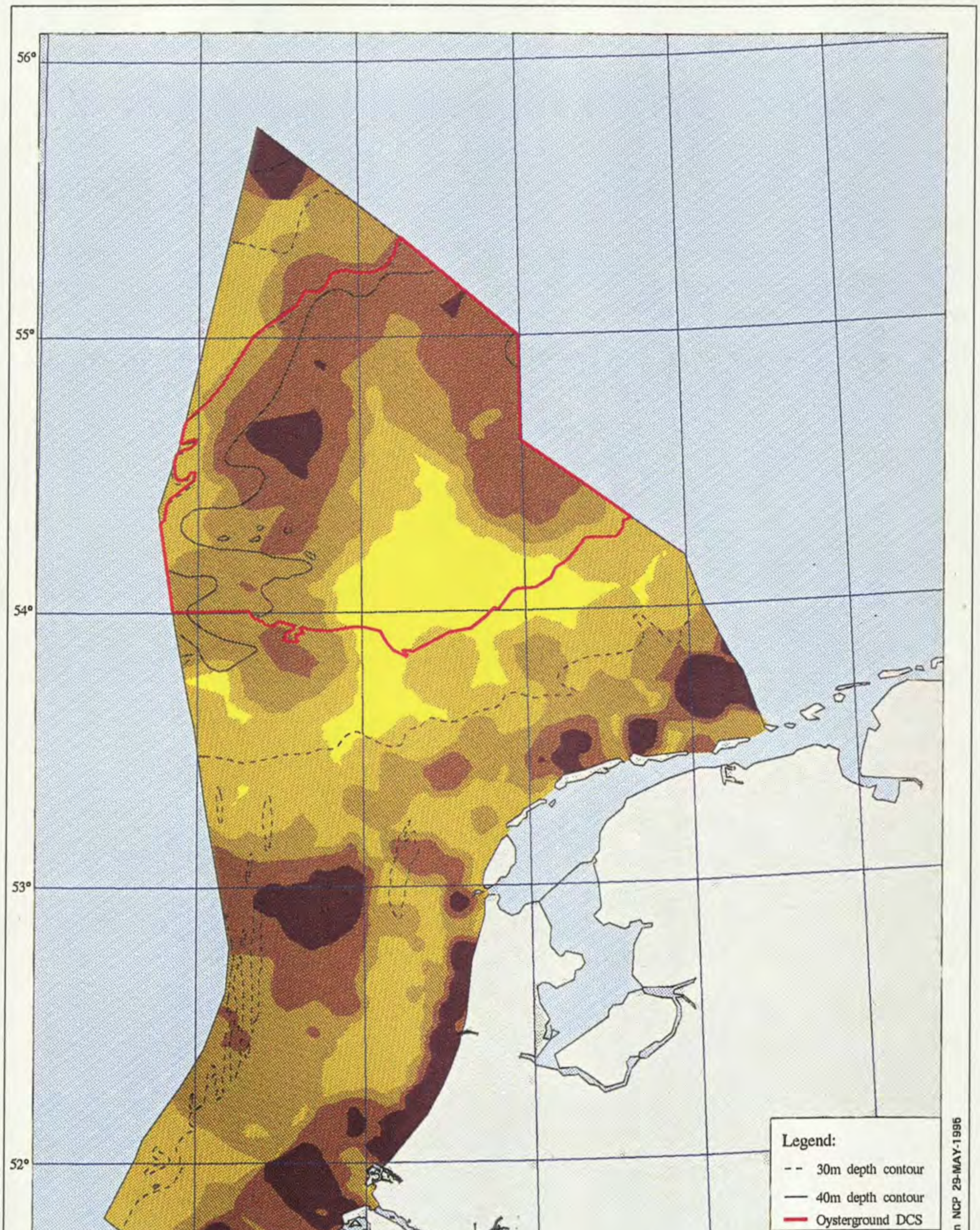
Distribution of Glycera rouxii on the basis of density

Figure 36



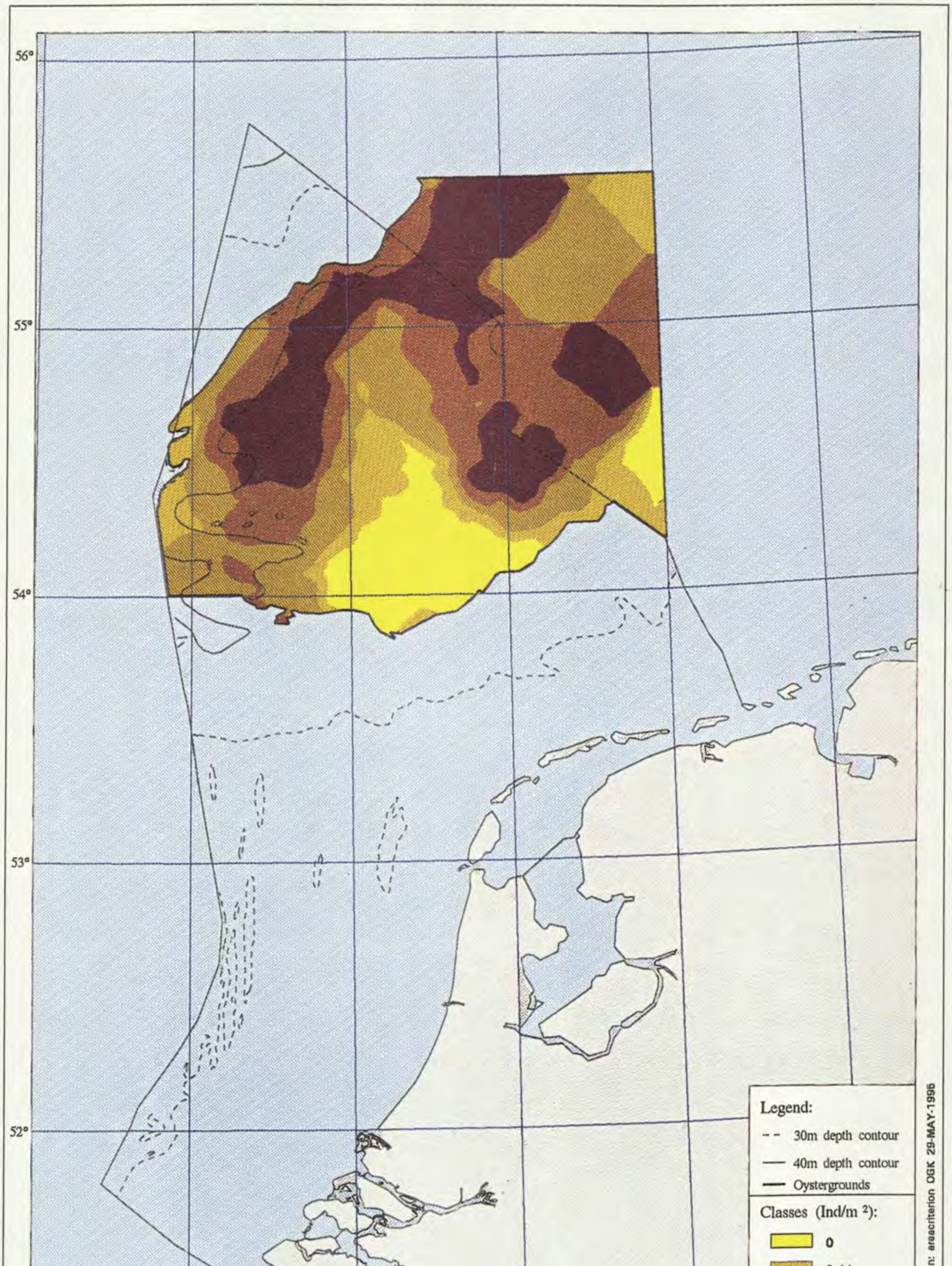
Distribution of Glycera rouxii on the basis of density

Figure 37



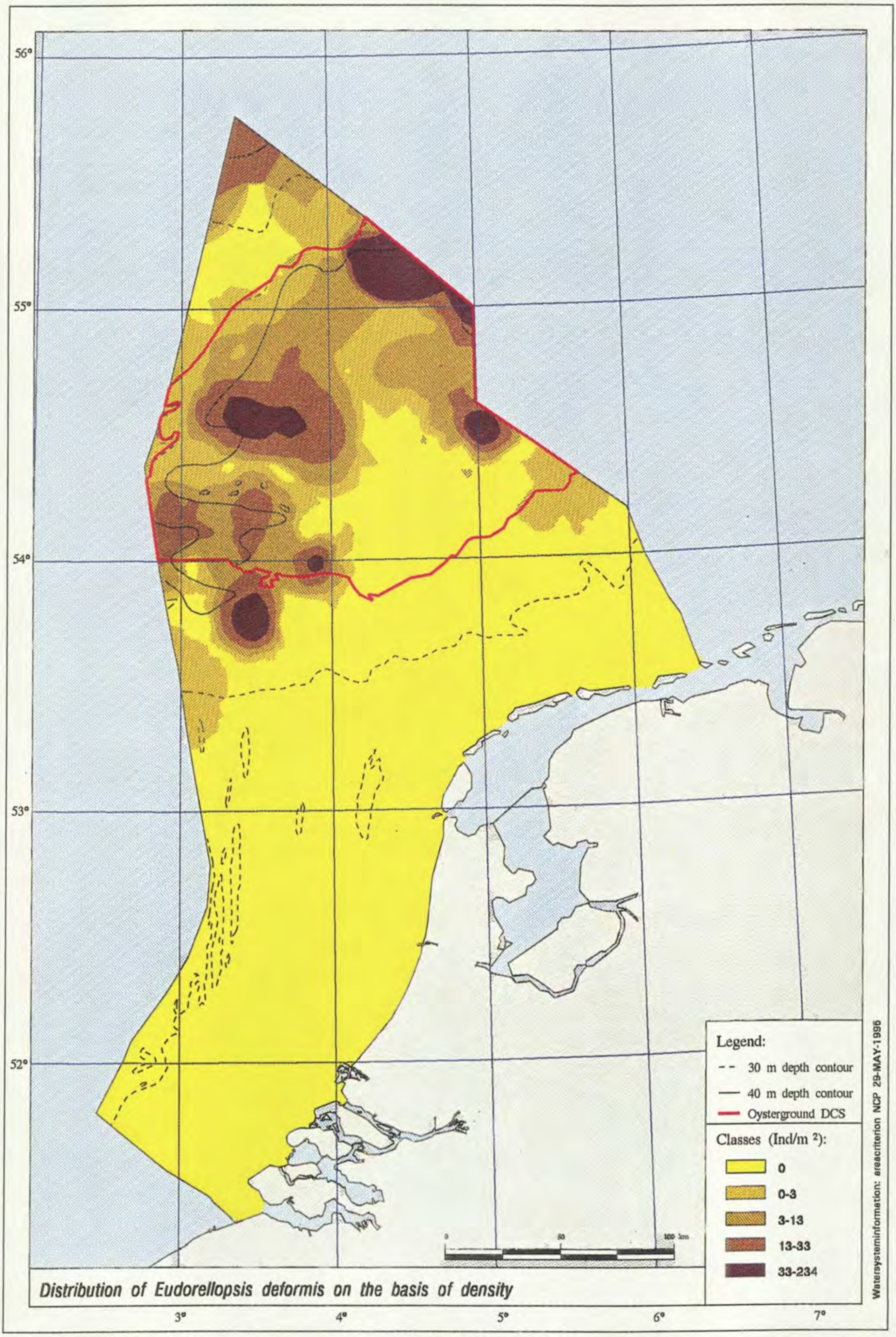
Distribution of Scoloplos armiger on the basis of density

Figure 38



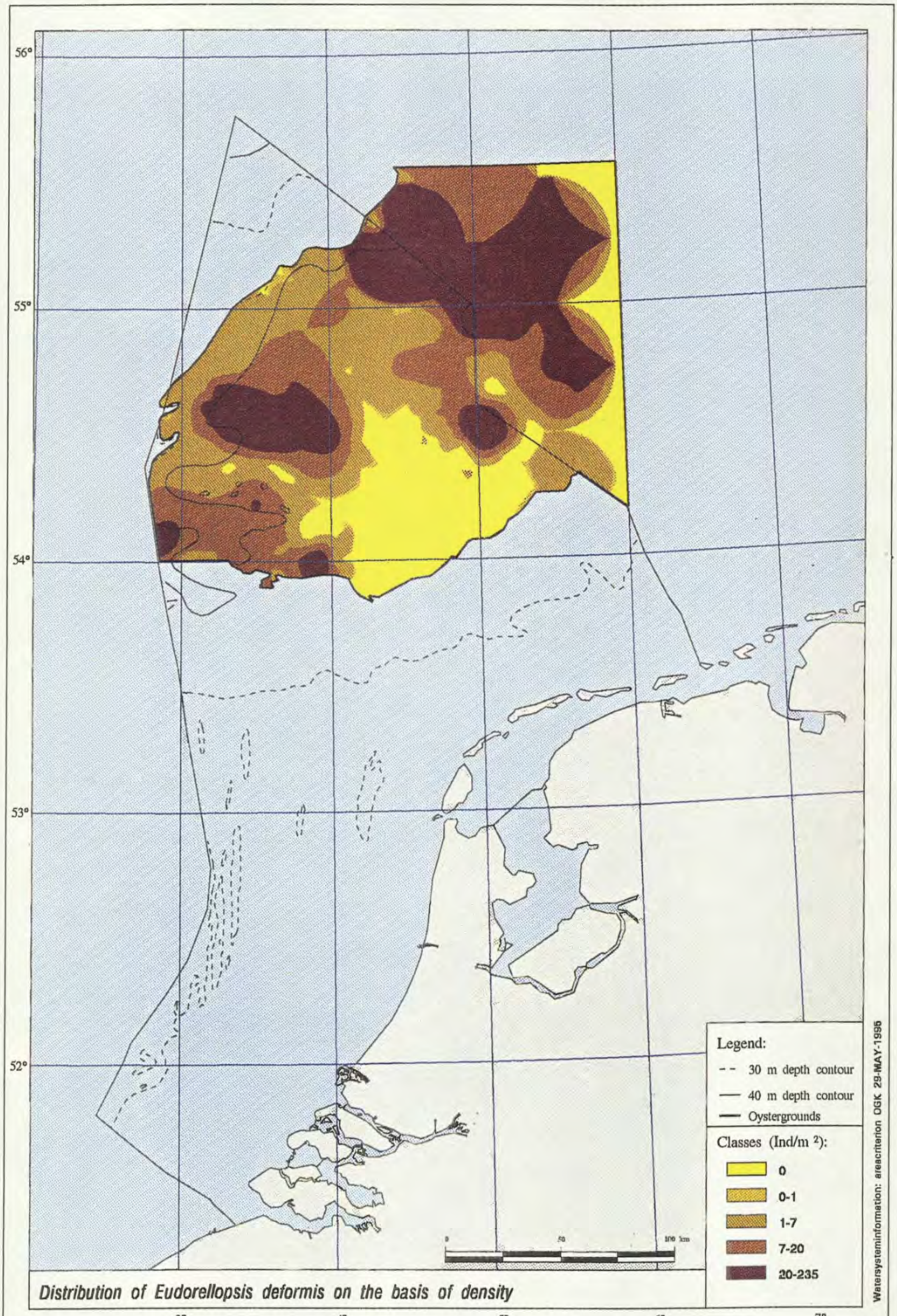
Distribution of Scoloplos armiger on the basis of density

Figure 39



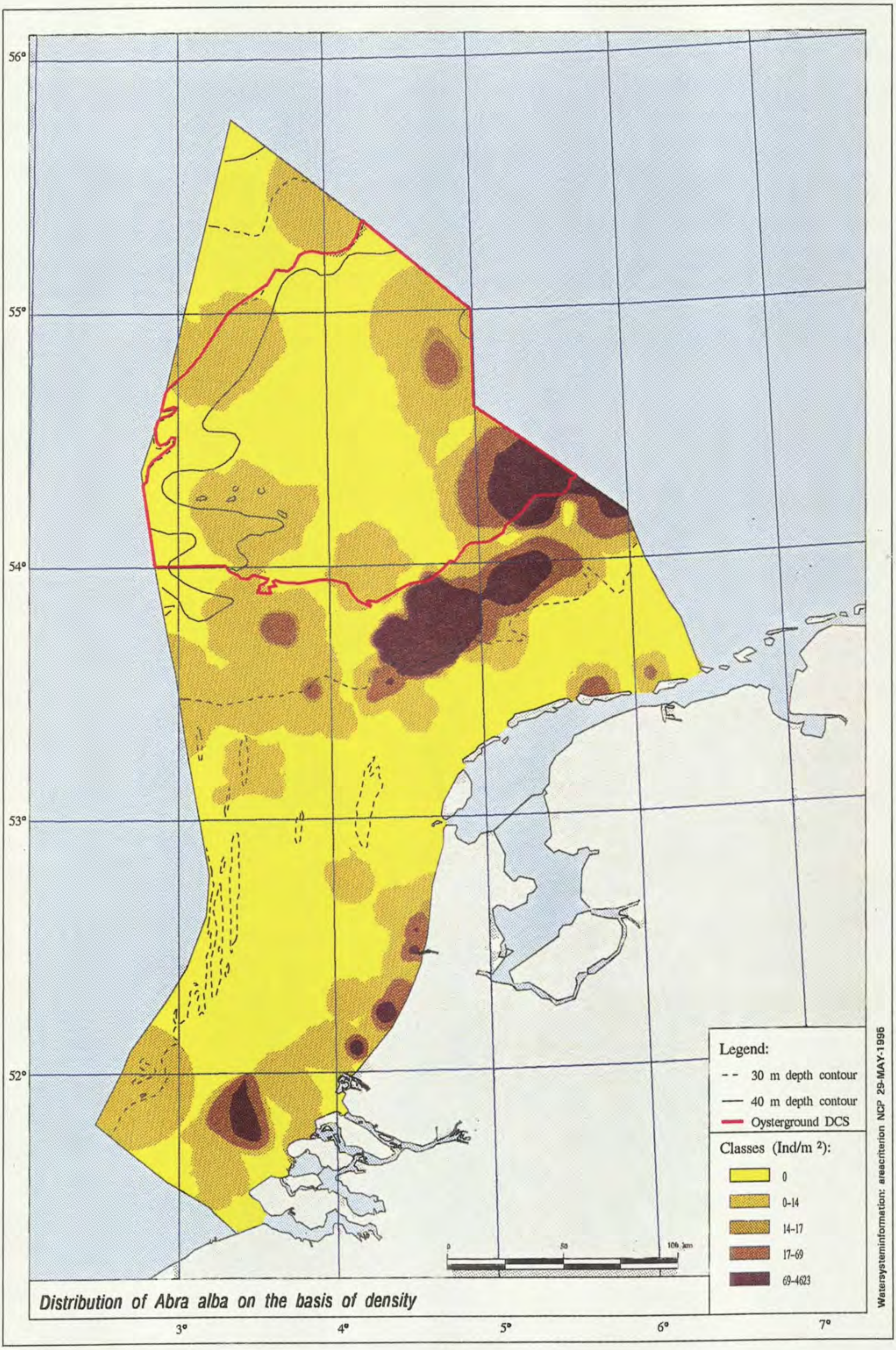
Distribution of Eudorellopsis deformis on the basis of density

Figure 40



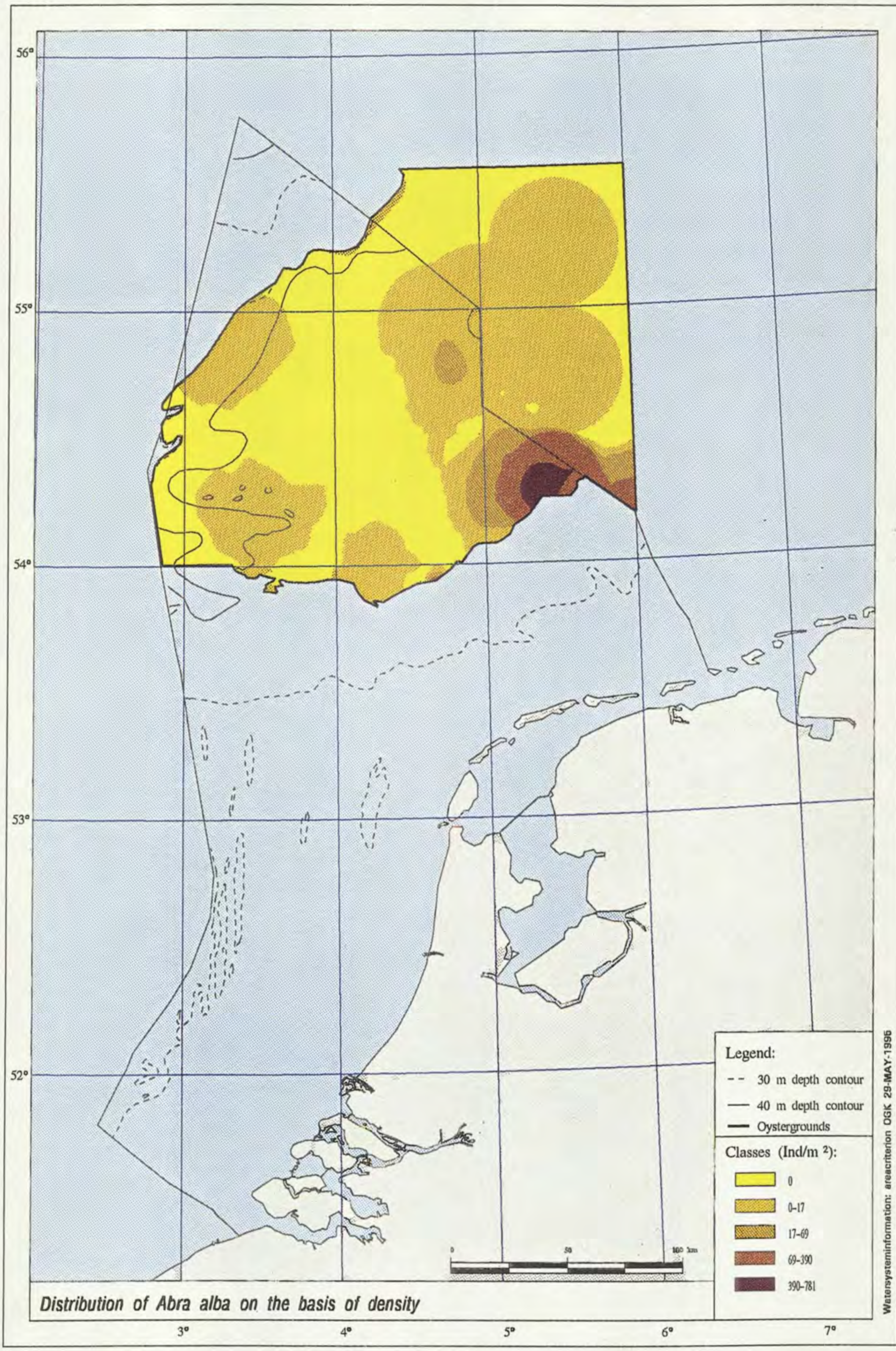
Distribution of Eudorellopsis deformis on the basis of density

Figure 41



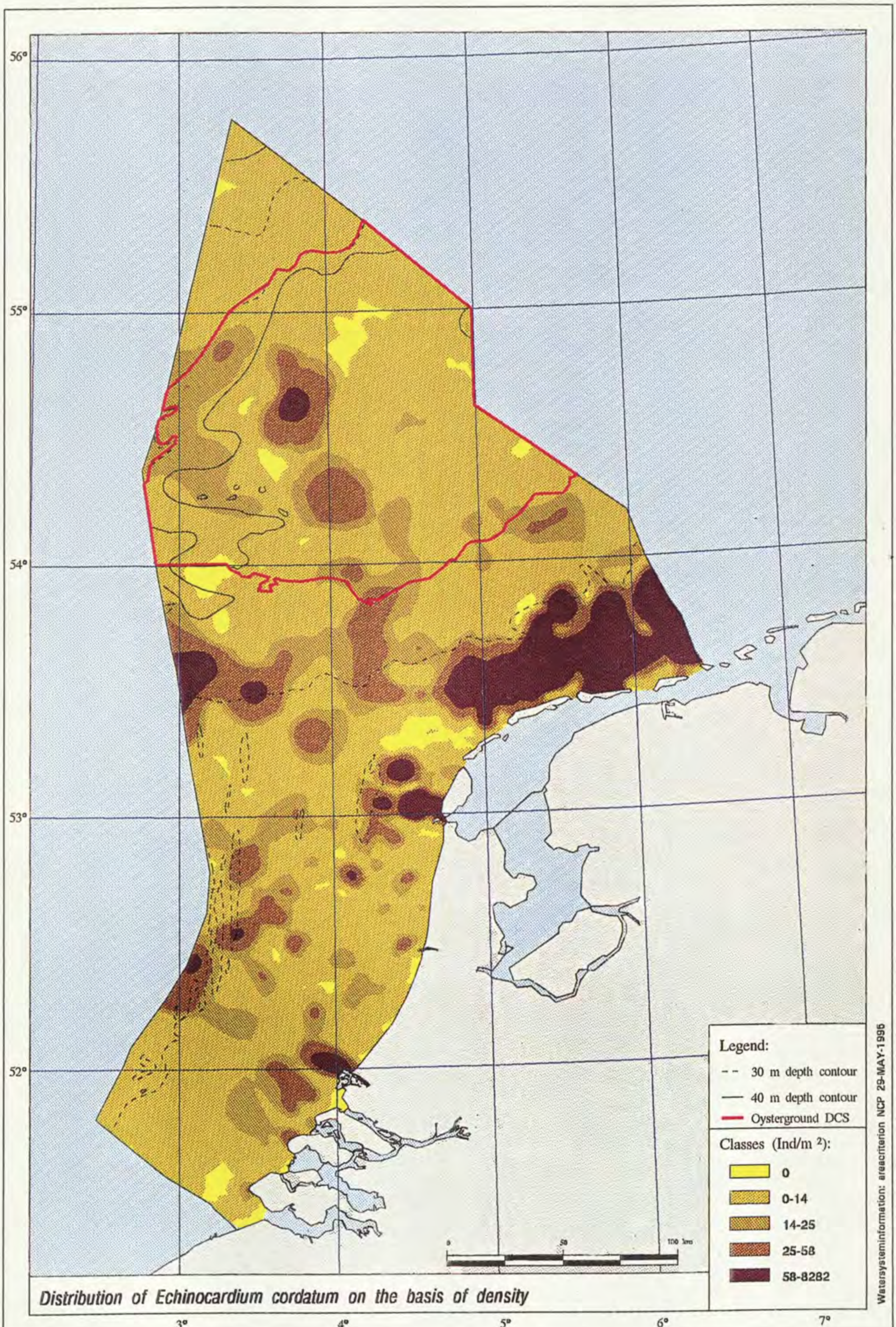
Distribution of Abra alba on the basis of density

Figure 42



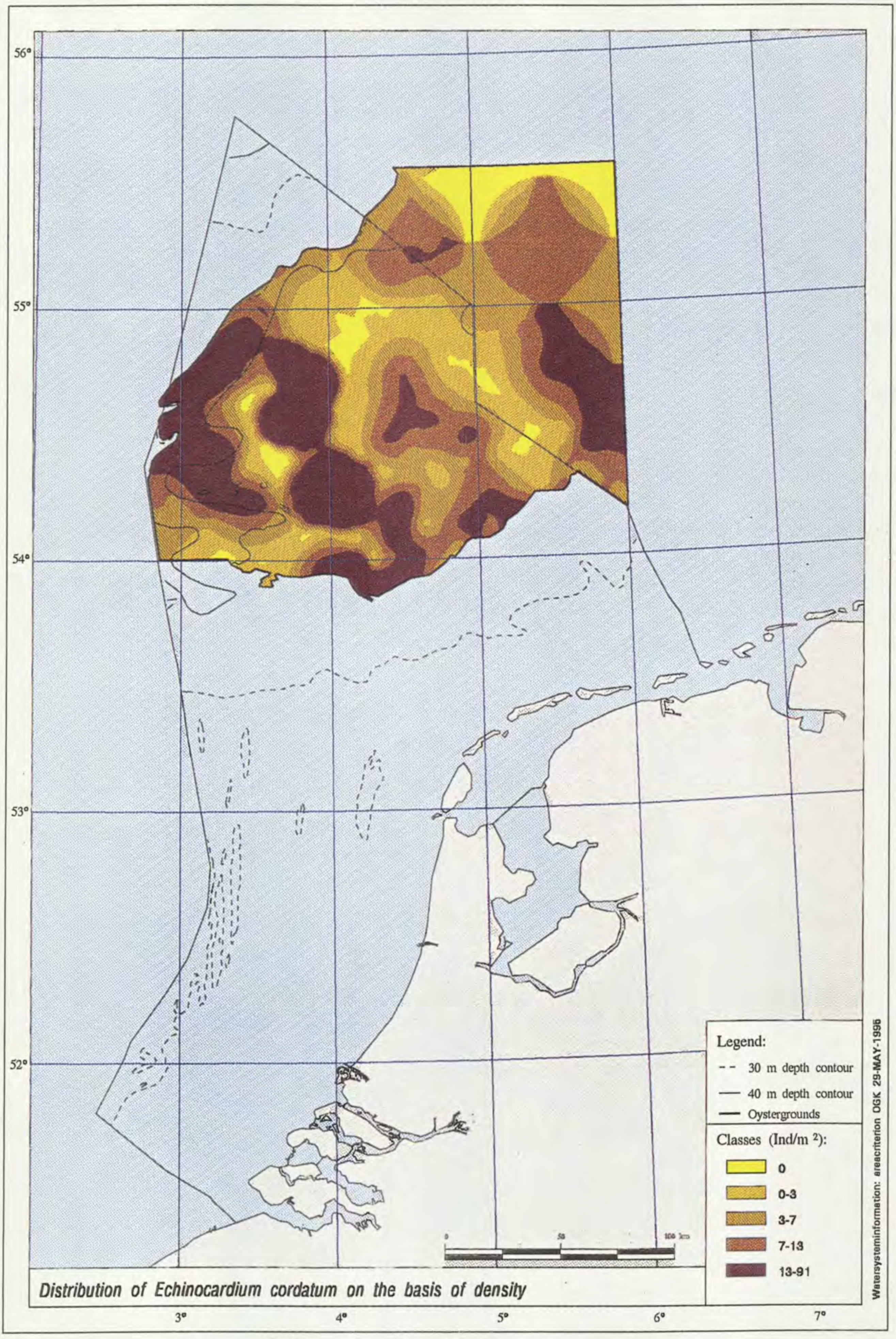
Distribution of Abra alba on the basis of density

Figure 43



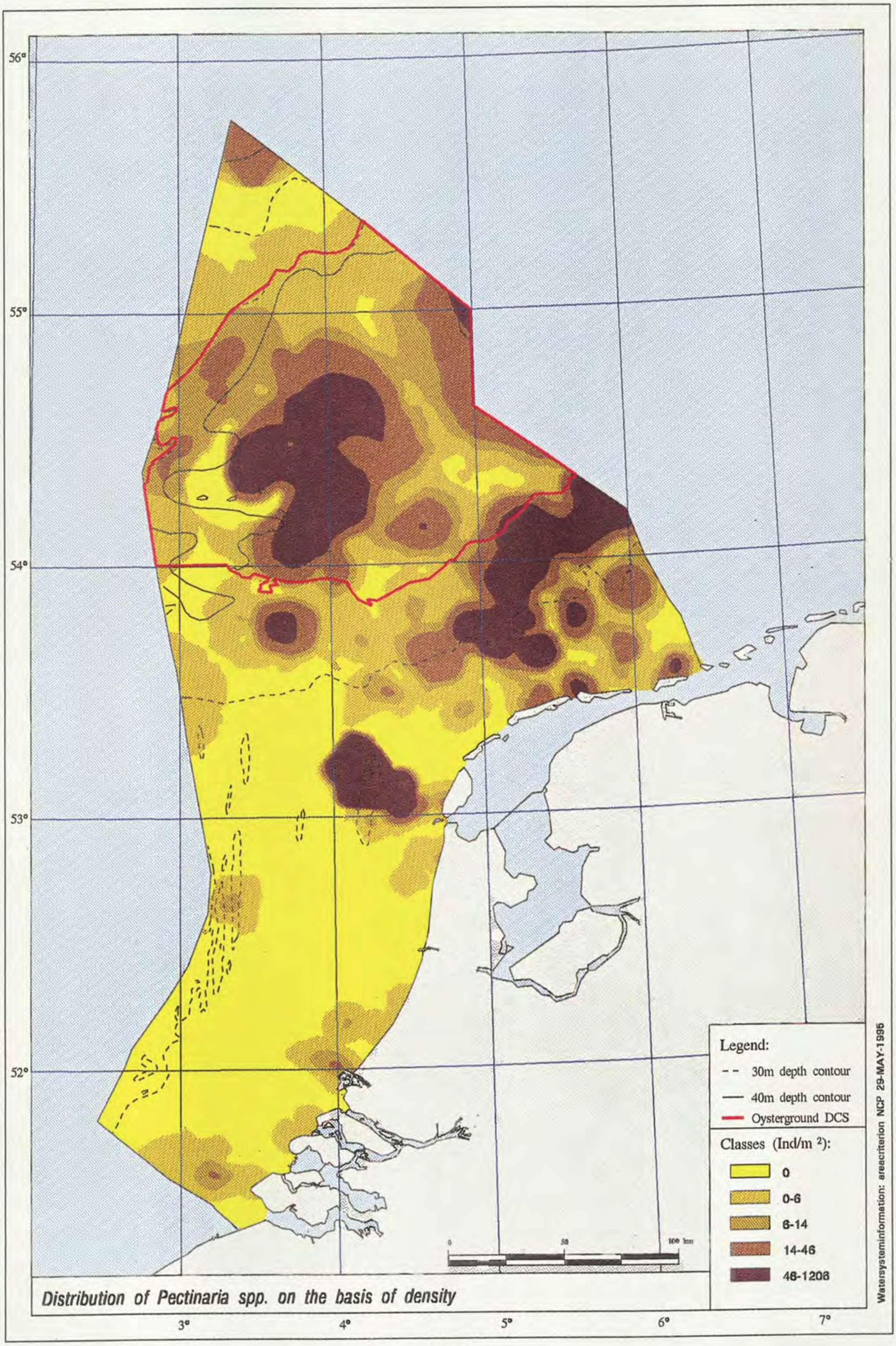
Distribution of Echinocardium cordatum on the basis of density

Figure 44



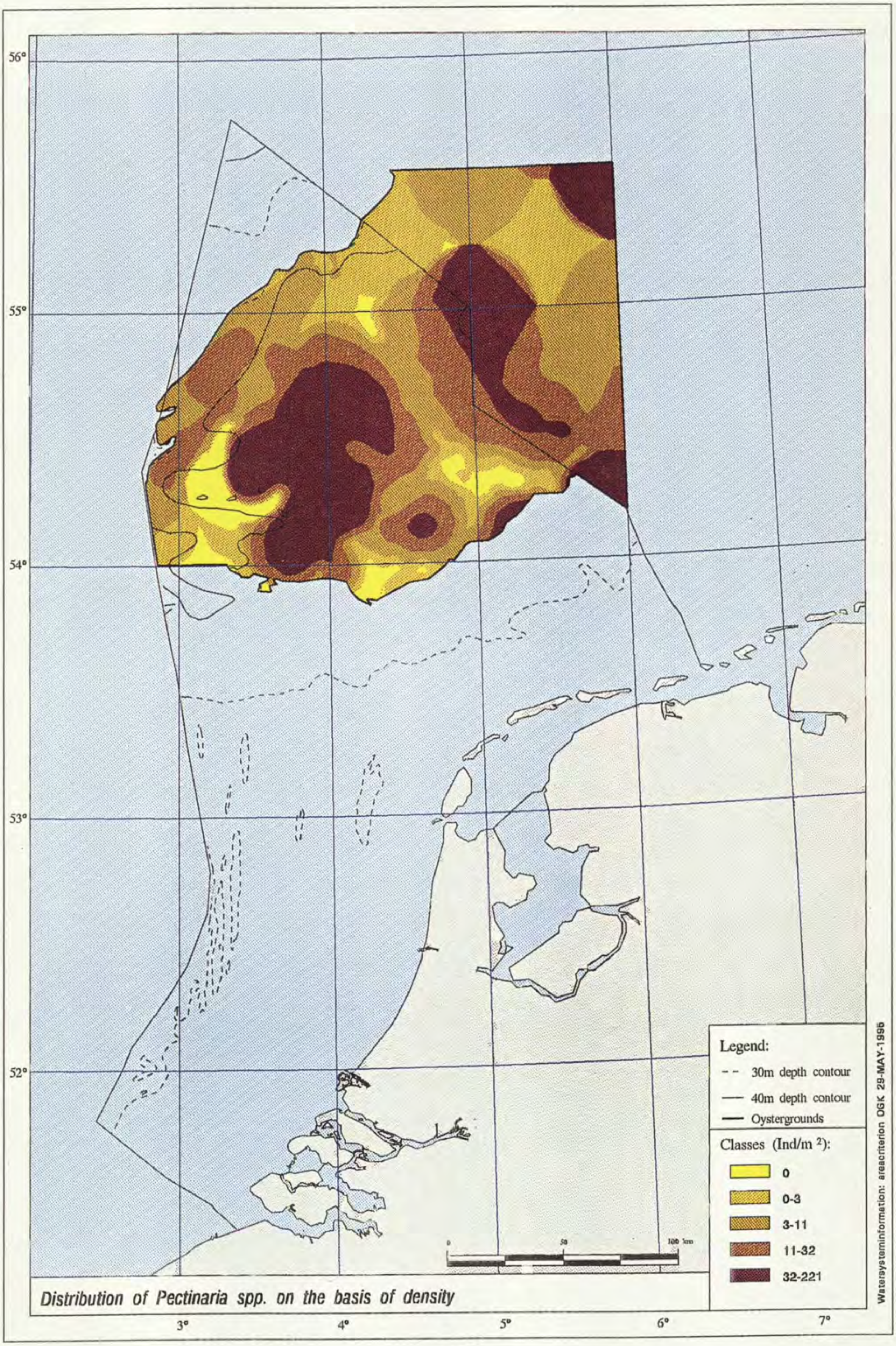
Distribution of Echinocardium cordatum on the basis of density

Figure 45



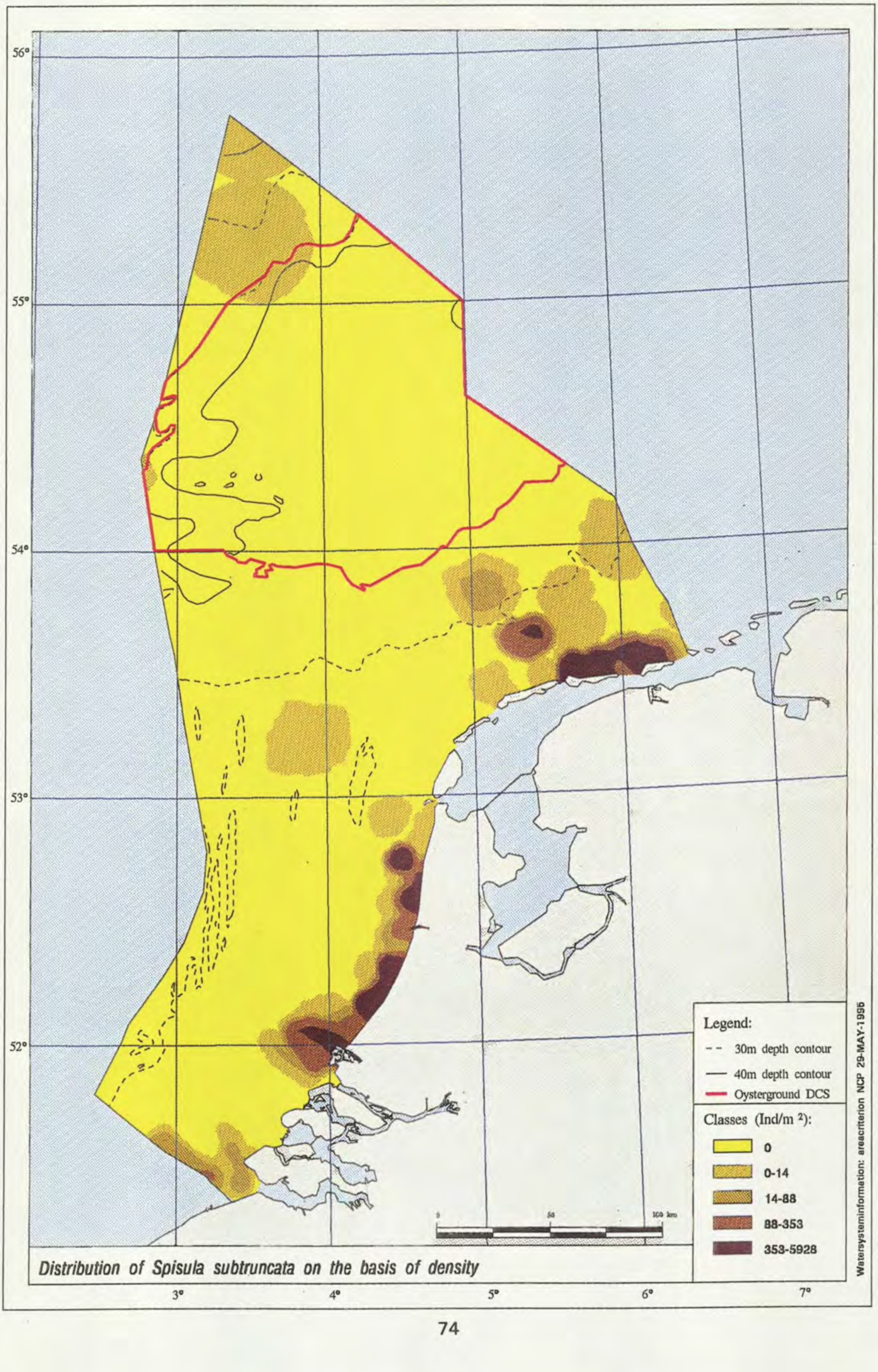
Distribution of Pectinaria spp. on the basis of density

Figure 46



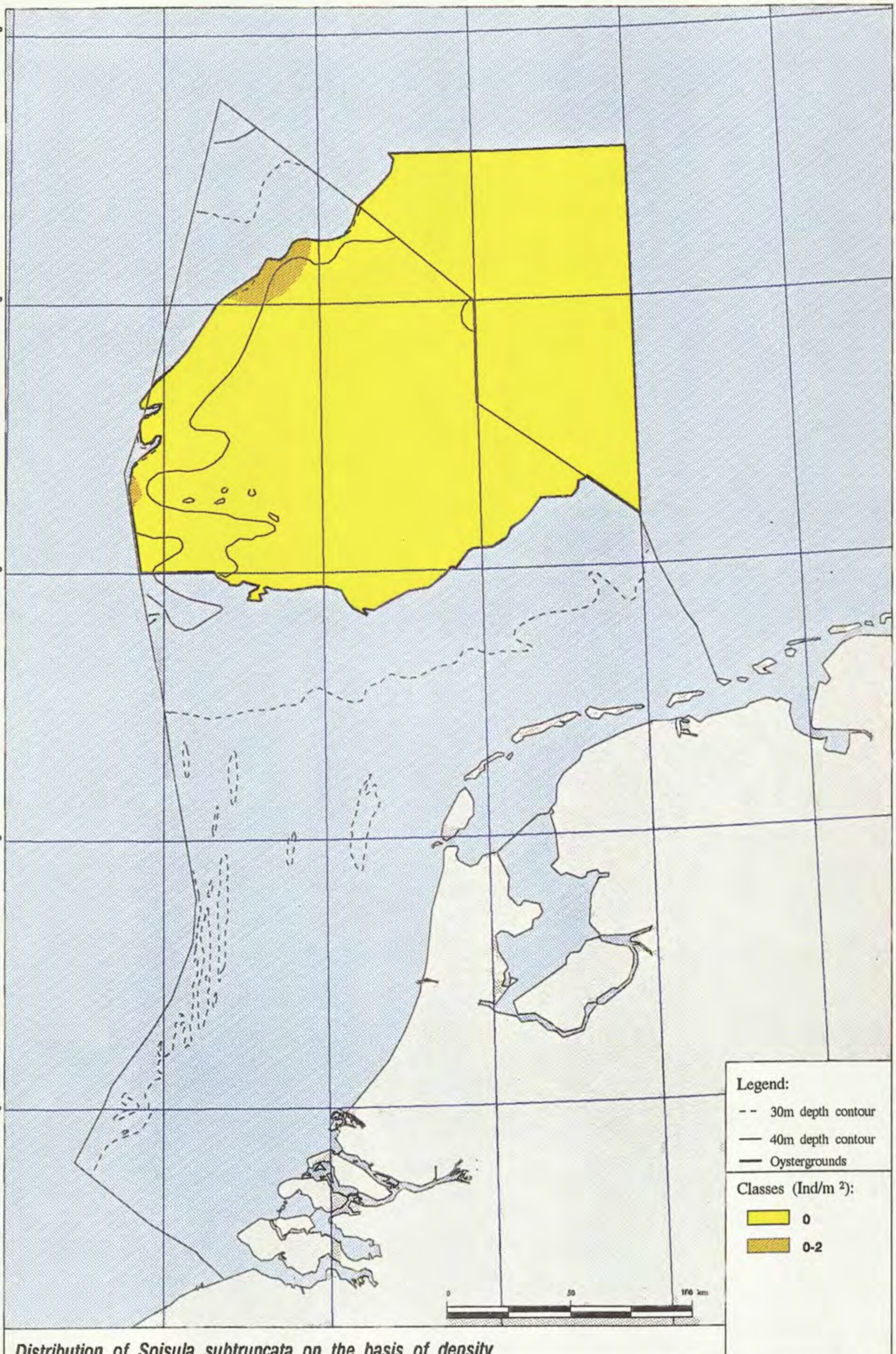
Distribution of Pectinaria spp. on the basis of density

Figure 47



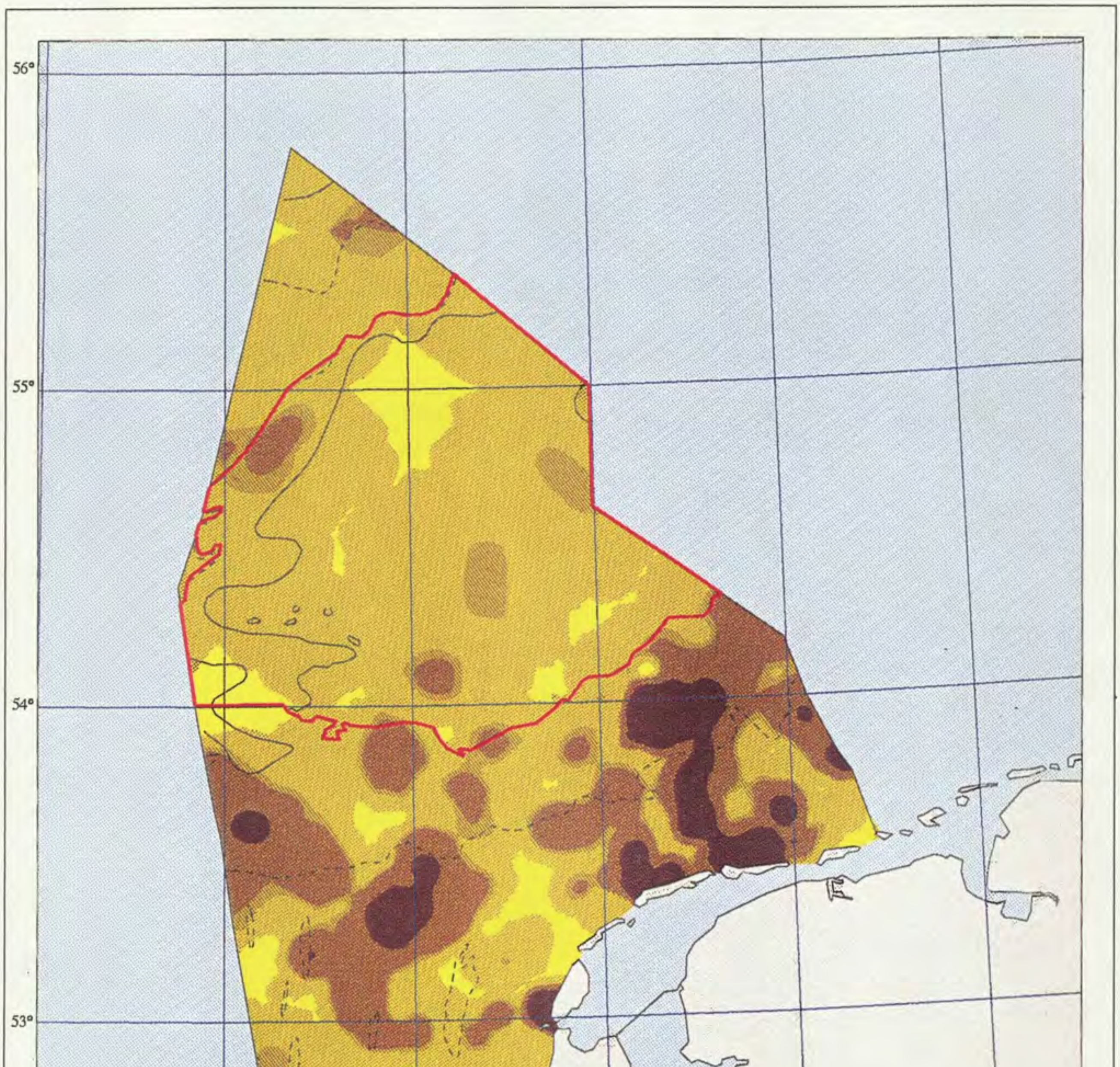
Distribution of Spisula subtruncata on the basis of density

Figure 48



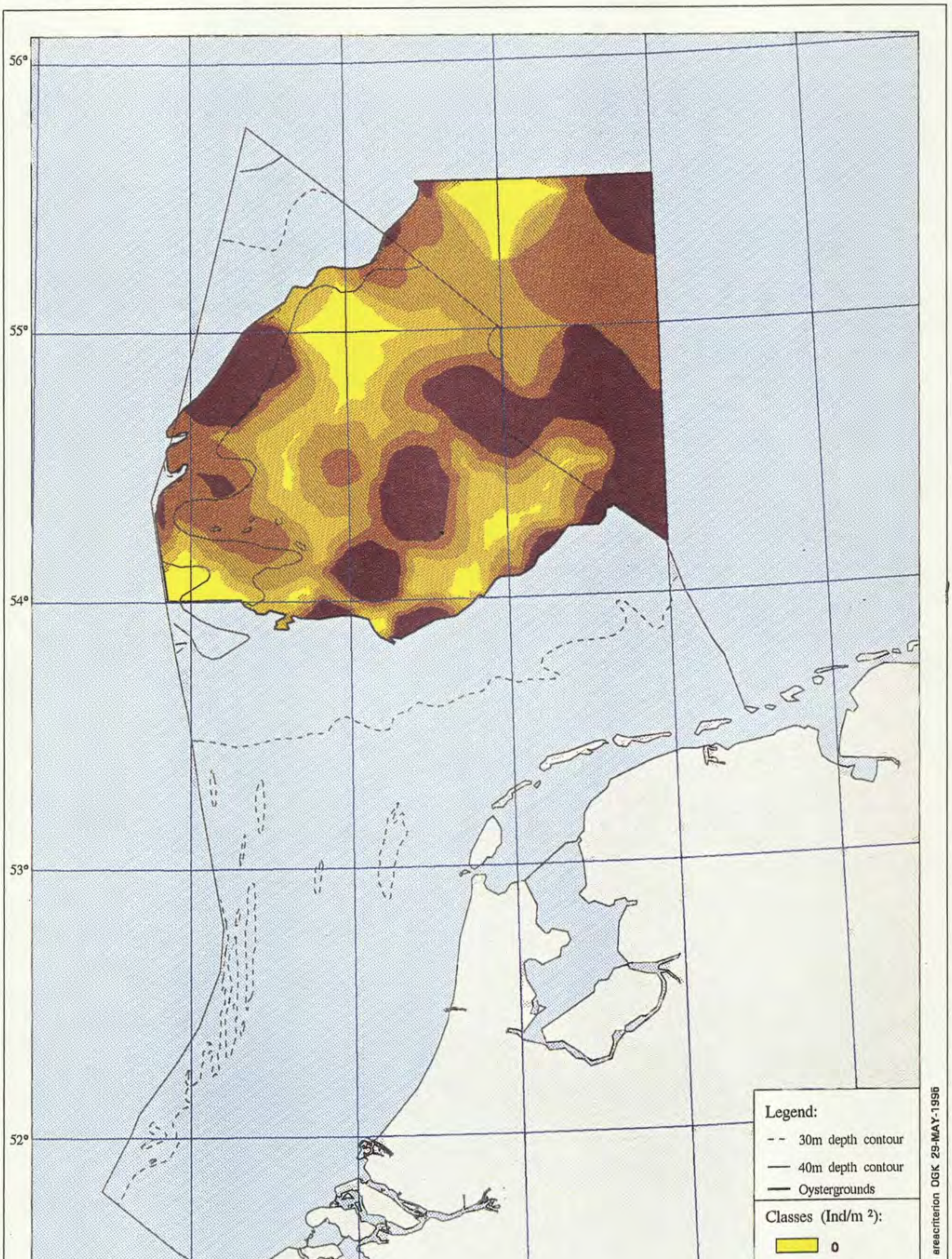
Distribution of Spisula subtruncata on the basis of density

Figure 49



Distribution of Tellimya ferruginosa on the basis of density

Figure 50



Distribution of Tellimya ferruginosa on the basis of density