Data report:
The effect of dyke reinforcement on benthic species in the Oosterschelde: T0 Cluster 2 and T1 Cluster 1.

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Samenvatting

In dit rapport zijn de data van de bodembewonende levensgemeenschappen beschreven voor locaties in de Oosterschelde voorafgaand aan oeververdedigingsactiviteiten (T0 Cluster 2) en locaties in de Oosterschelde in de periode na oeververstерkingen (T1 Cluster 1). Op de Cluster 1 locaties zijn de oevers versterkt in de periode 2009-2010, terwijl oeververdedigingsactiviteiten voor Cluster 2 gepland zijn voor de periode 2011-2012. Deze data dienen enerzijds als vergelijkingsmateriaal (de zogenaamde T0) voor in de toekomst uit te voeren monitoring studies (Cluster 2) en anderzijds als eerste effectmeting van oeververdedigingsactiviteiten op bodembewonende levensgemeenschappen (T1 Cluster 1).

Bodemdiermonsters zijn in september 2010 verzameld op twee Cluster 2 locaties (Burghsluis-west, Schelphoek-west II), telkens op drie dieptes (3 m, 7 m en 15 m). Daarnaast is er in 2010 op twee van de vijf Cluster 1 locaties een nieuwe sedimentlaag aangetroffen die dik genoeg is voor bemonstering ten behoeve van de analyse van bodembewonende levensgemeenschappen na oeververdedigingsactiviteiten. Deze bodemmonsters zijn genomen op de locaties Schelphoek-oost (alle drie de dieptes) en Zeelandbrug-De Val (15 m). In het lab zijn de bodemdieren gedetermineerd op soort- of taxonniveau.

In deze studie is wederom een grote variatie in de bodemdiergemeenschap te zien binnen locaties, en tussen locaties, dieptes en replica's. Dominantie van Annelida (wormen) is echter zichtbaar op de meeste locaties tijdens de T0-meting.

Op elke locatie is een grote spreiding in dichtheid (aantal per m^2) zichtbaar per monster. De verandering van de dichtheid met de diepte vertoont geen vast patroon. De hoogste gemiddelde aantallen organismen op de locatie Schelphoek-oost (Cluster1) is veel hoger tijdens T0 (2009) dan tijdens T1 (2010). Op 3 en 7 m diepte is tijdens de T1-meting één organisme aangetroffen in vergelijking tot 14.5 en 24 organismen tijdens de T0. Op 15 m diepte is tijdens de T1 een gemiddelde van 5.5 organismen aangetroffen tegen 13.5 tijdens de T0. Op de locatie Zeelandbrug-De Val is op 15 m diepte een hoger gemiddelde aan aantal organismen aangetroffen tijdens de T1 in vergelijking tot de T0. Hoewel de bovenste laag van de bodem op dit monsterpunt wordt gedomineerd door fijne fracties, met 73% van de fracties ≤90 µm, duidt de samenstelling van de gemeenschap niet op een kolonisatie van nieuw gesedimenteerd materiaal. De bemonstering op deze locatie heeft plaatsgevonden op de ondergrens van het staalslakbed (op 14 m NAP, binnen de stortzone). Waarschijnlijk betreft het hier de oude sedimentlaag aan de onderzijde van het staalslakbed, waarop fijn nieuw materiaal is gesedimenteerd.

Soortenrijkdom varieerde eveneens sterk tussen de locaties, transecten en dieptes. Er is geen duidelijke trend zichtbaar.

Diversiteit is naast soortenrijkdom ook uitgedrukt aan de hand van een aantal diversiteitsindices (Shannon-Wiener Index en Evenness), waarbij niet alleen het aantal soorten, maar ook de verdeling van de individuen over de soorten in rekening wordt gebracht. Diversiteit gemeten tijdens de T0-monitoring van Cluster 1 (2009) en 2 (2010) is het laagst op de locatie Burghsluis-west. Er kon geen score berekent worden voor Schelphoek-oost 3 m en 7 m diepte vanwege het lage aantal organismen dat is aangetroffen in deze monsters. Diversiteit op 15 m diepte op de locatie Schelphoek-oost van Cluster 1 is tijdens T1 lager dan tijdens T0. De diversiteit op 15 m diepte op de locatie Zeelandbrug-De Val is vergelijkbaar tijdens de T0 en T1. Er is geen algemene trend voor Evenness aanwezig voor de verschillende locaties.

Op basis van de T0-monitoring in 2009 (Cluster 1) en 2010 (Cluster 2) kunnen drie gemeenschappen van bodembewonde organismen worden vastgesteld in de Oosterschelde. De soortenrijke gemeenschap C is aanwezig op de dieper gelegen monsterpunten van Cluster 1 (ten oosten van Schelphoek-west II). Op de meest westelijk gelegen locaties is de soortenarme variant A aangetroffen. Op de oostelijk gelegen locaties is op 3 m en 7 m gemeenschap B aangetroffen. De totale dichtheid van individuen per m^2 in deze gemeenschappen (3074-5957 per m^2) is hoog in vergelijking met dichtheden zoals aangetroffen in het Biologisch Monitorings Programma 2000-2005 (2000 individuelen per m^2). Na versterking van de vooroevers is op enkele locaties een nieuwe laag fijn sediment terechtgekomen. Op de locatie Schelphoek-oost is dit pakket dik genoeg voor bemonstering en analyse. Hierin hebben zich de eerste bodemdieren kunnen vestigen. Het betreft zeven soorten met gemiddeld vier individuen per m2. Dit is nog laag in vergelijking tot de oorspronkelijke gemeenschap, die tijdens de T0 in 2009 is aangetroffen, maar laat zien dat rekolonisatie inmiddels aan het plaatsvinden is.

Deze data vormen een geschikte basis om toekomstige monitoringsdata mee te vergelijken en een eerste beeld van rekolonisatie van nieuw gesedimenteerd materiaal te krijgen. Wel zal er in de toekomst rekening gehouden moeten worden met de grote spreiding in resultaten binnen locaties, en tussen locaties, transecten, dieptes en replica's. Aanbevolen wordt om een groter aantal replica's te bemonsteren, waardoor er een meer betrouwbaar beeld van de aanwezige en zich ontwikkelende benthische levensgemeenschappen ontstaat.

Abstract

In this study we compile data of the current benthic community structure in the Oosterschelde Estuary in seven locations prior to dyke reinforcement activities in the area (T0) and in two of those location immediately after reinforcement (T1). These data are intended for future comparison with data to be collected at the same locations on several occasions after reinforcement to investigate possible effects on the local benthic community.

Sampling locations were divided into clusters, which indicate the time of dyke reinforcement; locations in Cluster 1 indicate reinforcement carried out in 2009/2010, Cluster 2 indicate reinforcement to be carried out in 2011/2012. Samples of benthic infauna species were collected in 2009 at five Cluster 1 locations (Schelphoek-west, Schelphoek-oost, Lokkersnol-oost, Zeelandbrug-De Val and Zeelandbrug-west) for T0 and at two of those locations (Schelphoek-oost at all three depths and Zeelandbrug-De Val at 15 m) for T1 in 2010. Two Cluster 2 locations were also sampled (Burghsluis-west, Schelphoek-west II in 2010). At each location, three depths were sampled (3 m, 7 m, 15 m). Samples for Cluster 1 for T0 were collected in September 2009 and for T1 in September 2010, and were then further analysed in the lab. Samples for Cluster 2 were collected in September 2010.

This preliminary study of the benthic infauna surrounding the base of dykes showed a varied diversity between locations, depths, replicates and, for Schelphoek-oost and Zeelandbrug-De Val, between T0 and T1. However, certain trends could be seen. In particular the dominance and diversity of annelids (worms) was obvious in all locations.

At each location, each sample showed variable mean total abundance (number per m^2) of organisms. There is no common pattern between the number of species per depth.

Mean total abundance at Schelphoek-oost in T0 was considerably higher than in T1. At 3 m and 7 m depth, only one organism was found during sampling for T1 compared with a mean of 14.5 and 24 organisms in T0 respectively, while at 15 m depth a mean of 13.5 organisms were found during sampling for T0 compared with 5.5 for T1. At Zeelandbrug-De Val total abundance was higher in T1 compared with T0 at 15 m. A mean of 18 organisms were found during sampling for T0 compared with a mean of 31.5 organisms for T1.

There was also a wide variety of species richness between locations and depths, and there was no obvious general trend.

Diversity (expressed as the Shannon-Wiener Index) also varied between locations and depths. Of the Cluster 1 locations, diversity was lowest for the 3 m samples in all locations. Diversity as measured during the T0-monitoring of Cluster 1 (2009) and 2 (2010) is lowest at the location Burghsluis-west. Of the T0 Cluster 1 locations (2009), Lokkersnol-oost showed the highest diversity (mean score of 2.8 at 15 m depth), while Lokkersnol-oost showed the lowest diversity (mean score of 0.8 at 3 m depth). Of the T0 Cluster 2 locations (2010) mean diversity was highest at Schelphoek-west II at 7 m depth (1.8) and lowest at Burghsluis-west at 7 m.

No diversity score was calculated for Schelphoek-oost at 3 m and 7 m depth for T1 due to the lack of organisms found there, while in T0 the mean diversity scores were 1.1 and 1.8 respectively. At 15 m depth diversity score was higher in T0 (mean score of 1.3) compared with T1 (mean score of 0.85). At Zeelandbrug-De Val at 15 m diversity was slightly higher for T0 (mean score of 2.1) compared with T1 (mean score of 2.08).

There was no general trend in Evenness across locations.

In the T0-situation in 2009 (Cluster 1) and 2010 (Cluster 2) there were three main community groups of benthic fauna present in the Oosterschelde. The species-rich community C was present in the east of the location Schelphoek-west II at all locations and particularly at deeper depths. In the western locations there was the species-poor community A and community B in shallow depths at the locations Lokkersnol-oost and Zeelandbrug-De Val. The total abundance of individuals per m^2 in these communities (3074-5957 per m^2) is high in comparison with the density found in the Biological Monitoring Programme in 2000-2005, where the density in the sublittoral was around 2000 individuals per m^2. After the reinforcement of the dykes at some locations fine particle sediment developed. In the T1-situation in 2010 (Cluster 1) one main group and three species poor variants were present. From this the first species of benthic fauna to establish could be identified. Only 7 species with an average density of 4 individuals per m^2 were found in the new sediment.

This data provides an adequate basis for comparison for future surveys conducted after dyke reinforcement. However the variation seen in the data between locations, depths and replicates must be taken into account during future comparisons. More replicate samples will reduce standard errors in future monitoring campaigns.

1. Introduction

In 2010 the base of several parts of the dykes in the Oosterschelde were strengthened. To investigate any changes in species communities that may have occurred due to this activity, it is important to have a reliable basis for comparison. In this study we compile data of the current benthic community structure in seven locations at three different depths in the Oosterschelde prior to the dyke enforcement. These data are intended for future

comparison with data to be collected at the same locations after reinforcement to investigate possible effects on the local benthic community. This report follows the 'cluster 1' report on the data collected in 2009 (Van den Brink and Brummelhuis, 2009) and the 2010 data reported here are also integrated in an overview report describing the outcomes of research on epifauna and heavy metal analyses (Van den Heuvel-Greve et al., 2011).

In 2010, following some reinforcement activities, data was again collected from two previously sampled locations; Schelphoek Oost at three depths, and Zeelandbrug-de Val at one depth. This report presents and compares data from before the reinforcement (T0) and after the reinforcement (T1). At this time Cluster 2 locations were also monitored for T0.

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2. Materials and Methods

2.1 Sampling

Sampling locations were divided into clusters. Clusters indicate the time of dyke reinforcement; locations in Cluster 1 indicated reinforcement carried out in 2009/2010, Cluster 2 indicated reinforcement to be carried out in 2011/2012.

Sampling was conducted by Stichting de Zeeschelp in two transects at five Cluster 1 locations: Schelphoek-west, Schelphoek-oost, Lokkersnol-oost, Zeelandbrug-De Val and Zeelandbrug-west. Schelphoek-west, Schelphoek-oost, Lokkersnol-oost, Zeelandbrug-De Val and Zeelandbrug-west were initially sampled between 1-18 September 2009 (T0) (see van den Brink & Brummelhuis, 2009). Schelphoek-oost and Zeelandbrug De Val (at 15 m depth) were again sampled between 10-19 October 2010 (T1). The two Cluster 2 locations: Burghsluis-west and Schelphoek-west II were sampled between 2-5 September 2010.

Three cores per sample were collected using a sediment core (65 mm in diameter). At all locations two replicate samples per depth were collected along a transect, resulting in two replicate samples per depth per location. At Lokkersnol-oost two transects were sampled resulting in four replicate samples per depth. Although the depths sampled were not the exactly same for all locations, they are termed 3 m, 7 m and 15 m here for ease of comparison (Table 1). Samples were stored in formalin and kept at room temperature until further analysis. For further details on sampling methods see De Kluijver & Dubbeldam (2009, 2010).

The samples were sorted in the lab of IMARES and species in each sample were identified and counted. Oligochaetes were unable to be identified to species level, and were therefore grouped and labelled under the Subclass Oligochaeta.

Due to either the presence of only a fragment of the individual or a juvenile stage of an individual, a few individuals could not be identified to species level, but only to a higher taxonomic level:
-*Actinaria*: may consist of two unidentified species.
-*Glycera* spec.: the species name could not be identified
-*Neoamphitrite* spec.: the species name could not be identified, possibly *Neoamphitrite figulus*
-*Ensis* spec: the species name could not be identified, most likely *Ensis directus*.

Other individuals which could also not be identified to species level may overlap with other individuals that were identified to species level (see table 1):
-*Anaitides* spec.: these may overlap with *Anaitides mucosa.*
-Aoridae: may overlap with *Aora typical*
-Bivalva undet: may overlap with *Abra alba*, *Mysella bidentata*, *Petricola pholadiformis*
-*Corophium* spec: may overlap with *Corophium sextone* or unknown.
-*Eteone* spec.: may overlap with Eteoninae
-*Melita* spec.: may overlap with *Melita obtusata*
-*Nereis* spec.: may overlap with *Nereis virens*, *Nereis diversicolor* or *Nereis longissima*
-*Ophiura* spec.: may overlap with *Ophiura albida*.
-Pollynoidae: may overlap with *Malmgreniella lunulata* or *Stenelais boa*
-Polychaeta spec: may overlap with several polychaete species.

Of the group of Nemertinae most of the individuals may have disappeared during the sieving process. The numbers found in the tables may therefore be an underestimation of the actual numbers present in the original sediment.

One species recently received a new name. Only the newly accepted name is used in this report:
-Accepted name: *Malmgreniella lunulata*
-Old name: *Harmothoe lunulata*

Of the following species a lot of juvenile individuals were present in the samples: *Cossura longocirrata*, *Eteoninae*, *Spiophanus bombyx*, *Aphelochaeta marioni.* Of the following species almost all individuals were present as juveniles or subadults: *Capitella capitata*, *Heteromastus filiformis*, *Scoloplos armiger*. This is due to the season of collection (September), when a lot of young organisms are present in the environment (Beukema, 1974).

On three occasions only an unidentifiable fragment of an organism was recovered, these were identified as three separate organisms and were therefore subsequently referred to as Unknown 1, Unknown 2 and Unknown 3.

Table 1. Actual depths (m) of sampling and what they are referred to in the present report.

Cluster	Sampling Year	Sampling Location	T	Depth stated in report		
				3 m	7 m	15 m
				Actual Depth Sampled (m)		
2	2010	Burghsluis-west	0	5	10	15
2	2010	Schelphoek-west II	0	3	7.5	15
1	2009	Schelphoek-west	0	3	7.5	15
1	2009	Schelphoek-oost	0	3	7	9
1	2010	Schelphoek-oost	1	3	9	15
1	2009	Lokkersnol-oost	0	3	7	15
1	2009	Zeelandbrug-De Val	0	3	7	15
1	2010	Zeelandbrug-De Val	1			12.5
1	2009	Zeelandbrug-west	0	3	7	15

3. Data analysis

3.1 Abundance

Total abundance is the total number of individuals in a given area.

From the number of individuals per sample, the number per m^2 was calculated using the formula:

$$\chi = n / (3 \times (\pi \times 3.25^2)) \times 10000$$

where n is the number of individuals per sample. From this equation it was possible to estimate and compare n/m^2 between replicates, depths and locations.

3.2 Species richness

Species richness (S) is the number of different species in a given sample.

3.3 Indices

Shannon-Wiener Index
The Shannon-Wiener index is one of several diversity indices used to measure diversity in categorical data. It is simply the information entropy of the distribution, treating species as symbols and their relative population sizes as the probability. It takes into account the number of species and the evenness of the species and has the base

assumptions that all species in the community have been sampled and that the sampling was completely random. The score is increased either by having additional unique species, or by having a greater species evenness.

To gain an indication of species diversity, the Shannon-Wiener Diversity Index was applied to the data with the equation:

$$H = -\Sigma\ p_i \ln(p_i)$$

Where p_i is the relative abundance of each species,. This index measures the species composition of a sample by adding the relative abundance of each species. Greater scores indicate higher species diversity.

Evenness

Evenness is the measure of how similar the abundances of different species are. When the proportions of all species in the sample are similar, evenness is high, while when the proportions are very dissimilar (some rare and some common species) the value decreases. Evenness was calculated using the Pielou Index with the equation:

$$E = H / \log(S)$$

Where S is the species richness (number of species). This formula is based on the Shannon-Wiener Diversity index, but only takes into account the relative abundances of each species within the sample.

3.4 Soft substrate communities in the Oosterschelde

To determine whether there was a change at the community level a cluster analysis was conducted by Mario de Kluijver (Stichting Zeeschelp) with the data from the T_0 and T_1 inventory of species for 2009 and 2010. The data was log transformed using the program MVSP (Kovach, 1999) with the Bray-Curtis' coefficient in combination with the 'average-linkage' method. Sediment characteristics of the top few centimetres were determined by sieving samples through seven calibrated sieves (mesh size: 2.8-0.053 mm).

4. Results

4.1 Species Composition

The abundances and type of species varied between locations and depths (Table 2). There was also variation between replicates and depths (see appendices A and B for raw data from 2010 and Van den Brink & Brummelhuis, (2009) for raw data from 2009). Most of the locations were dominated in abundance by annelid polychaetes (worms), but there were generally also bivalve molluscs (shell fish) and crustaceans (phylum: Arthropoda) present along with some cnidarians (such as anemones), echinoderms (such as seastars) and other taxonomic groups.

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Table 2. The mean number per sample and number per m^2 of each species in each transect (see appendices A and B for raw data from 2010 and Van den Brink & Brummelhuis, (2009) for raw data from 2009.

Location	Phylum	Species	Depth					
			3 m		7 m		15 m	
			Mean n per sample	Mean n per m^2	Mean n per sample	Mean n per m^2	Mean n per sample	Mean n per m^2
Cluster 2: Burghsluis-west (T0)	Annelida	*Aphelochaeta marioni*	9.5	954.3			1.5	150.7
		Heteromastus filiformis	1.5	150.7			4	401.8
		Nephtys (spec)	0.5	50.2				
		Nephtys hombergii					2	200.9
		Oligochaeta	22.5	2260.2	35	3515.8	88	8839.8
		Scoloplos armiger	0.5	50.2				
		Streblospio benedicti			0.5	50.2	1.5	150.7
	Arthropoda	*Melita obtusata*	0.5	50.2				
	Cnidaria	Actiniaria	0.5	50.2	0.5	50.2		
	Echinodermata	*Echinocadium cordatum*					1	100.5
		Ophiothrix fragilis	0.5	50.2	0.5	50.2		
	Mollusca	*Montacuta ferruginosa*					0.5	50.2
Cluster 2: Schelphoek-west II (T0)	Annelida	*Aphelochaeta marioni*	0.5	50.2	4	401.8	4	401.8
		Cossura longocirrata					0.5	50.2
		Heteromastus filiformis	0.5	50.2	2	200.9	1	100.5
		Lanice conchilega					0.5	50.2
		Nephtys (spec)	1	100.5	0.5	50.2		
		Nephtys hombergii	2	200.9			2	200.9
		Oligochaeta	5	502.3	2	200.9		
		Polydora cornuta (ligni)			0.5	50.2	0.5	50.2
		Scoloplos armiger			0.5	50.2	0.5	50.2
		Streblospio benedicti	2.5	251.1	3	301.4	1	100.5
	Arthropoda	Caprellidae			0.5	50.2		
	Cnidaria	Actiniaria	2.5	251.1	1.5	150.7	1.5	150.7
	Mollusca	*Abra alba*			0.5	50.2		
		Bivalva			2	200.9	0.5	50.2
		Gastropoda			0.5	50.2		
	Phoronida	Phoronida	0.5	50.2	6.5	652.9	1.5	150.7
Cluster 1: Schelphoek-west (T0)	Annelida	*Aonides oxycephala*			0.5	50.2		
		Aphelochaeta marioni	7	703.2	18	1808.2		
		Cossura longocirrata			0.5	50.2		
		Eteone (spec.)			0.5	50.2		
		Heteromastus filiformis	1	100.5	2.5	251.1	7.5	753.4
		Neoamphitrite (spec.)	0.5	50.2				
		Nephtys hombergii	1	100.5	0.5	50.2	1	100.5
		Nereis (spec)	0.5	50.2				
		Nereis longissima			1.5	150.7		
		Nereis virens					0.5	50.2
		Notomastus latericeus			1	100.5	1	100.5
		Oligochaeta	1	100.5	4.5	452.0	7.5	753.4
		Owenia fusiformis					0.5	50.2
		Pholoe minuta					0.5	50.2
		Polychaeta (spec.)					0.5	50.2
		Polycirrus (spec.)					0.5	50.2
		Polydora cornuta (ligni)			13	1305.9		
		Scoloplos armiger			1.5	150.7	5.5	552.5
		Spio martinensis			0.5	50.2		
		Spiophanes bombyx			1	100.5		
		Stenelais boa			1	100.5	2	200.9
		Streblospio benedicti	1.5	150.7	1	100.5	1	100.5
	Arthropoda	*Ampelisca brevicornis*			0.5	50.2		
		Amphipoda (spec.)			1	100.5		
		Corophium spec.					1	100.5
		Decapoda			0.5	50.2		
		Caprellidae					0.5	50.2
		Nymphon (spec)			0.5	50.2		
	Cnidaria	Actiniaria			1	100.5	3	301.4
	Mollusca	*Abra alba*					0.5	50.2
		Bivalve spec.					0.5	50.2
		Mysella bidentata			0.5	50.2		
		Petricola pholadiformis			1	100.5		

Location	Phylum	Species	Depth					
			3 m		7 m		15 m	
			Mean n per sample	Mean n per m^2	Mean n per sample	Mean n per m^2	Mean n per sample	Mean n per m^2
	Phoronida	Phoronida			4.5	452.0	0.5	50.2
Cluster 1: Schelphoek-oost (T0)	Annelida	*Anaitides* (spec.)					0.5	50.2
		Aphelochaeta marioni	1.5	150.7	3	301.4	0.5	50.2
		Capitella capitata					1.5	150.7
		Cossura longocirrata	3	301.4	0.5	50.2	0.5	50.2
		Gattyana cirrosa			2	200.9		
		Hesionidae			0.5	50.2	0.5	50.2
		Heteromastus filiformis	0.5	50.2	3	301.4	2.5	251.1
		Nephtys hombergii	1	100.5	1.5	150.7	1	100.5
		Nereis longissima					0.5	50.2
		Oligochaeta	13	1305.9	3.5	351.6	48.5	4872.0
		Owenia fusiformis					0.5	50.2
		Polychaeta (spec.)					0.5	50.2
		Pygospio elegans					0.5	50.2
		Scoloplos armiger			0.5	50.2	1.5	150.7
		Spiophanes bombyx					0.5	50.2
		Stenelais boa			1	100.5	1	100.5
	Arthropoda	*Bathyporeia*			1	100.5		
		Melita (spec.)					1	100.5
		Melita obtusata			0.5	50.2	0.5	50.2
	Cnidaria	Actiniaria	0.5	50.2	1.5	150.7	3	301.4
	Echinodermata	*Ophiothrix fragilis*	0.5	50.2	0.5	50.2		
	Mollusca	*Abra alba*					0.5	50.2
		Tellina fabula					0.5	50.2
	Nemertea	Nemertea			16	1607.2	0.5	50.2
	Phoronida	Phoronida			2.5	251.1	0.5	50.2
Cluster 1: Schelphoek-oost (T1)	Annelida	*Malmgreniella lunulata*					0.5	50.2
	Arthropoda	*Photis spec.*					0.5	50.2
	Chordata	Ascidiacea					0.5	50.2
	Cnidaria	Actiniaria					3.5	351.6
	Echinodermata	*Asteria rubens*					0.5	50.2
	Mollusca	*Mytilus edulis*	0.5	50.2				
		Nudibranchia			0.5	50.2		
Cluster 1: Lokkersnol-oost (T0)	Annelida	*Ampharete acutifrons*					4	401.8
		Anaitides (spec.)			0.5	50.2	0.5	50.2
		Anaitides mucosa					1.5	150.7
		Aonides oxycephala					0.25	25.1
		Aphelochaeta marioni	2	200.9	0.25	25.1	4	401.8
		Capitella capitata	0.5	50.2				
		Cossura longocirrata	2.25	226.0	1.5	150.7	1.5	150.7
		Eteone (spec.)					0.5	50.2
		Eteoninae					0.5	50.2
		Exogone naidina	0.25	25.1			0.75	75.3
		Gattyana cirrosa					2.75	276.2
		Heteromastus filiformis	0.5	50.2	0.5	50.2	8.25	828.7
		Kefersteinia cirrata					1	100.5
		Lanice conchilega					1	100.5
		Lepidonotus (spec.)					0.25	25.1
		Neoamphitrite figulus					5.75	577.6
		Nephtys hombergii			0.75	75.3	6.5	652.9
		Nereis diversicolor					1.5	150.7
		Notomastus latericeus					3	301.4
		Oligochaeta	32.75	3289.8	9.25	929.2	14	1406.3
		Owenia fusiformis			1	100.5	1.5	150.7
		Pholoe minuta					8.25	828.7
		Plathynereis dumerilli					0.5	50.2
		Polycirrus (spec.)					13.5	1356.1
		Pygospio elegans			0.5	50.2		
		Scoloplos armiger					14.75	1481.7
		Stenelais boa					1.25	125.6
		Streblospio benedicti	0.25	25.1			2	200.9
	Arthropoda	Caprellidae					1.75	175.8
		Ampelisca brevicornis					1.5	150.7
		Amphipoda (spec.)					0.5	50.2

Location	Phylum	Species	Depth					
			3 m		7 m		15 m	
			Mean n per sample	Mean n per m^2	Mean n per sample	Mean n per m^2	Mean n per sample	Mean n per m^2
		Aora typica					0.5	50.2
		Aoridae			0.5	50.2	3.5	351.6
		Bodotria scorpiodes					1.5	150.7
		Carcinus maenas					0.5	50.2
		Corophium sextonae					2.5	251.1
		Corophium spec.					1.25	125.6
		Crangon crangon			0.25	25.1	0.5	50.2
	Cnidaria	Actiniaria					1.5	150.7
	Echinodermata	Ophiura					1	100.5
		Ophiura albida					1.5	150.7
	Mollusca	*Abra alba*			1.25	125.6	4	401.8
		Abra nitida					0.5	50.2
		Crepidula fornicata			0.25	25.1	1.5	150.7
		Macoma balthica			0.25	25.1	0.5	50.2
		Mya arenaria			0.25	25.1		
		Mytilus edulis					1.75	175.8
		Petricola pholadiformis					0.25	25.1
		Venerupis senegalensis			0.75	75.3	0.25	25.1
	Nemertea	Nemertea	0.75	75.3	0.5	50.2	0.5	50.2
	Phoronida	Phoronida					1.75	175.8
		onbekend	1.625	163.2	0.5	50.2	0.5	50.2
Cluster 1: Zeelandbrug-De Val (T0)	Annelida	*Ampharete acutifrons*					0.5	50.2
		Aphelochaeta marioni	4	401.8	2	200.9		
		Capitella capitata	7.5	753.4	1	100.5		
		Cossura longocirrata	10.5	1054.8	2	200.9	0.5	50.2
		Exogone naidina			1	100.5		
		Glycera (spec)					0.5	50.2
		Hesionidae			0.5	50.2		
		Heteromastus filiformis	2.5	251.1	0.5	50.2	0.5	50.2
		Lanice conchilega					0.5	50.2
		Neoamphitrite (spec.)					0.5	50.2
		Nephtys hombergii	1	100.5	1	100.5	3	301.4
		Nereis (spec)			0.5	50.2	1	100.5
		Oligochaeta	22	2210.0	4	401.8	5	502.3
		Pholoe minuta					0.5	50.2
		Polycirrus (spec.)	1	100.5				
		Polynoidae					0.5	50.2
		Scoloplos armiger	1.5	150.7	0.5	50.2	1	100.5
		Spiophanes bombyx					0.5	50.2
		Streblospio benedicti	3	301.4	3.5	351.6		
	Arthropoda	Aoridae	1	100.5	2.5	251.1	0.5	50.2
		Crangon crangon	0.5	50.2	0.5	50.2		
	Cnidaria	Actiniaria			0.5	50.2	1.25	125.6
	Echinodermata	*Ophiothrix fragilis*					0.5	50.2
	Mollusca	*Ensis* (spec.)			0.5	50.2		
	Nemertea	Nemertea	2	200.9				
	Phoronida	Phoronida					0.5	50.2
		onbekend	0.5	50.2				
Cluster 1: Zeelandbrug-De Val (T1)	Annelida	*Ampharete acutifrons*					1	100.5
		Anaitides mucosa					3.5	351.6
		Autolytus (spec)					0.5	50.2
		Eumida (spec.)					1	100.5
		Heteromastus filiformis					1	100.5
		Lanice conchilega					1.5	150.7
		Nephtys (spec)					0.5	50.2
		Nereis diversicolor					0.5	50.2
		Notomastus latericeus					0.5	50.2
		Scoloplos armiger					10.5	1054.8
		Syllis gracillis					0.5	50.2
	Arthropoda	*Bodotria pulchella*					0.5	50.2
		Brachyura					0.5	50.2
		Cheirocratus sundevallii					1.5	150.7
		Decapoda					3	301.4
	Cnidaria	Actiniaria					2	200.9

Location	Phylum	Species	Depth					
			3 m		7 m		15 m	
			Mean n per sample	Mean n per m^2	Mean n per sample	Mean n per m^2	Mean n per sample	Mean n per m^2
	Echinodermata	Ophiura					1	100.5
	Mollusca	*Abra alba*					0.5	50.2
		Crepidula fornicata					0.5	50.2
		Ensis (spec.)					0.5	50.2
Cluster 1: Zeelandbrug-west (T0)	Annelida	*Ampharete acutifrons*					0.5	50.2
		Anaitides (spec.)	1.5	150.7				
		Anaitides mucosa					0.5	50.2
		Aonides oxycephala	1.5	150.7				
		Aphelochaeta marioni	1.5	150.7	0.5	50.2	1	100.5
		Eteoninae	1.5	150.7				
		Exogone naidina	0.5	50.2	0.5	50.2	0.5	50.2
		Glycera (spec)	1	100.5	0.5	50.2	0.5	50.2
		Hesionidae	1	100.5	0.5	50.2		
		Heteromastus filiformis	18.5	1858.4	0.5	50.2	1	100.5
		Lanice conchilega	0.5	50.2	0.5	50.2		
		Malmgreniella lunulata	0.5	50.2			1	100.5
		Nephtys hombergii	2.5	251.1	1	100.5	1	100.5
		Notomastus latericeus	3.5	351.6			1.5	150.7
		Oligochaeta	43	4319.5	0.5	50.2	1	100.5
		Owenia fusiformis	0.5	50.2				
		Pholoe minuta	2	200.9	1	100.5		
		Plathynereis dumerilli	0.5	50.2				
		Polychaeta (spec.)			0.5	50.2		
		Polycirrus (spec.)	1	100.5				
		Polydora pulchra	0.5	50.2				
		Scoloplos armiger	7.5	753.4	0.5	50.2	0.5	50.2
		Stenelais boa	1	100.5	0.5	50.2		
	Arthropoda	*Ampelisca brevicornis*					1	100.5
		Amphipoda *(spec.)*	0.5	50.2	2	200.9	1	100.5
		Aoridae	1	100.5				
		Caprellidae			4.5	452.0	0.5	50.2
		Carcinus maenas			0.5	50.2		
		Corophium spec.	0.5	50.2				
		Perioculodes longimanus			0.5	50.2		
	Bryozoa	Bryozoa					0.5	50.2
	Cnidaria	Actiniaria	1	100.5	0.5	50.2		
	Echinodermata	*Ophiothrix fragilis*					0.5	50.2
	Mollusca	*Abra alba*	1	100.5	0.5	50.2		
		Abra nitida					0.5	50.2
		Crepidula fornicata	0.5	50.2				
		Ensis (spec.)			1	100.5		
		Venerupis senegalensis	0.5	50.2				
	Phoronida	Phoronida	0.5	50.2				
	Platyhelminthes	Platyhelminthes	0.5	50.2	0.5	50.2		
		onbekend	1	100.5	0.5	50.2	0.5	50.2

4.2 Community composition per location

In the following analyses of community composition, not all species could be identified to species level (as is particularly the case with oligochaetes), but for ease of reading, all higher taxonomic groups are also referred to as 'species'. Care should therefore be taken when interpreting the results to avoid invalid comparisons between different taxonomic groups.

4.2.1 Cluster 2: Location Burghsluis-west

At Burghsluis-west there was a range of taxonomic groups found in at all depths, but all depths were largely dominated by oligochaete annelids (Figure 1). At 3 m oligochaete annelids comprised 63% of the community followed by the polychaete annelids which comprised 33% of the community and included *Aphelochaeta marioni* (26%), *Heteromastus filiformis* (4%). *Scoloplos amiger* (1.3%)and *Nephtys* (spec) (1.3%). The other species present, one actinarian (phylum: Cnidaria), one echinoderm (*Ophiothrix fragilis*) and one crustacean (Phylum: Arthropoda), *Melita obtusata,* comprised 1.3% of the community each.

At 7 m, oligochaete annelids comprised 96% of the community while the other species present included one annelid polychaete (*Streblospio benedicti*), one echinoderm (*Ophiothrix fragilis*) and one actinarian (phylum: Cnidaria). These species each comprised 1.3% of the community.

At 15 m oligochaete annelids comprised 89% of the composition followed by the polychaete annelids which comprised 9% of the community and included *Heteromastus filiformis* (4%), *Nephtys hombergii* (2%), *Streblospio benedicti* and *Aphelochaeta marioni* (1.5% each). Other species present included the mollusc bivalve *Montacuta ferruginosa*, the annelid polychaetes and the echinoderm *Echinocadium cordatum* (1.5% each).

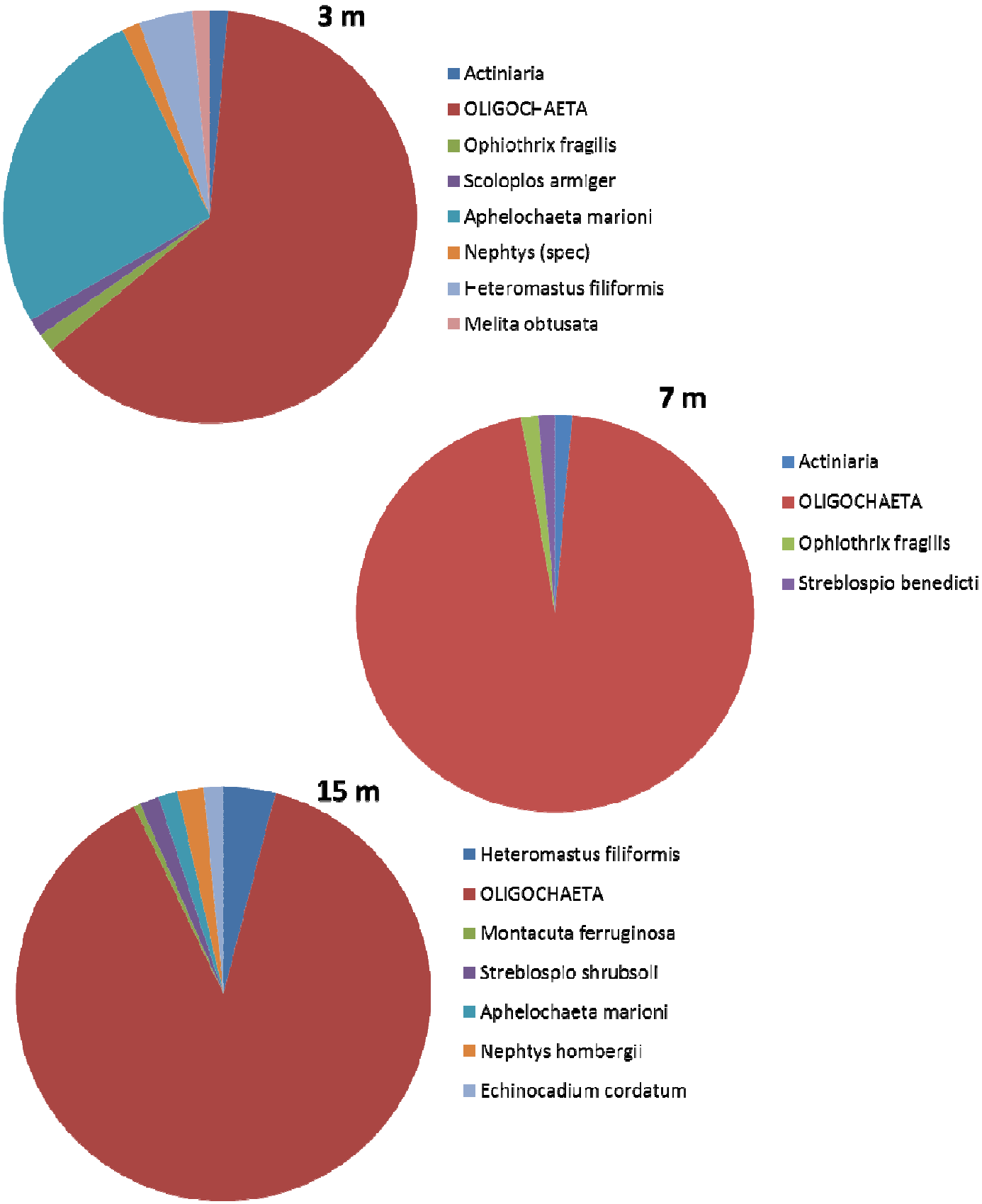

Figure 1. Community composition (number of individuals of species per m^2) at Burghsluis-west at 3, 7, and 15 m (total from two replicate samples) for Cluster 2, T0, 2010.

4.2.2 Cluster 2: Location Schelphoek-west II

At Schelphoek-west II there was a range of taxonomic groups found in at all depths (

Figure 2). At 3 m polychaete annelids were the most abundant, comprising 45% of the community and included *Streblospio benedicti* (17%), *Nephtys homergii* (14%), *Nephtys* (spec) (7%), *Heteromastus filiformis* and *Aphelochaeta marioni* (3.5% each). Oligochaete annelids comprised 34.5% of the community followed by actinarians (phylum: Cnidaria) (17%) and species from the phylum Phoronida (3.5%).

At 7 m depth polychaete annelids were the most abundant (38%) and included *Aphelochaeta marioni* (17%), *Streblospio benedicti* (13%) and *Heteromastus filiformis* (8.3%), followed by species from the phylum Phoronida (27%), oligochaete annelids (8.3%) and bivalve molluscs (8.3%). The other species present comprised 2% of the community each.

At 15 m polychaete annelids were the most abundant, comprising 75% of the community and included *Aphelochaeta marioni* (30%), *Nephtys hombergii* (15%), *Streblospio benedicti* (7%) and *Heteromastus filiformis* (7%) and four others comprising 4% each. Other species and groups present included actinarians (phylum: Cnidaria), species from the phylum Phoronida (11% each), and bivalve molluscs (4%).

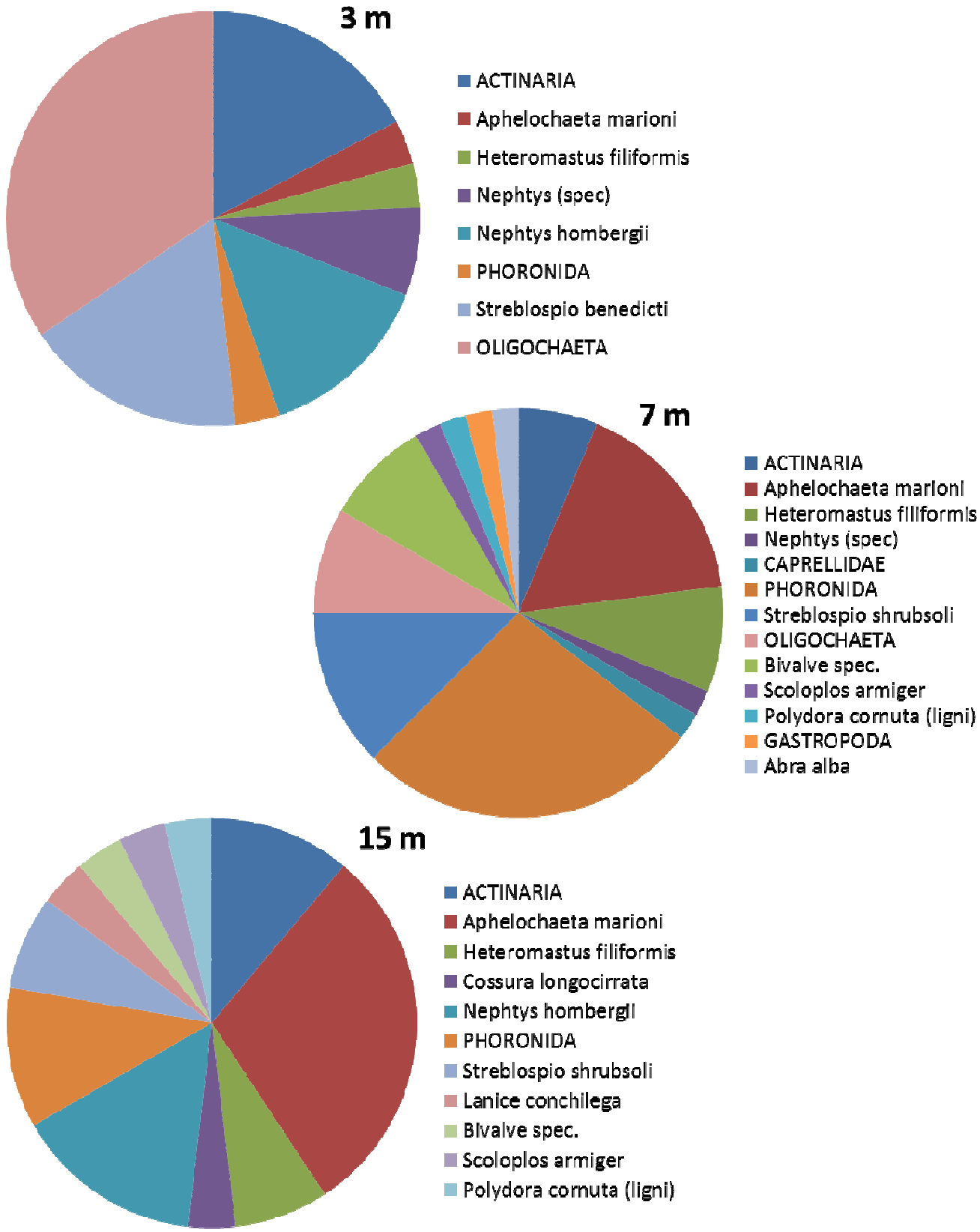

Figure 2. Community composition (number of individuals of species per m^2) at Schelphoek-west II at 3, 7, and 15 m (total from two replicate samples) for Cluster 2, T0, 2010.

4.2.3 Cluster 1: Location Schelphoek-west

At Schelphoek-west there was a range of taxonomic groups found in at all depths (Figure 3). At 3 m the entire community was made up of annelids. Polychaetes were the dominant class, comprising 92% of the community and included *Aphelochaeta marioni* (56%), *Streblospio benedicti* (12%), *Heteromastus filiformis* and *Nephys hombergii* (both 8%), *Nereis* (spec) and *Neoamphitrite* (spec) (both 4%). Ologocahete species comprised the remainding 8% of the community.

At 7 m a wider range of species was present. But the polychaete annelids were still dominant, comprising 53% of the community, with *Aphelochaeta marioni* again the most abundant at 32% of the community followed by *Polydora cornuta* (23%) and others comprising 1-4%. The other species present included the gammarid (phylum: Arthropoda) *Ampelisca brevicornis*, and the group of oligochaete annelids (both 8%). The rest of the species each made up 1-4% of the community and comprised of various actinarians (phylum Cnidaria), species from the phylum Phoronida, crustaceans (Phylum: Arthropoda) and molluscs.

At 15 m polychaete annelids were the most abundant, comprising 44% of the community and included *Heteromastus filiformis* (22%), *Scoloplos armiger* (16%) and *Stenelais boa* (6%) along with others each comprising 1-3% of the community. The group of oligochaete annelids were the next most abundant (22%), while the rest of the community was made up of a range of species (each 1-3%) including actinarians (phylum: Cnidaria), molluscs and crustaceans (phylum: Arthropoda).

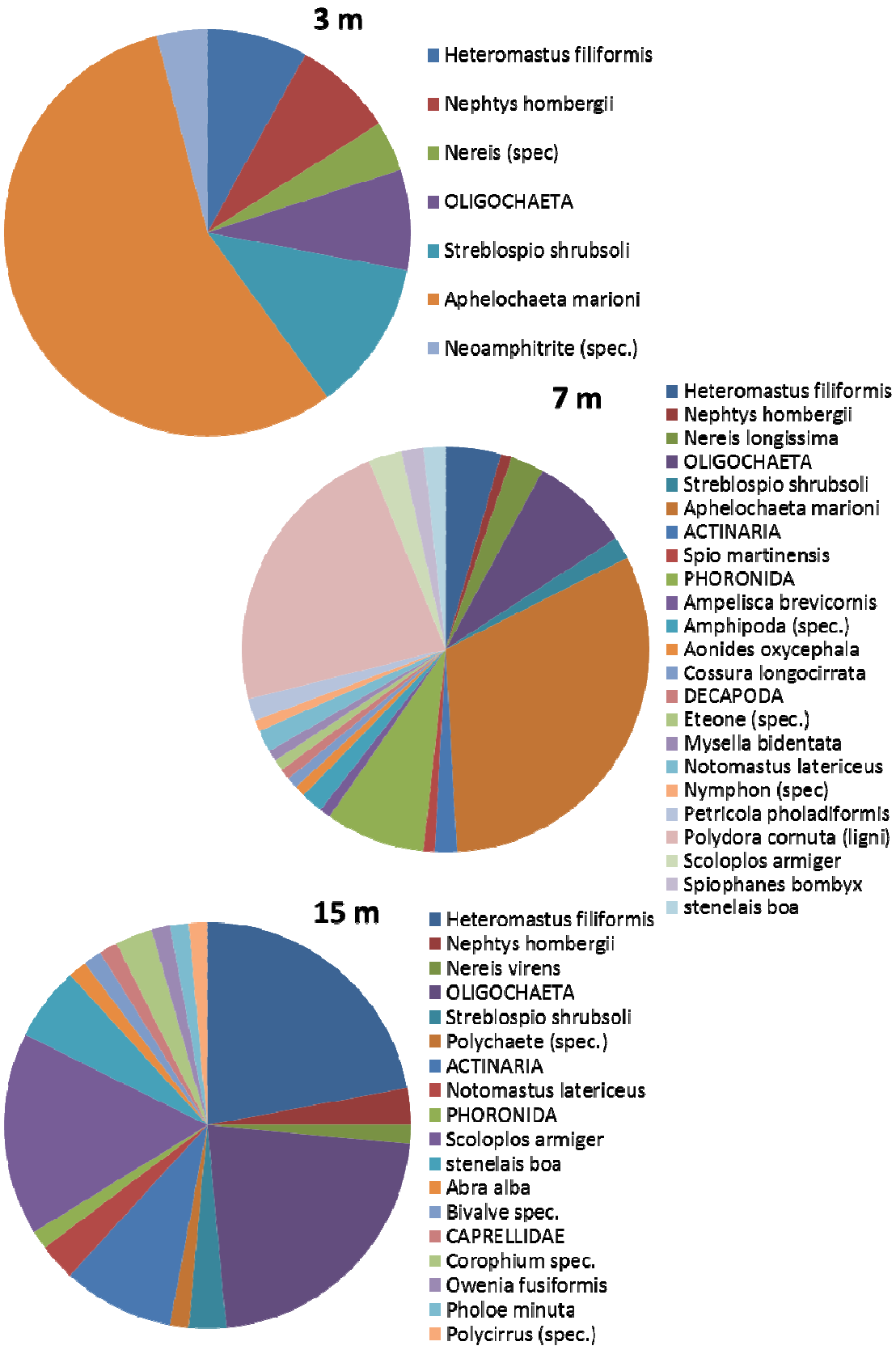

Figure 3. Community composition (number of individuals of species per m^2) at Schelphoek-west at 3, 7, and 15 m (total from two replicate samples) for Cluster 1, T0, 2009.

4.2.4 Cluster 1: Location Schelphoek-oost

At Schelphoek-oost there was a range of taxonomic groups found in at all depths for T0 (Figure 4Figure 3). At 3 m the community was dominated by oligochate annelid species (65%) followed by the polychaete annelids (46%) including *Cossura longocirrata* (15%), *Aphelochaeta marioni* (8%) and *Nephtys hombergii* (5%) and *Heteromastus filiformis* (3%). The echinoderm *Ophiothrix fragilis* and actinarian cnidarians each comprised 3% of the community.

For T1 at 3 m, only one individual mussel, *Mytilus edulis* (phylum Mollusca) was found.

At 7 m depth there was a wider range of species found compared with 3 m. Species from the phylum Nemertea were the most abundanct, comprising 42% of the community. The next most abundant were polychaete annelids (26%) including *Heteromastus filiformis* and *Aphelochaeta marioni* (both 8%) and other species comprising 1-5% of the community. Other species present included Oligochaete annelids (9%), actinarians (phylum: Cnidaria) and species from the phylum Phoronida (both 6%) and an echinoderm (1%).

For T1 only one species of Nudibranchia (phylum: Mollusca) was found.

At 15 m for T0 oligochaete annelids were the most abundant, comprising 72% of the community. The next most abundant were polychaete annelids (21%) including *Hetermastus filiformis* (4%) and other species each comprising 1-2% of the community. Other species present included actinarians (phylum: Cnidaria) (4%), species from the phylums Phoronida and Nemertea and other groups each comprising 1-2% of the community.

For T1 the community at 15 m varied greatly from T0. Actinarians (phylum: Cnidaria) were the most abundant, comprising 64% of the community, followed by ascidians (Phylum: Chordata), the echinoderm *Asterias rubens*, the polychaete annelid *Malmgreniella lunulata* and the crustacean *Photis* spec. (phylum: Arthropoda), each comprising 9% of the community.

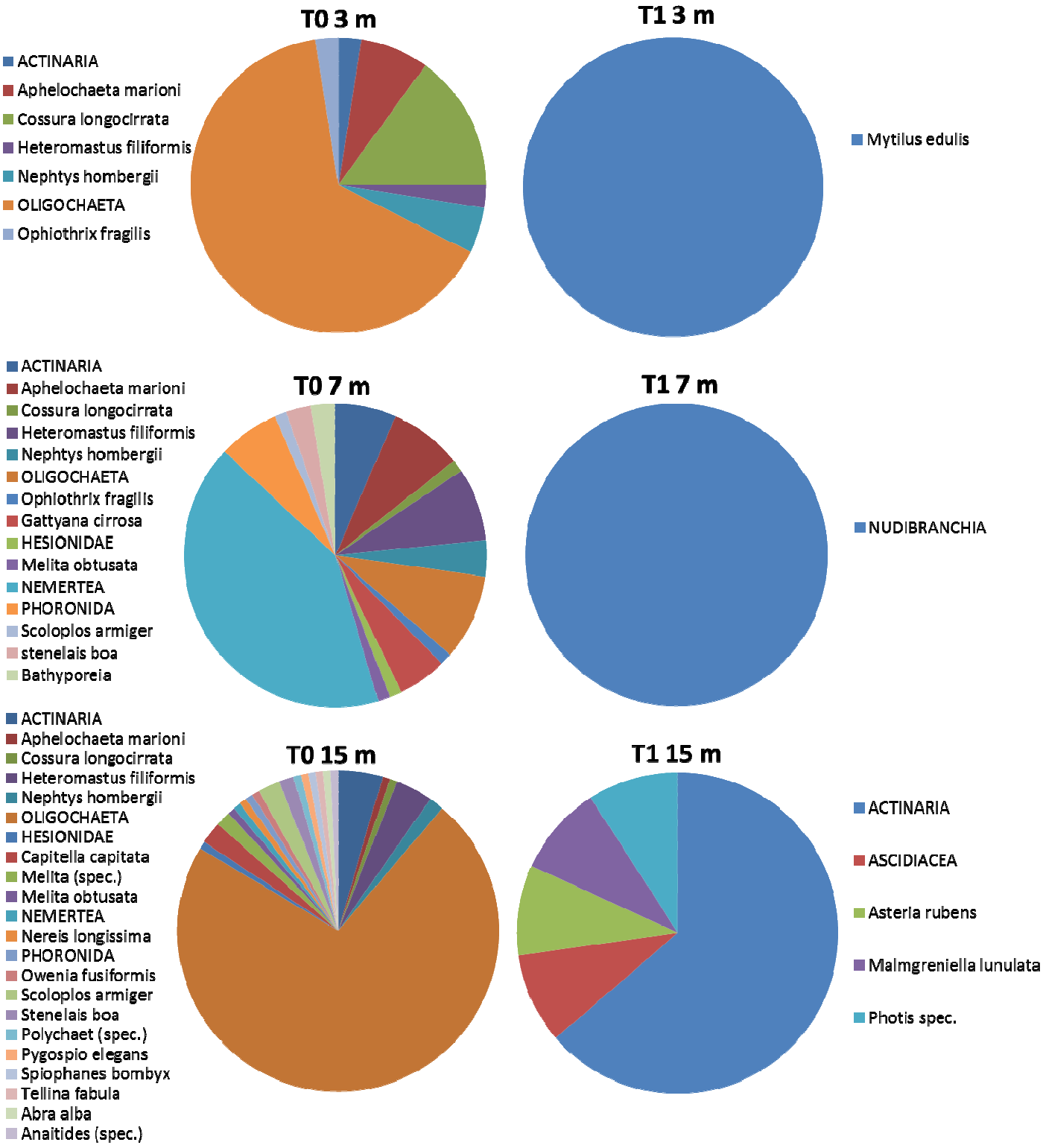

Figure 4. Community composition (number of individuals of species per m2) at Schelphoek-oost at 3, 7, and 15 m for T0 (2009) and T1 (2010) (total from two replicate samples) for Cluster 1.

4.2.5 Cluster 1: Location Lokkersnol-oost

At Lokkersnol-oost the community composition varied with depth (Figure 5). At 3 m the community was dominated by oligochaete annelids, comprising 80% of the community. Polychaete annelids were the next most abundant (13%) including *Cossura longocirrata* (6%), *Aphelochaeta marioni* (5%) and others comprising 1% of the community. The rest of the community was comprised of an unidentified group (5%) and species from the phylum Nemertea each comprising less than 1% of the community.

At 7 m the community was still dominated by oligochaete annelids, which comprised 54% of the community. The next most abundant was polychaete annelids (35%) including *Cossura longocirrata* (9%), *Nephtys hombergii* (4%) and others each comprising 1-3% of the community. Other species present included the bivalve molluscs *Abra alba* (7%) and *Venerupis senegalensis* (4%) along with other species and groups making up 1-3% of the community including species from the phylum Nemertea, crustaceans (phylum: Arthropoda) and bivalve molluscs.

At 15 m depth 49 species and groups were recorded, none with an obvious dominance in the community. Polychaete annelids were the most abundant, comprising 72% of the community and including *Scolopos armiger* (12%), *Polycirrus* spec. (11%) and *Nephtys hombergii* (11%), *Phloe minuta* (7%) and *Heteromastus filiformis* (7%) along with others each comprising 1-5% of the community. The other species and groups present included oligochaete annelids, bivalve molluscs, species from the phylum Nemertea, crustaceans (phylum: Arthropoda) and echinoderms. each making up 1-5% of the community.

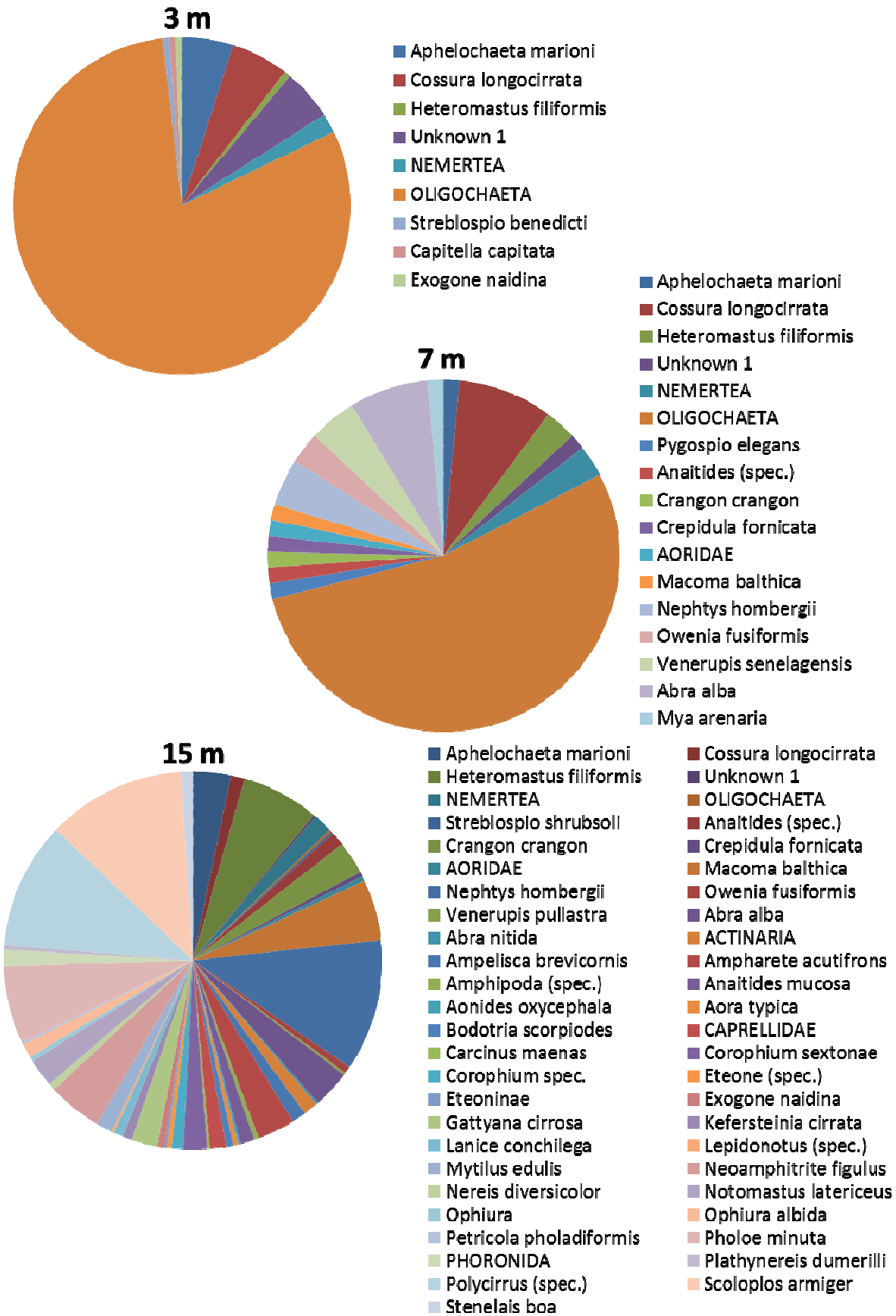

Figure 5. Community composition (number of individuals of species per m^2) at Lokkersnol-oost at 3, 7, and 15 m (total from four replicate samples) for Cluster 1, T0, 2009.

4.2.6 Cluster 1: Location Zeelandbrug-De Val

At Zeelandbrug-De Val a range of species and groups were found at all depths (Figure 5). At 3 m the community was dominated by polychaete annelids, comprising 54% of the community and included *Cossura longocirrata* (18%), *Capitella capitata* (13%) and *Aphelochaeta marioni* (7%) along with other species each comprising 1-5% of the community. Oligochaete annelids were the next most abundant, comprising 38% of the community. The rest of the community was made up of species and groups each comprising 1-5% of the community and included crustaceans (Phylum: Arthropoda) and species from the phylum Nemertea.

At 7 m there was a less obvious dominant of one species or group compared with 3 m. Polychaete annelids were the most abundant, comprising 58% of the community and included *Streblospio benedicti* (17%), *Aphelochaeta marioni* and *Cossura longocirrata* (both 10%) along with other species each comprising 2-5% of the community. Oligochaete annelids were the next most abundant group, comprising 20% of the community, followed by crustacean species from the family Aoridae (phylum: Arthropoda) (12%). The rest of the community was made up of species and groups each comprising 2-5% of the community, and included actinarians (phylum: Cnidaria), crustaceans (phylum: Arthropoda) and bivalve molluscs.

At 15 m for T0 polychaete annelids were the most abundant group, comprising 50% of the community and included *Nephtys hombergii* (17%), *Nereis* spec. (6%) and other species each comprising 3% of the community. Oligochaete annelids were the next most abundant, comprising 28% of the community, followed by actinarians (phylum: Cnidaria) (11%) and an echinoderm (3%).

For T1 the community was dominated by polychaete annelids, comprising 71% of the community and included *Scoloplos amiger* (33%), *Anaitides mucosa* (11%) along with other species each comprising 2-5% of the community. Other species present included decapod crustaceans (phylum: Arthropoda) and actinarians (phylum: Cnidaria) (6%) , bivalve molluscs, echinoderms and crustaceans (phylum: Arthropoda) each comprising 2-5% of the community.

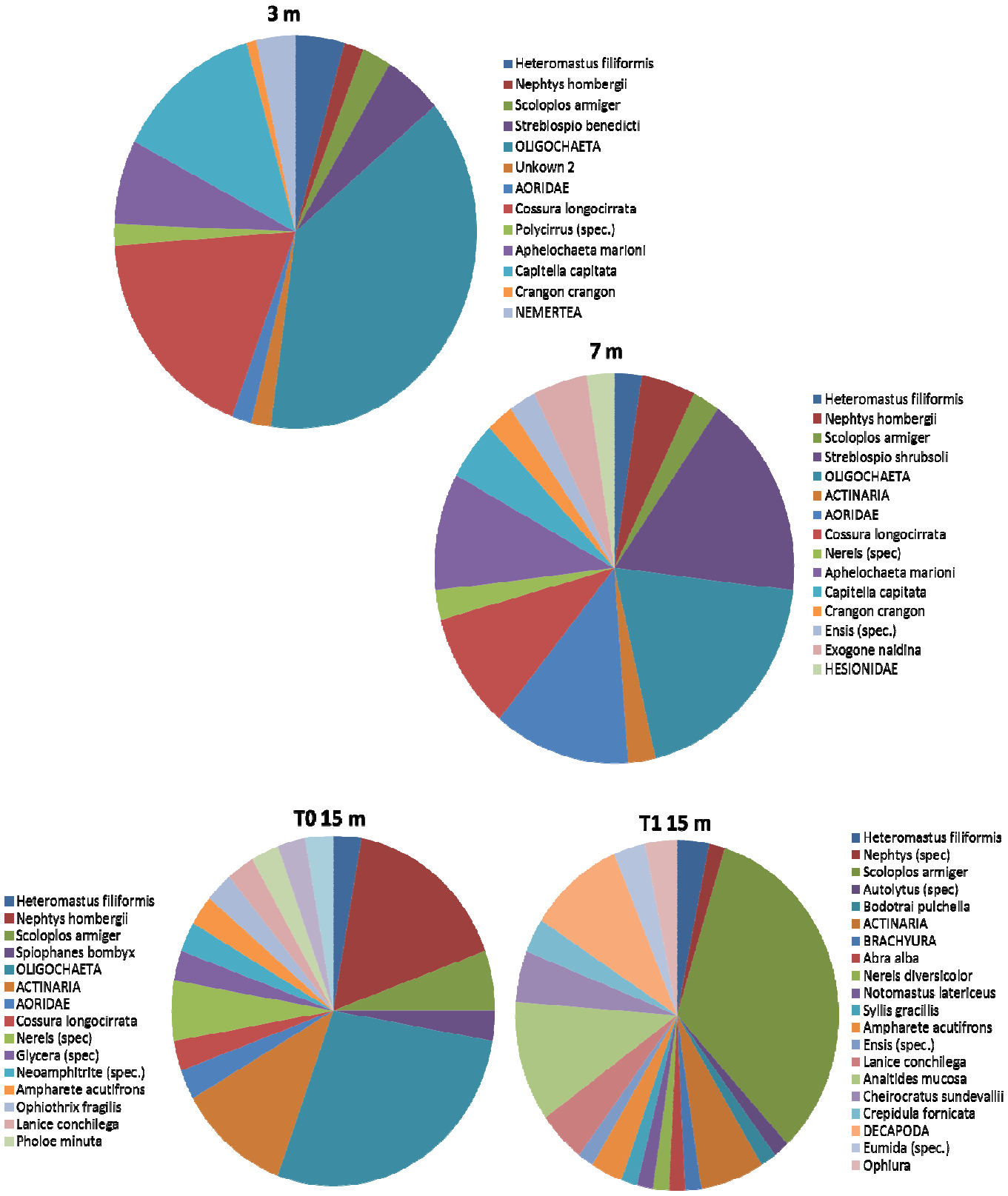

Figure 6. Community composition (number of individuals of species per m2) at Zeelandbrug-De Val at 3, 7, and 15 m (total) from two replicate samples) for Cluster 1, T0 (2009) and at 15 m for T1 (2010).

4.2.7 Cluster 1: Location Zeelandbrug-west

At Zeelandbrug-west various species and groups were present at all depths (Figure 7). At 3 m polychaete annelids were the most abundant, comprising 47% of the community and included *Heteromastus filiformis* (19%) and *Scoloplos armiger* (8%) along with other species each comprising 1-4% of the community. Oligochate annelids were the next most abundant, comprising 44% of the community. The rest of the community was made up of species and groups each comprising 1-4% of the community and included species from the phylum Phoronida, actinarians (phylum: Cnidaria) and crustaceans (Phylum: Arthropoda).

At 7 m polychaete annelids were the most abundant, comprising 36% of the community and included *Nephtys hombergii* and *Pholoe minuta* (6% each) and other species each comprising 3% of the community. Caprellids (Arthropoda: Crustacea) were the next most abundant, comprising 25% of the community, followed by amphipods (Arthropoda: Crustacea) (11%), actinarians (phylum: Cnidaria (6%) and the bivalve mollusc *Ensis* spec. (6%). The rest of the community was made up of species and groups each comprising 3% of the community and included oligochaete annelids, actinarians (phylum: Cnidaria) and crustaceans (phylum: Arthropoda).

At 15 m the range of species and groups found were present in very similar numbers. Polychaete annelids were the most abundant, comprising 66% of the community and included *Notomastus latericeus* (11%) *Aphelochaeta marioni, Heteromastus filiformis, Malmgreniella lunulata* and *Nephtys hombergii* (all 7%) along with other species each comprising 4% of the community. The rest of the community included amphipods (Arthropoda: Crustacea), oligochaete annelids (7% each) echinoderms and crustaceans (4% each).

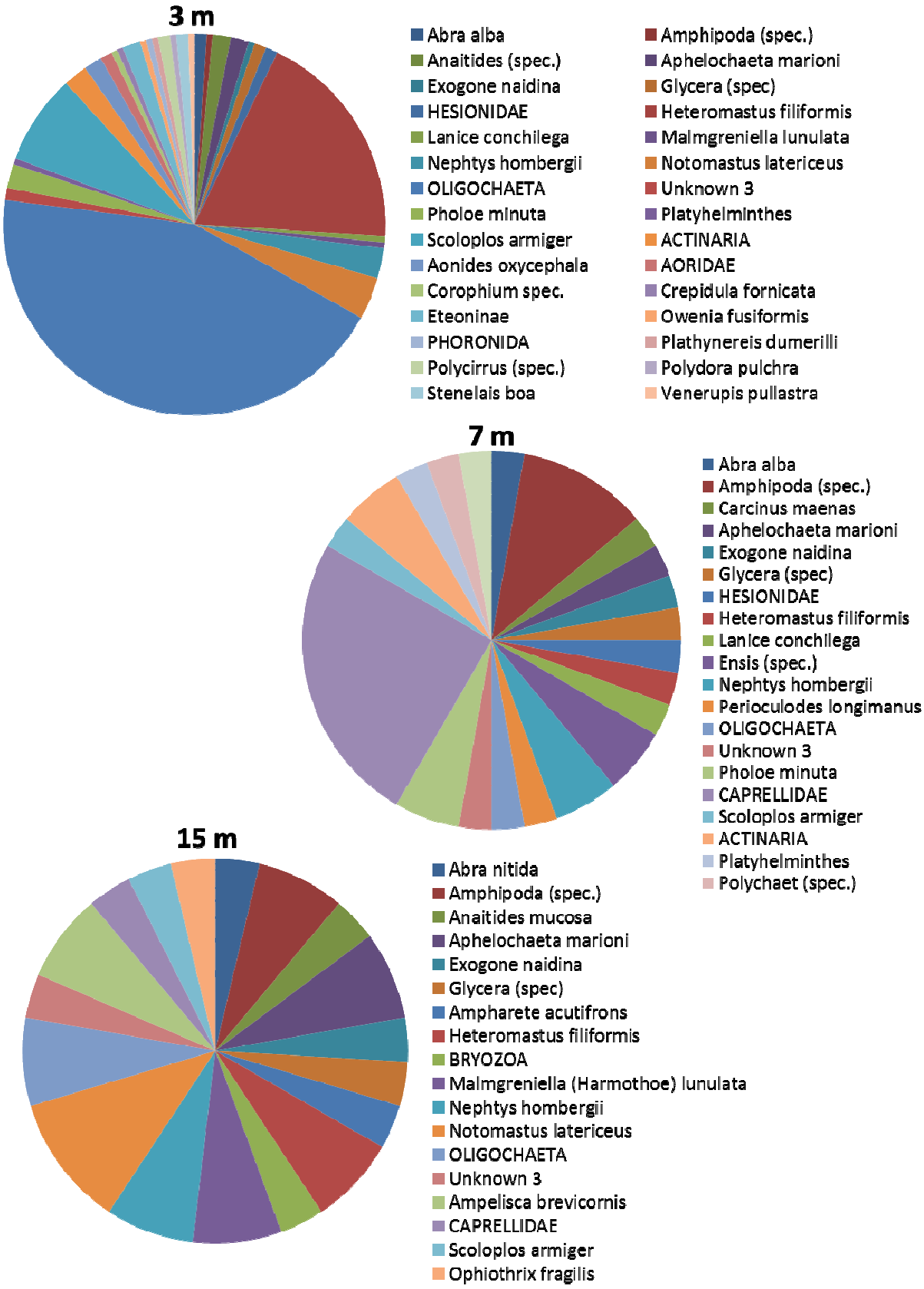

Figure 7. Community composition (number of individuals of species per m^2) at Zeelandbrug-west at 3, 7, and 15 m (total from two replicate samples) for Cluster 1, T0, 2009.

4.3 Community Attributes

The total number of species from different phyla found in different depths at each location is shown in Figure 8.

Cluster 1:
The largest number of species were found at 15 m depth at Schelphoek-oost (22 species), Lokkersnol-oost (49 species) and Zeelandbrug-de Val (17 species). The highest number of species were found at 7 m depth at Schelphoek-west (23 species). The highest number of species were found at 3 m depth at and Zeelandbrug-west (30 species).

When comparing the number of species per phylum in different locations and depths, Annelida was the dominant phylum in all cases and were present in varying proportions of the total number of species ranging from 47% (8 out of 17 species) at 7 m at Lokkersnol-oost to 100% (7 species) at Schelphoek-west.

Molluscs and arthropods were the next most diverse phyla in most locations. The largest proportions of the total number of species in which molluscs and arthropods were found were 29% (5 out of 17 species) at 7 m at Lokkersnol-oost and 20% (10 out of 49 species) at 15 m at Lokkersnol-oost, respectively. Molluscs occurred in all locations and predominantly at 7 m and 15 m depth. Only at Zeelandbrug-west were molluscs found at 3 m. Arthropods occurred in all locations and were found at all depths except 3 m in Schelphoek-west, Schelphoek-oost and Lokkersnol-oost.

The total number of species from different phyla found in different depths at Schelphoek-oost and Zeelandbrug-De Val are compared between T0 and T1 in Figure 10. At Schelphoek-oost the number of species found in T1 was considerably smaller than in T0. Only one species was found in T1 at both 3 m and 7 m depth compared with seven in T0 at 3 m and 15 in T0 at 7 m. At 15 m depth, 5 species were found in T1 compared with 15 species in T0. Conversely, at 15 m depth at Zeelandbrug-De Val, fewer species were found in T0 compared with T1 (17 species in T0 compared with 20 species in T1).

While annelids dominated the samples in T0, in T1 at Schelphoek-oost no annelids were found at 3 m and 7 m depth. The only species found at these depths were from the phylum Echinodermata. At 15 m depth, one species from five different phyla were found (Annelida, Chordata, Cnidaria, Arthropoda and Echinodermata). At 15 m depth. Species from the phyla Phoronida, Nermertea and Mollusca were found in T0, but not in T1, While no species from the phylum Chordata were found in T0, one species was found at 15 m depth in T1.

Annelida was the dominant phylum at Zeelandbrug-De Val at both T0 and T1, but while more species were found in T1, the number of annelids was comparable to those in T0 (13 species in T0 and 11 species in T1). Additionally, while these phyla were not found in T0, three arthropods species and three molluscs were found in T1, and while one phoronid was found in T0, this phylum was not found in T1.

Cluster 2:
At Schelphoek-west II the highest number of species were found at 7 m depth (13 species), while at Burghsluis-west the highest number of species were found at 3 m depth (eight species). When comparing the number of species per phylum at both locations and depths.

When comparing the number of species per phylum in different locations and depths, Annelida was the dominant phylum in both locations and was present in varying proportions of the total number of species ranging from two out of four species (50%) at Burghsluis-west at 7 m depth at to 8 out of 11 species (73%) at Schelphoek-west II at 15 m. All other phyla present were represented by a single species, except in Schelphoek-west II at 7 m where three molluscs were found

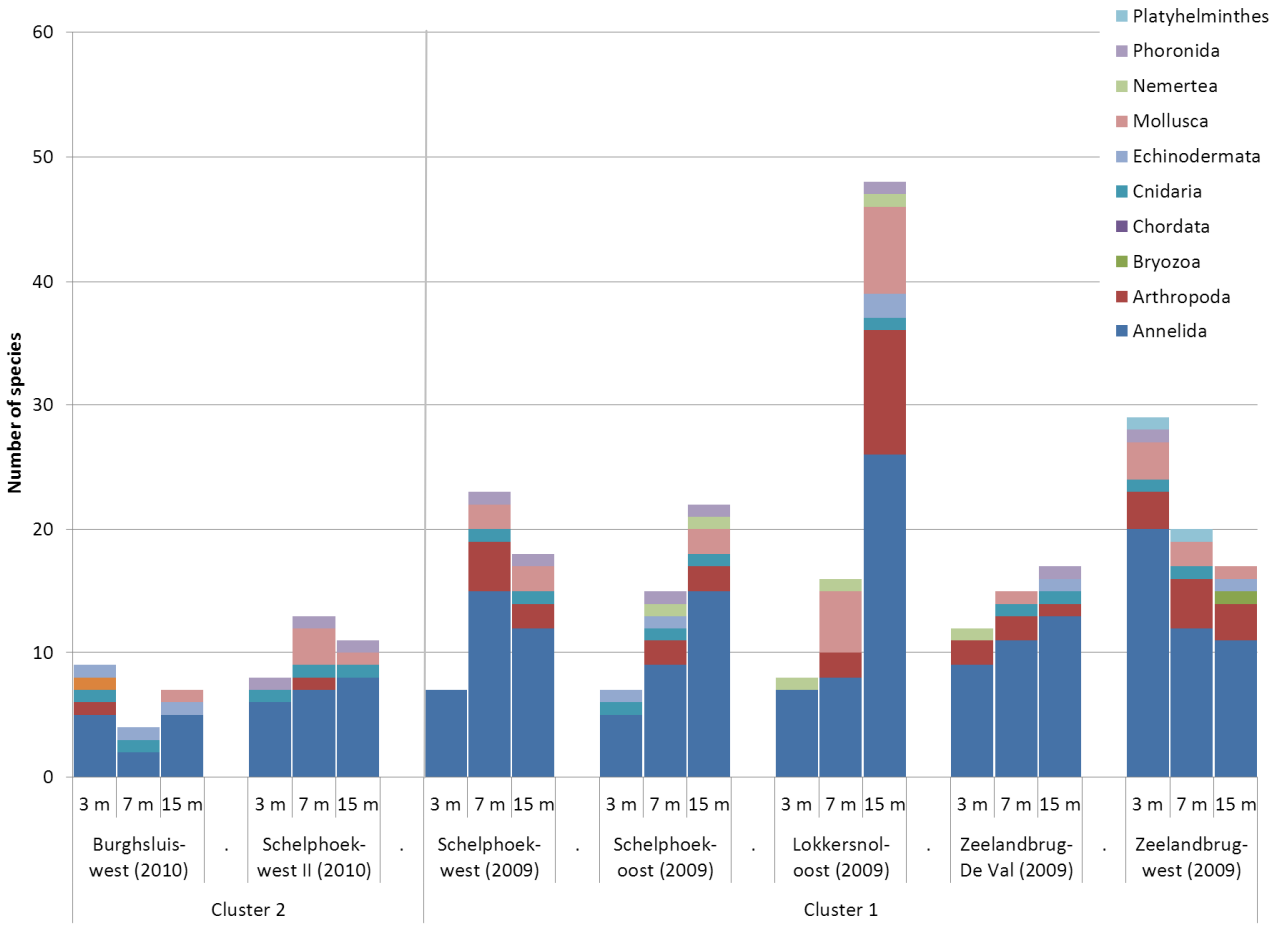

Figure 8. Total number of species of different phyla recorded in the Oosterschelde at depths of 3, 7 and 15 m for T0 at all locations.

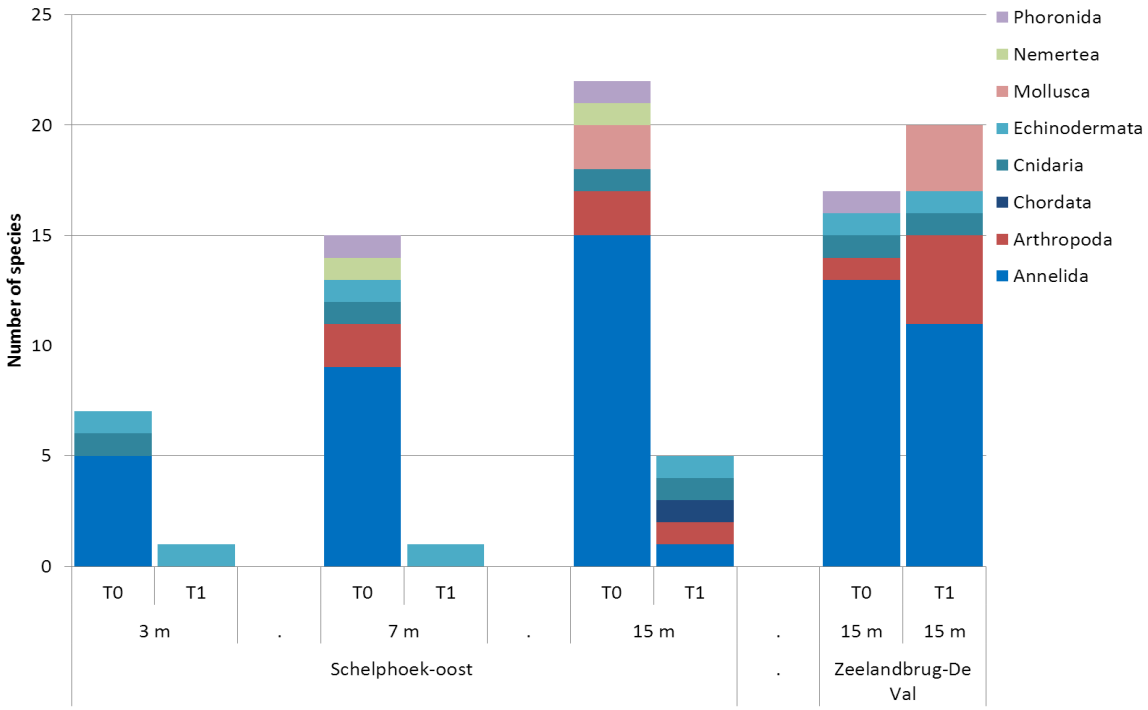

Figure 9. Total number of species of different phyla recorded at depths of 3, 7 and 15 m for T0 (September 2009) and T1 (October 2010) at Schelphoek and de Val Oost (T1 data for de Val Oost was only available for 15 m depth) for Cluster 1.

4.4 Total Abundance

There was a wide range of estimated mean total abundance of organisms between locations and depths (Figure 10).

Cluster 1:
The highest estimated mean total abundance of organisms was found in Lokkersnol-oost at 15 m depth with 12 506 individuals per m^2, while the lowest was found at Schelphoek-west at 3 m depth with 1256 individuals per m^2. Estimated mean total abundance was highest at 15 m depth at Schelphoek-oost (6730 individuals per m^2) and Lokkersnol-oost (12 506 individuals per m^2). Mean total abundance was highest at 7 m depth at Schelphoek-west (5726 individuals per m^2). Estimated mean total abundance was highest at 3 m depth at Zeelandbrug-De Val (9844 individuals per m^2) and Zeelandbrug-west (5776 individuals per m^2).

Estimated mean total abundance was compared between T0 and T1 for Schelphoek-oost and Zeelandbrug-De Val (Figure 11). At Schelphoek-oost estimated mean total abundance was considerably lower in T1 compared with T0 at all depths. At 3 m, 7 m and 15 m depth, the estimated mean total abundance in T0 was 2009, 3867 and 6730 individuals per m^2 respectively, while in T1 the estimated mean total abundance at 3 m, 7 m and 15 m was 100, 100 and 552 individuals per m^2 respectively. Conversely, at 15 m at Zeelandbrug-De Val, the estimated mean total abundance of organisms was lower in T0 (1356 individuals per m^2) compared with T1 (3164 individuals per m^2).

Cluster 2:
Estimated mean total abundance was highest at Burghsluis-west at 15 m depth (9945 individuals per m^2) and lowest at 3 m depth (3616 individuals per m^2), while at Schelphoek-west II mean total abundance was highest at 7 m depth (2411 individuals per m^2) and lowest at 15 m depth (1356 individuals per m^2).

4.5 Species Richness

For species richness the term 'species' is used to identify each species as well as higher taxonomic groups where identification was not made to species level. Species richness also varied greatly between locations and depths (Figure 12).

Cluster 1:
The highest mean species richness was found in Lokkersnol-oost at 15 m depth with 29 species per m^2, while the lowest was found at Schelphoek-oost at 3 m depth with 5 species per m^2. Mean species richness was highest at 15 m depth at, Schelphoek-oost (13.5 species per m^2), Lokkersnol-oost (26 species per m^2) and Zeelandbrug-west (11.5 species per m^2). Mean species richness was highest at 7 m depth at Schelphoek-west (16 species per m^2). Mean species richness was highest at 3 m depth only at Zeelandbrug-De Val (21 species per m^2), but also had the highest variation between replicates (±9).

Mean species was compared between T0 and T1 for Schelphoek-oost and Zeelandbrug-De Val (Figure 13). At Schelphoek-oost mean species was considerably lower in T1 compared with T0 at all depths. At 3 m, 7 m and 15 m depth, the mean species richness in T0 was five, 11 and 13.5 species per m^2 respectively, while in T1 the mean species richness at 3 m, 7 m and 15 m was one, one and three species per m^2 respectively. Conversely, at 15 m at Zeelandbrug-De Val, the mean species richness was comparative in T0 (10.5 species per m^2) and T1 (12 individuals per m^2) as error bars overlapped.

Cluster 2:
Mean species richness at Burghsluis-west was highest at 15 m depth (6.5 species per m^2) and lowest at at 7 m depth with 2.5 species per m^2 while at Schelphoek-west II species richness was highest at 7 m depth (eight species per m^2) and lowest at lowest at 3 m depth (5.5 species per m^2).

4.6 Diversity

According to the Shannon Wiener Diversity Index, diversity varied between locations and depths (Figure 14).

Cluster 1:
Diversity was considerably higher at Lokkersnol-oost at 15 m, with the highest diversity score of all locations (mean score of 2.8) than at 7 m (mean score of 1.3) and 3 m with the lowest diversity score of all locations (mean score of 0.8). At Schelphoek-oost, diversity was highest at 7 m (mean score of 1.8) compared with 3 m and 15 m (mean scores of 1.1 and 1.3 respectively). At all locations the mean diversity score was lowest at 3 m depth. At Schelphoek-west, Zeelandbrug-De Val and Zeelandbrug-west, the mean diversity score was comparable between 7 m and 15 m depth.

Mean Shannon-Wiener Diversity scores was compared between T0 and T1 for Schelphoek-oost and Zeelandbrug-De Val (Figure 15Figure 11). As only one species was found in Schelphoek-oost at 3 m and 7 m depth in T1, there is no diversity score. Diversity at 15 m was considerably lower in T1 (mean score of 0.8) compared with T0 (mean score of 1.3). Conversely, at Zeelandbrug-De Val at 15 m, the mean diversity score was almost equal between T0 (mean score of 2.1) and T1 (mean score of 2.08).

Cluster 2:
At Burghsluis-west mean diversity was highest at 3 m depth (mean score of 1) compared to 7 m and 15 m (mean scores of 0.2 and 0.5 respectively). At Schelphoek-west II mean diversity was highest at 7 m depth (mean score of 1.85) compared to 3 m and 15 m (mean scores of 1.8 and 1.5 respectively).

4.7 Evenness

Cluster 1:
Evenness was highest at Zeelandbrug-west at 15 m (mean score of 0.97) and lowest at Lokkersnol-oost (mean score of 0.5). Evenness was highest at 15 m at Schelphoek-west (mean score of 0.86), Lokkersnol-oost (mean score of 0.88) and Zeelandbrug-west (mean score of 0.97) and lowest at Schelphoek-oost (mean score of 0.53). Evenness was highest at 7 m depth at Schelphoek-oost (mean score of 0.77) and Zeelandbrug-De Val (mean score of 0.90). While evenness was not highest at 3 m depth for any location, it was lowest at 3 m at Schelphoek-west (mean score of 0.72), Lokkersnol-oost (mean score of 0.5), Zeelandbrug-De Val (mean score of 0.66) and Zeelandbrug-west (mean score of 0.71).

Mean evenness scores was compared between T0 and T1 for Schelphoek-oost and Zeelandbrug-De Val (Figure 17Figure 11). As only one species was found in Schelphoek-oost at 3 m and 7 m depth in T1, there is no evenness score. At 15 m evenness was higher at Schelphoek-oost in T1 (mean score of 0.86) compared with T0 (mean score of 0.53), while at Zeelandbrug-De Val, evenness was comparable between T0 and T1 (mean scores of 0.88 and 0.85 respectively).

Cluster 2:
At Burghsluis-west the mean evenness score was highest at 3 m depth (0.59) compared to 7 m (0.2) and 15 m depth (0.28). At Schelphoek-west II mean evenness was also highest at 3 m (0.94) and equal for both 7 m and 15 m depth (0.89 each).

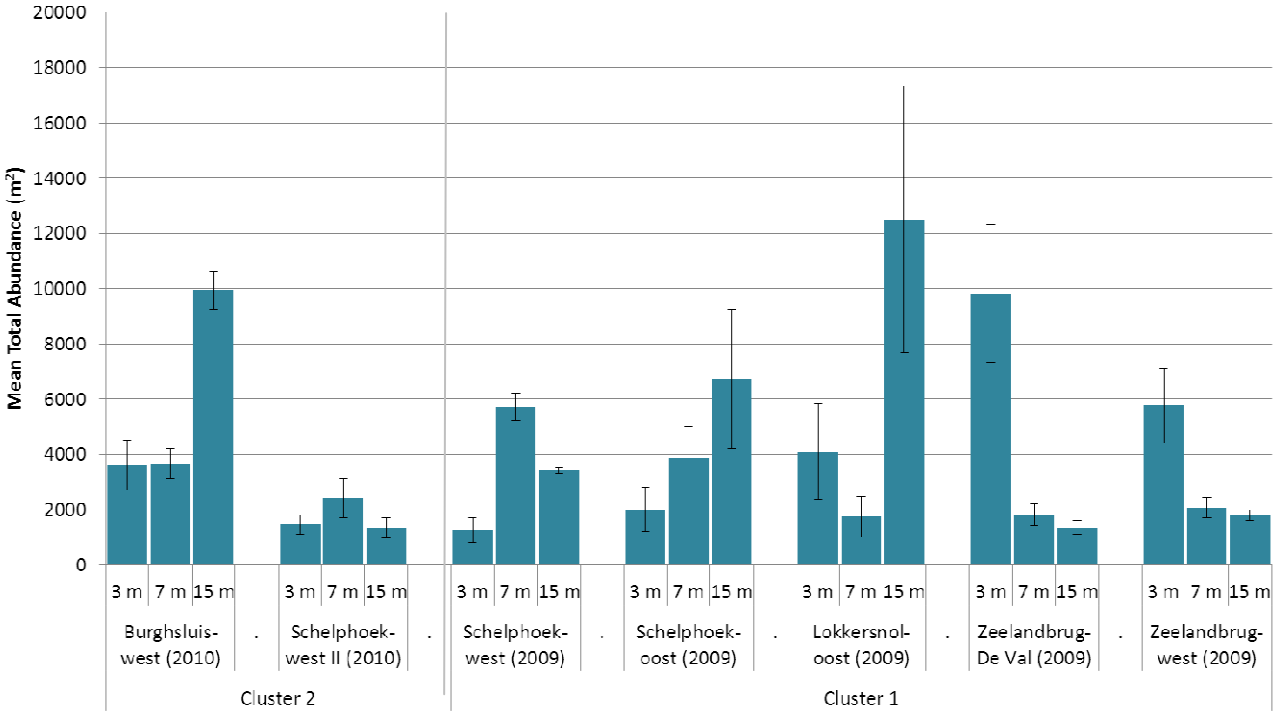

Figure 10 Estimated mean total abundance per m² for T0 at all locations and depths. Error bars are ±1SE.

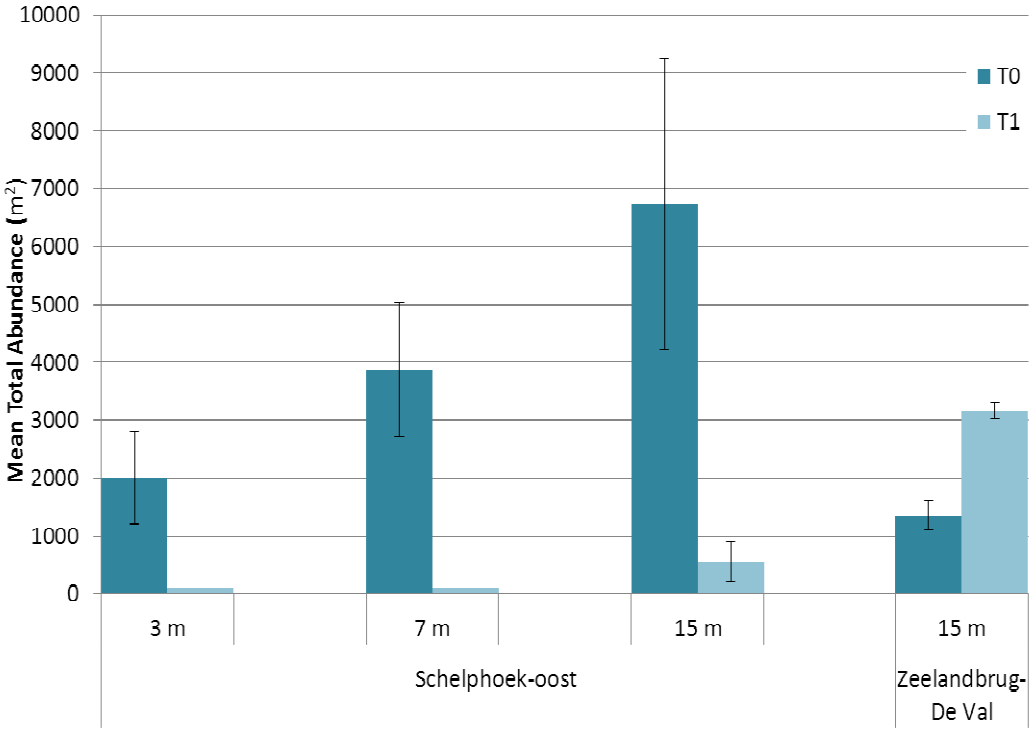

Figure 11. Estimated mean total abundance per m² for T0 and T1 at different depths for Cluster 1. Error bars are ±1SE.

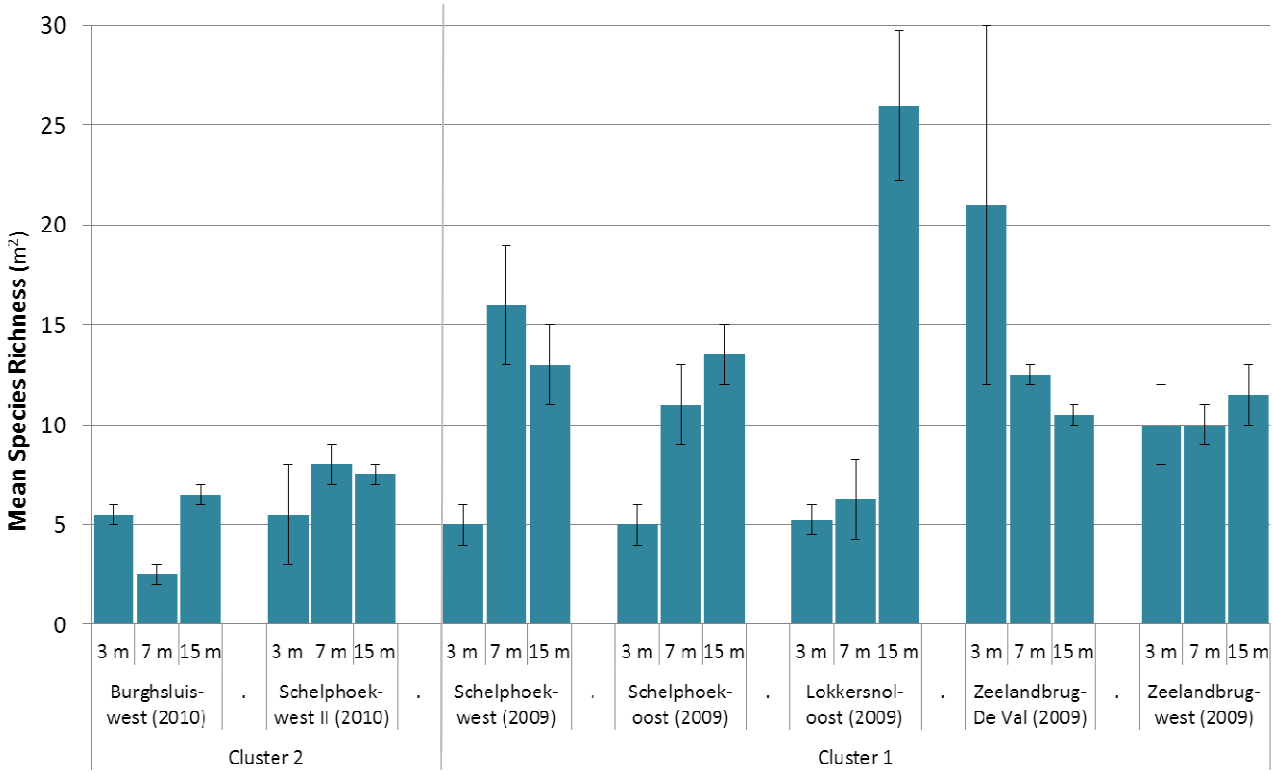

Figure 12. Mean species richness per m^2 for T0 at all locations and depths. Error bars are ±1SE.

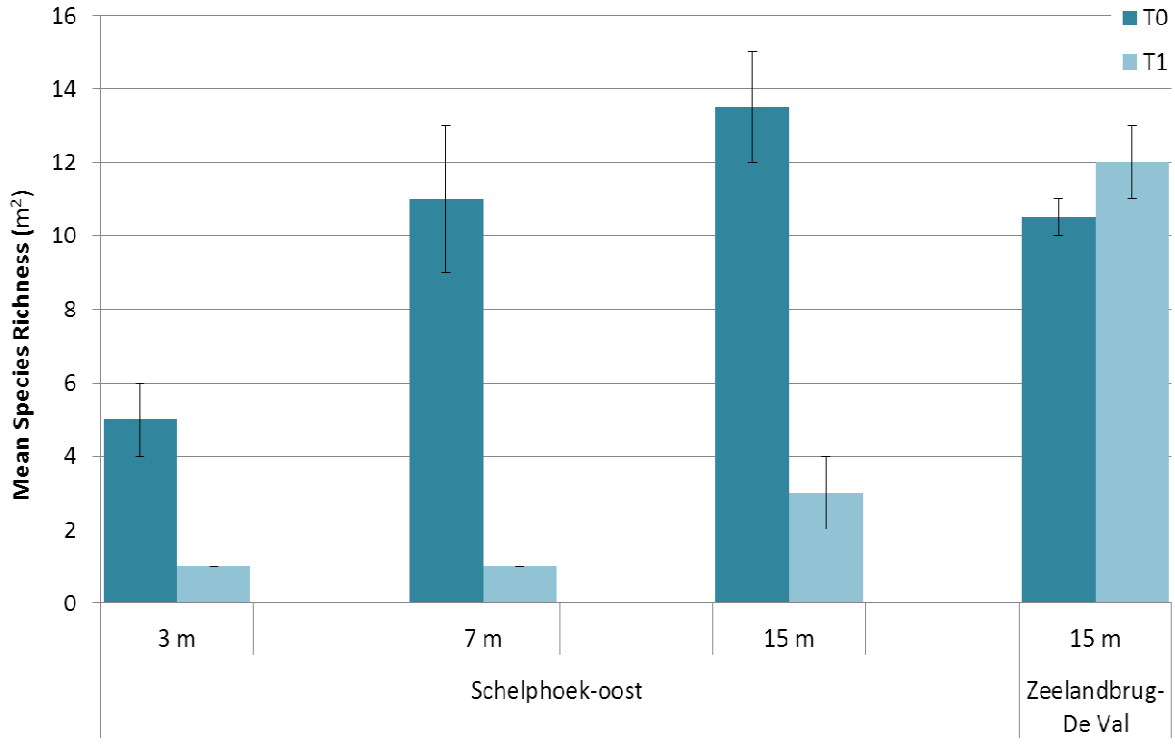

Figure 13. Mean species richness per m^2 for T0 and T1 at different depths for Cluster 1. Error bars are ±1SE.

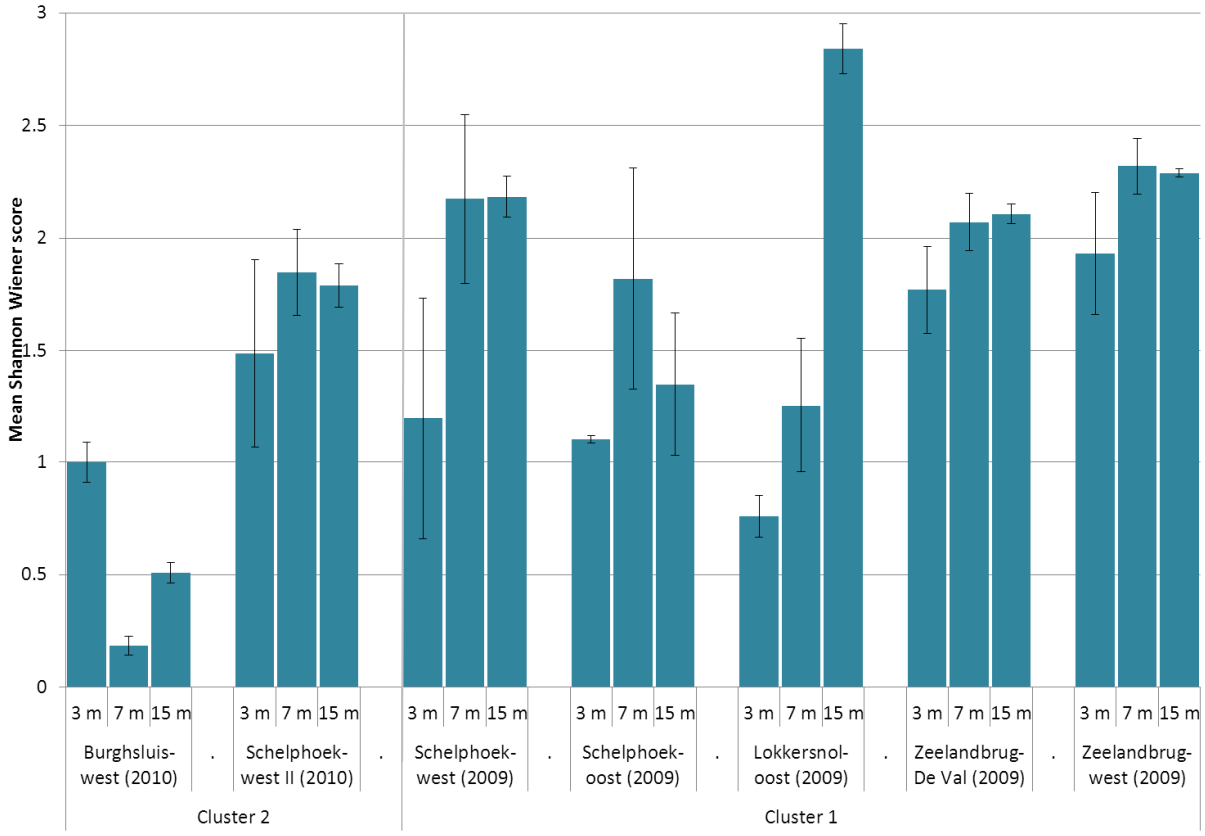

Figure 14. Mean Shannon-Wiener Diversity Index scores for T0 at all locations and depths. Error bars are ±1SE.

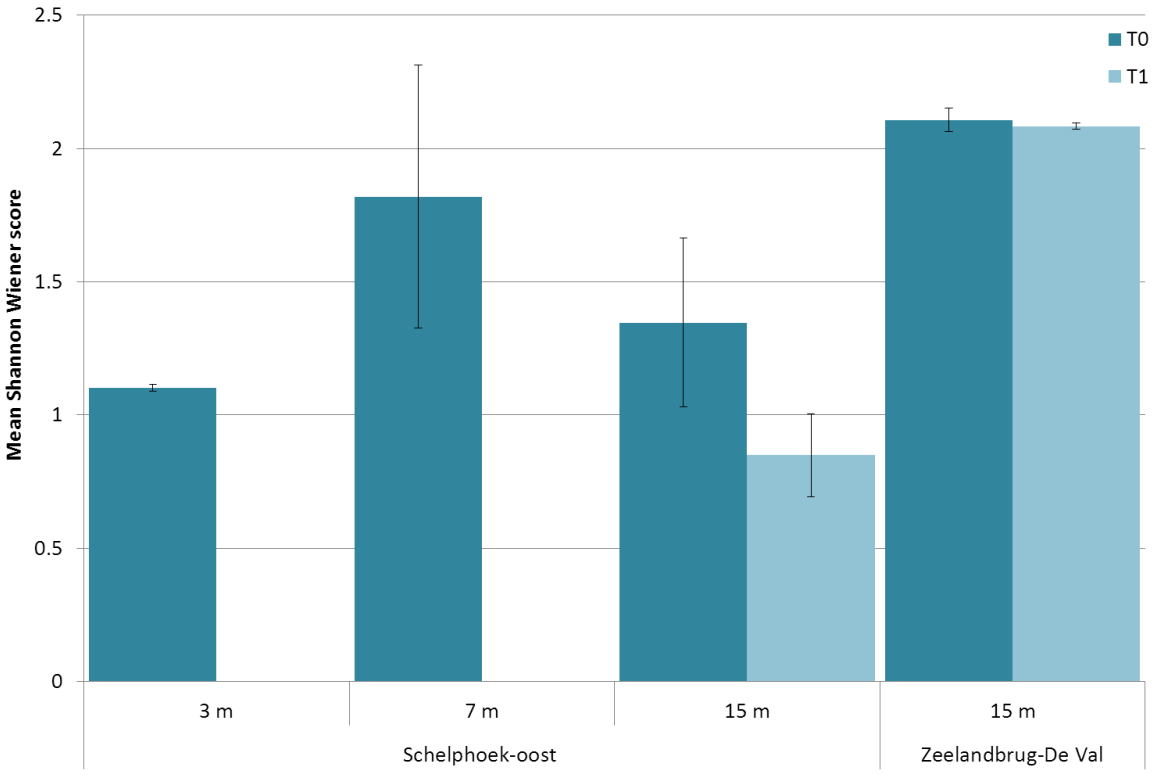

Figure 15. Mean Shannon-Wiener Diversity Index scores for T0 and T1 at different depths for Cluster 1. Error bars are ±1SE.

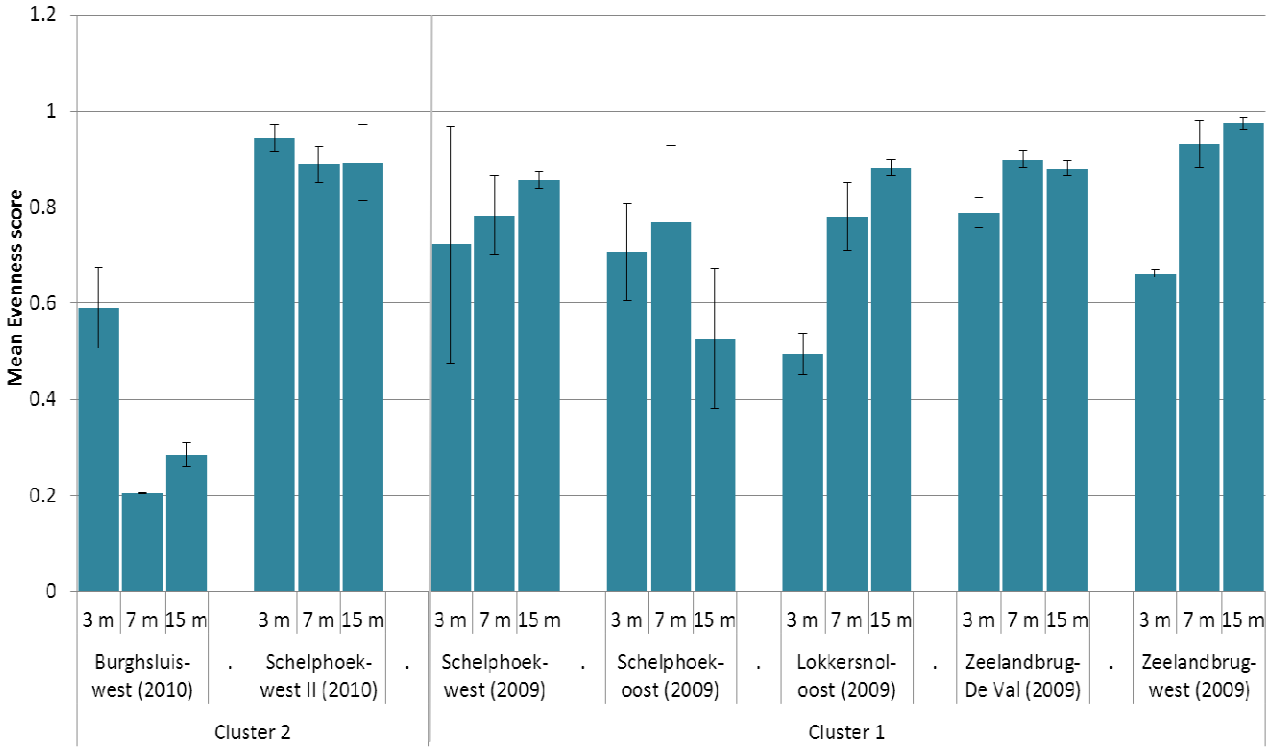

Figure 16. Mean Evenness scores for T0 at all locations and depths. Error bars are ±1SE.

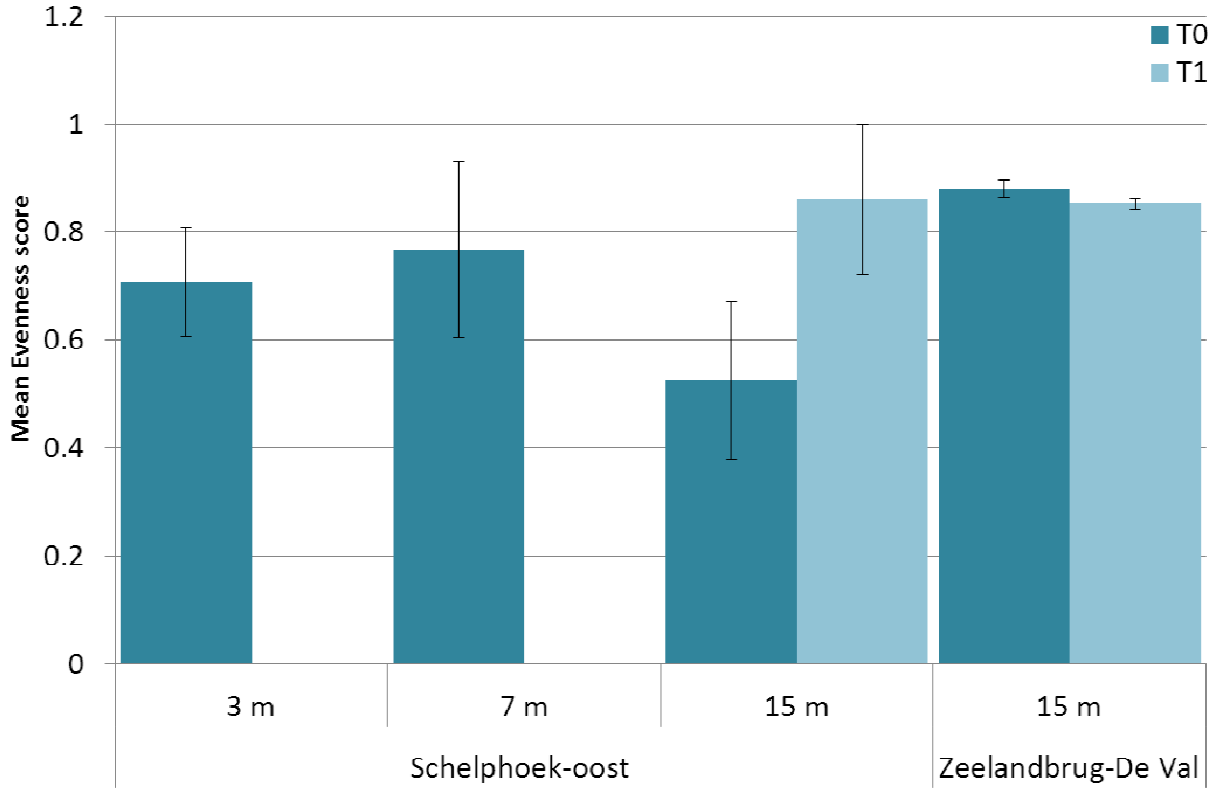

Figure 17. Mean Evenness scores for T0 and T1 at different depths for Cluster 1. Error bars are ±1SE.

4.8 Soft substrate communities in the Oosterschelde

Community
Five main groups (A-E) and five species poor variants(F-J) were identified from the cluster analysis of the community composition in a dendogram (Figure 18). The inverse analysis is shown in Appendix C.

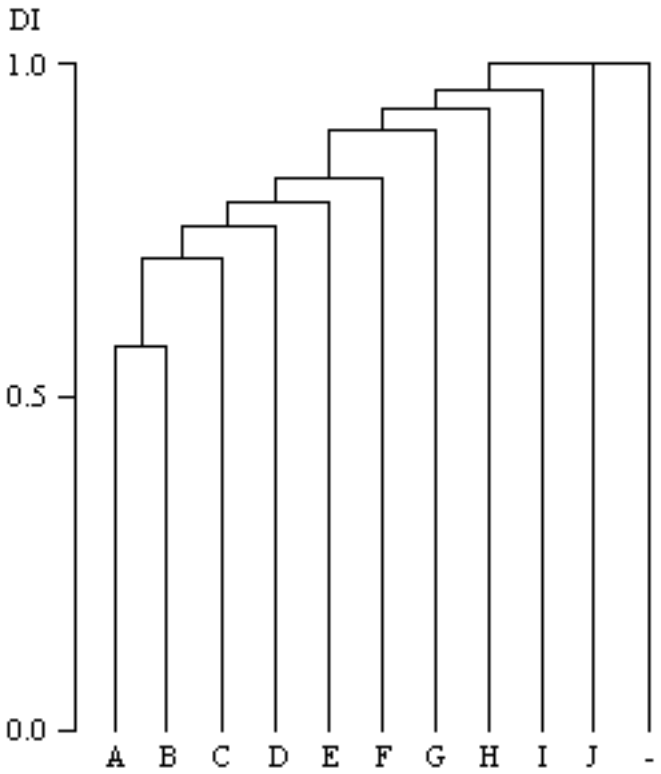

Figure 18. Dendogram showing the clustering of the soft substrate data.

			09-Sch-w	09-Sch-o	09-Lok-a	09-Lok-b	09-Zeel-w	09-Zeel-o
3 m			A	A	B	B	C	B
7 m			C	C	B	B	C	B
15 m			C	C	C	C	C	C
	10-Burg-w	10-Sch-W-II		10-Sch-o				10-Zeel-o
3 m	A	A		H				-
7 m	A	A		J				-
15 m	A	A		G				D

Figure 19. Schematic distribution of the communities over locations

In the T0-situation in 2009 and 2010 there were three prominent groups (A, B and C) in the Oosterschelde and in the T1-situation in 2010 one main group (D) and three species poor variants (G, H and J) (Figure 19).

Sediment
The sediment characteristics were calculated as the percentage of the total dry weight of the different particle sizes. Because sizes of sediment particles were not normally distributed, a typology of dominant sediment types of benthic fauna was developed (Table 3). When the sediment showed a bimodal distribution due to recent sediment disturbance, the sediment was presented as 'disturbed coarse' type. The composition of the benthic sediment within the three different communities is shown in Table 4.

Table 3. Typology of the benthic sediment

Type of sediment	I	II	III	IV	V	VI	VII	VIII
Dominant particle size in mm	>2.8	2-8-1.4	1.4-0.6	0.6-0.3	0.3-0.15	0.15-0.09	0.09-0.05	<0.05
Particle name	Shell gravel		Very coarse sand	Coarse sand	Fine sand	Very fine sand	ultra-fine sand	mud

Table 4. Composition of the benthic sediment in 2009 and 2010.

Type:	V	VI	V(dis)	VIII	%≤90 µm
2010-T0-A	33.3	33.3	16.7	16.7	28.9
2009-T0-C	28.6	12.28	57.1	-	44.7
2009-T0-A	-	-	50.0	50.0	50.6
2009-T0-B	-	-	100.0	-	53.7
2010-T1-H	-	-	-	100.0	65.6
2010-T1-D	-	-	-	100.0	72.7
2010-T1-J	-	-	-	100.0	74.5
2010-T1-G	-	-	-	100.0	78.3

4.8.1 T0-situation in 2009 (Cluster 1)

In the T0-situation in 2009 community C was the most common and was present at all locations, particularly at greater depths. In total there were 77 species found in the community and polychaetes were the largest group both in number (n=40) and in density (3265 m^{-2}). After polychaetes oligochaetes had the greatest density. In total there were 34 species characteristic to this community. The dominant species were the polychaetes *Polycirrus* spec., *Pholoe minuta*, *Polydora cornuta* (*ligni*) and *Neoamphitrite figulus* (Table 6).

At the locations Schelphoek-west and –east Community A was found at 3 m depth. The total number of species and the total density was half that of Community C. Oligochaetes had the greatest density (1420 m^2) within this community, followed by polychaetes (1215 m^2).

Community B was found at 3 and 7 m depth at Lokkersnol and Zeelandbrug-De Val. The total number of species was lower than in Community A. Here, oligochaetes were also at the greatest density (1842 m^{-2}) followed by polychaetes (1038 m^{-2}).Due to the absence of the dominant species in Community A and B (Appendix C) this community is considered a species poor variant of Community C.

For a basis of comparison data collected in 2000-2005 during the Biological Monitoring Programme (Sistermans et al., 2000, 2001a, 2001b, 2002a, 2002b, 2003a, 2003b, 2004a, 2004b, 2005a, 2005b, 2006) was analysed. This analysis produced two communities in the western Oosterschelde. One community was limited to the eulittoral zone, while the second community was present in the 2-8 m depth range and deeper than 8 meter range.

These communities can be explained either by small differences in the abiotic factors or by anthropogenic disturbances caused by the nearby laying of mussel cultures.
From measurements at the time of sampling the salinity, level of O2 and pH was not considerably different between the sampling stations of the different communities.

Community C: 32.1-32.5‰ S, 92.3-104.2 $\%O_2$ and pH 8.11-8.13,
Community A: 32.3-32.6‰ S, 90.9-104.5 $\%O_2$ and pH 8.09-8.12,
Community B: 32.1-32.2‰ S, 88.4-92.7 $\%O_2$ and pH 8.11-8.13.

Table 5

Type:	V	VI	V(dis)	VIII	%≤90 µm
2010-T0-A	33.3	33.3	16.7	16.7	28.9
2009-T0-C	28.6	12.28	57.1	-	44.7
2009-T0-A	-	-	50.0	50.0	50.6
2009-T0-B	-	-	100.0	-	53.7
2010-T1-H	-	-	-	100.0	65.6
2010-T1-D	-	-	-	100.0	72.7
2010-T1-J	-	-	-	100.0	74.5
2010-T1-G	-	-	-	100.0	78.3

shows that Community B only had a sediment of disturbed sand and Community A the sediment types V and VIII, both slightly higher with sediment particles ≤90 µm.

Table 5. Total species and density per taxa within the community in the T0- and T1- inventory (see figure 19).

Community	A	B	C	D	G	H	J
Total number of species							
Polychaeta	18	14	40	14	1	0	0
Mollusca	7	6	11	5	0	1	1
Crustacea	5	2	15	5	1	0	0
Echinodermata	2	0	3	3	1	0	0
Phoronida	1	0	1	1	0	0	0
Oligochaeta	1	1	1	1	0	0	0
Other groups	2	3	6	1	2	0	0
Total number of species	36	26	77	30	5	1	1
Density n/m²:							
Polychaeta	1215	1038	3265	1189	50	0	0
Mollusca	251	100	246	519	0	50	50
Crustacea	27	92	447	234	50	0	0
Echinodermata	20	0	55	100	50	0	0
Phoronida	57	0	126	1959	0	0	0
Oligochaeta	1420	1842	1421	33	0	0	0
Other groups	84	176	397	100	402	0	0
Total density n/m²	3073.9	3248.0	5956.9	4135.3	552.5	50.2	50.2

4.8.2 T0-Situation in 2010 (Cluster 2)

In 2010 the T0 situation the composition of the macrofauna at the locations Burgsluis-west and Schelphoek-west II was investigated. Community A was found at all depths in both locations, similar to what occurred in the T0-situation in 2009 (Figure 19).

From the field measurements the variation in salinity, O_2 level and pH was also similar to that of 2009: 30.0-30.5‰ S, 101.0-102.6 %O_2 en pH 8.22. The composition of the benthic sediment at these western locations is rough. Only at 7 and 15 m depth at Schelphoek-west II was there an increase in the sediment particle size ≤90µm (type V(dis) en VIII), the other stations were dominated by sandy sediment.

4.8.3 T1-situation in 2010 (Cluster 1)

In 2010 the T1 situation the composition of the macrobenthos at locations where dyke reinforcement was conducted was investigated. Sufficient sediment was only available at the stations at Schelphoek-oost and Zeelandbrug-De Val at 15 m depth.

At Schelphoek-oost variant H was found at 3 m depth with only a single mussel, at 7 m depth variant J was found with only a single sea slug and at 15 m variant G was found with a total of five species. Of the five species of variant G only anemones were dominant while only one ascidian and one amphipod of the genus *Photis* were included in the variant. The low total number of species and their low density indicated the early colonisation of the

newly laid sediment. This sediment was dominated by fine particle (type VIII), and 73% of the particles were ≤90 µm.

At Zeelandbrug-De Val at 15 m depth community D was found, with 20 species and a total density of 3164 individuals per m². The community at this station was generally dominated by polychaetes, with *Scoloplos armiger*, *Anaitides mucosa* and *Lanice conchilega* the most dominant, but Crustaceans were also dominant (*Cheirocratus sundevallii*). Oligochaetes and the polychaete *Aphelochaeta marioni*, which were dominant in community C, A and B were absent from this station. However, as the top layer of the sediment was dominated by fine particles (type VIII) with 73% of the particles ≤90 µm, it is likely that the community was not a colonisation of the newly laid sediment, but rather the older sediment underneath the new fine sediment.

5. Conclusions

This preliminary study of the benthic infauna on the base of dykes showed a varied diversity between locations, depths and replicates. However, certain trends could be seen. In particular the dominance and diversity of annelids (polychaetes and oligochaetes) was obvious in most locations as well as changes in community structure at different depths.

Community composition at all locations was dominated by annelids, generally both oligochaetes and polychaetes. The polychaete species *Aphelochaeta marioni, Cossura longocirrata, Heteromastus filiformis* and *Nephtys* spec. were dominant in most locations along with the group of oligochaetes. Among the non-annelid species, the phylums Arthropoda and Mollusca were the most abundant. The most frequently occurring species included the group of actinarians (phylum: Cnidaria), the echinoderm *Ophiothrix fragilis*, the group of horseshoe worms from the phylum Phoronida and the group of bivalve molluscs. Although these species were frequently present, they were often present in small numbers.

In general, deeper samples showed greater total abundance and species richness than shallow samples. Of all the locations, Lokkersnol-oost (Cluster 1) showed the highest total abundance, species richness and diversity at 15 m (but also the widest error margin), however at 3 m and 7 m these were among the lowest of the locations. Mean diversity was the lowest at 3 m compared with 7 m and 15 m depth for all Cluster 2 locations, while for one Cluster 1 location, Burghsluis-west, diversity was highest at 3 m depth.

There was no obvious trend of evenness between different depths for the Cluster 1 locations. Evenness was considerably different between the two Cluster 2 locations. At Burghsluis-west evenness was much lower than at Schelphoek-west II at all depths.

Sampling was conducted only a few months after the dyke reinforcement at the Cluster 1 locations. Consequently, in only a few locations was sediment present to sample for infauna. At Schelphoek-oost for T1 only a few organisms were found in this newly laid sediment suggesting the beginning of early settlement. Only one organism was found in each depth for T1, at 3 m a mussel, *Mytilus edulis*, and at 7 m a nudibranch (sea slug) (both phylum: Mollusca). At 15 m depth at Schelphoek-oost there was also a considerable decrease in total abundance, species richness and diversity in T1, where only five species of five different phyla were found, compared with T0 where 22 species of six different phyla were found.

At Zeelandbrug-De Val the comparison between T0 and T1 was considerably different from Schelphoek-oost. Samples were only collected from 15 m depth at Zeelandbrug-De Val and at this depth total abundance and species richness were both higher in T1 than in T0. For T0, 17 species of five different phyla were found, while for T1, 20 species of six different phyla were found. Diversity and evenness were almost equal for both T0 and T1, although the community composition differed. Species from the phyla Mollusca and Arthropoda were present in T1 but not in T0, while species from the phylum Phoronida were present in T0 but not in T1. The top layer of fine sediment in the samples suggests that the sampling, and therefore the community, in T1 may actually be from the older sediment underneath the newly laid layer.

Three main communities were present in the T0 situation in 2009 and 2010 in the Oosterschelde. The species-rich community C was present in the east of the location Schelphoek-west II at all locations and particularly at deeper depths. In the western locations there was the species-poor community A and community B in shallow depths at the locations Lokkersnol-oost and Zeelandbrug-De Val. The total abundance of individuals per m^2 in these communities (3074-5957 per m^2) is high in comparison with the density found in the Biological Monitoring Programme in 2000-2005, where the density in the sublittoral was around 2000 individuals per m^2 for a similar area covered.

After the reinforcement of the dykes at some locations fine particle sediment developed. From this the first species of benthic fauna to establish could be identified.

While this data provides an adequate basis for comparison for future surveys conducted after dyke reinforcement, given the current data it is difficult to come to any reliable conclusions about the general effect of dyke reinforcement on the benthic community. The variation in the data between locations, depths and replicates must be taken into account during future comparisons. More replicate samples over a longer period of time will allow the effect of dyke reinforcement on the benthic community to be monitored and detect more reliably.

6. Quality Assurance

IMARES utilises an ISO 9001:2000 certified quality management system (certificate number: 08602-2004-AQ-ROT-RvA). This certificate is valid until 15 December 2009. The organisation has been certified since 27 February 2001. The certification was issued by DNV Certification B.V. Furthermore, the chemical laboratory of the Environmental Division has NEN-AND-ISO/IEC 17025:2005 accreditation for test laboratories with number L097. This accreditation is valid until 27 March 2013 and was first issued on 27 March 1997. Accreditation was granted by the Council for Accreditation.

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Justification

Rapport C033/11
Project Number: 4303101401

The scientific quality of this report has been peer reviewed by the a colleague scientist and the head of the department of IMARES.

Approved: Johan Craeymeersch
Ecologist

Signature: 

Date: 19-05-2011

Approved: Birgit Dauwe
Head of Section Delta

Signature: 

Date: 19-05-2011

Appendix A. Number of individuals found per sample in each replicate (A-B), location and depth for Cluster 1, T1 and Cluster 2, T0 samples.

Location	T	Phylum	Species, or lowest level of identification	Depth (m)					
				3		7		15	
				A	B	A	B	A	B
Burghsluis-west	0	Annelida	*Aphelochaeta marioni*	12	7				3
			Heteromastus filiformis	1	2			5	3
		Arthropoda	*Melita obtusata*		1				
			Nephtys (spec)		1				
			Nephtys hombergii					3	1
			OLIGOCHAETA	12	33	30	40	93	83
			Scoloplos armiger	1					
			Streblospio benedicti			1		2	1
		Cnidaria	Actiniaria		1		1		
		Echinodermata	*Echinocadium cordatum*					2	1
			Ophiothrix fragilis	1			1		
		Mollusca	*Montacuta ferruginosa*					1	
Schelphoek-west II	0	Annelida	*Aphelochaeta marioni*	1		8			8
			Cossura longocirrata						1
			Heteromastus filiformis	1		2	2	1	1
			Lanice conchilega					1	
			Nephtys (spec)	2			1		
			Nephtys hombergii	4				2	2
			OLIGOCHAETA	5	5	3	1		
			Polydora cornuta (ligni)				1		1
			Scoloplos armiger			1		1	
			Streblospio benedicti	2	3	6		2	
		Arthropoda	Caprellidae				1		
		Cnidaria	Actiniaria	2	3		3	2	1
		Mollusca	*Abra alba*			1			
			Bivalve spec.				4		1
			Gastropoda				1		
		Phoronida	PHORONIDA	1		10	3	1	2
Schelphoek-oost	1	Annelida	*Malmgreniella lunulata*					1	
		Arthropoda	*Photis* spec.						1
		Chordata	Ascidiacea					1	
		Cnidaria	Actiniaria					6	1

Location	T	Phylum	Species, or lowest level of identification	Depth (m)					
				3		7		15	
				A	B	A	B	A	B
		Echinodermata	*Asteria rubens*					1	
		Mollusca	*Mytilus edulis*	1					
			Nudibranchia				1		
Zeelandbrug-De Val	1	Annelida	*Ampharete acutifrons*						2
			Anaitides mucosa					4	3
			Autolytus (spec)					1	
			Eumida (spec.)						2
			Heteromastus filiformis						2
			Lanice conchilega					1	2
			Nephtys (spec)						1
			Nereis diversicolor					1	
			Notomastus latericeus					1	
			Scoloplos armiger					10	11
			Syllis gracillis					1	
		Arthropoda	*Bodotria pulchella*						1
			Brachyura					1	
			Cheirocratus sundevallii						3
			Decapoda					6	
		Cnidaria	Actiniaria					4	
		Echinodermata	Ophiura						2
		Mollusca	*Abra alba*						1
			Crepidula fornicata					2	
			Ensis (spec.)					1	

Appendix B. Number of individuals found per m^2 in each replicate (A-B), location and depth for Cluster 1, T1 and Cluster 2, T0 samples.

Location	T	Phylum	Species, or lowest level of identification	Depth (m)					
				3		7		15	
				A	B	A	B	A	B
Burghsluis-west	0	Annelida	*Aphelochaeta marioni*	1205.43	703.17				301.36
			Heteromastus filiformis	100.45	200.91			502.26	301.36
			Nephtys (spec)		100.45				
			Nephtys hombergii					301.36	100.45
			OLIGOCHAETA	1205.43	3314.94	3013.58	4018.11	9342.11	8337.58
			Scoloplos armiger	100.45					
			Streblospio benedicti			100.45		200.91	100.45
		Cnidaria	Actiniaria		100.45		100.45		
		Arthropoda	*Melita obtusata*		100.45				
		Echinodermata	*Echinocadium cordatum*					200.91	100.45
			Ophiothrix fragilis	100.45			100.45		
		Mollusca	*Montacuta ferruginosa*					100.45	
Schelphoek-west II	0	Annelida	*Aphelochaeta marioni*	100.45		803.62			803.62
			Cossura longocirrata						100.45
			Heteromastus filiformis	100.45		200.91	200.91	100.45	100.45
			Lanice conchilega					100.45	
			Nephtys (spec)	200.91			100.45		
			Nephtys hombergii	401.81				200.91	200.91
			OLIGOCHAETA	502.26	502.26	301.36	100.45		
			Polydora cornuta (ligni)				100.45		100.45
			Scoloplos armiger			100.45		100.45	
			Streblospio benedicti	200.91	301.36	602.72		200.91	
		Arthropoda	Caprellidae				100.45		
		Cnidaria	Actiniaria	200.91	301.36		301.36	200.91	100.45
		Mollusca	*Abra alba*			100.45			
			Bivalve spec.				401.81		100.45
			Gastropoda				100.45		
		Phoronida	PHORONIDA	100.45		1004.53	301.36	100.45	200.91
	0	Annelida	*Anaitides* (spec.)						100.45
			Aphelochaeta marioni	200.91	100.45	200.91	401.81	100.45	
			Capitella capitata					301.36	
			Cossura longocirrata	200.91	401.81	100.45		100.45	
			Gattyana cirrosa			401.81			

			Hesionidae			100.45		100.45	
			Heteromastus filiformis	100.45		301.36	301.36	200.91	301.36
			Nephtys hombergii		200.91	100.45	200.91		200.91
			Nereis longissima					100.45	
			OLIGOCHAETA	703.17	1908.6	200.91	502.26	7333.06	2410.87
			Owenia fusiformis						100.45
			Polychaete (spec.)					100.45	
			Pygospio elegans						100.45
			Scoloplos armiger				100.45	100.45	200.91
			Spiophanes bombyx					100.45	
			Stenelais boa			200.91			200.91
		Arthropoda	*Bathyporeia*			100.45	100.45		
			Melita (spec.)					100.45	100.45
			Melita obtusata			100.45			100.45
		Cnidaria	Actiniaria		100.45	401.81	100.45	301.36	301.36
		Echinodermata	*Ophiothrix fragilis*		100.45		100.45		
		Mollusca	*Abra alba*					100.45	
			Tellina fabula					100.45	
		Nemertea	Nemertea				3214.49	100.45	
		Phoronida	PHORONIDA			502.26			100.45
Schelphoek-oost	1	Annelida	*Malmgreniella lunulata*					100.45	
		Chordata	Ascidiacea					100.45	
		Cnidaria	Actiniaria					602.72	100.45
		Arthropoda	*Photis* spec.						100.45
		Echinodermata	*Asteria Rubens*					100.45	
		Mollusca	*Mytilus edulis*	100.45					
			Nudibranchia				100.45		
Zeelandbrug-De Val	1	Annelida	*Ampharete acutifrons*						200.91
			Anaitides mucosa					401.81	301.36
			Autolytus (spec)					100.45	
			Eumida (spec.)						200.91
			Heteromastus filiformis						200.91
			Lanice conchilega					100.45	200.91
			Nephtys (spec)						100.45
			Nereis diversicolor					100.45	
			Notomastus latericeus					100.45	
			Scoloplos armiger					1004.53	1104.98
			Syllis gracillis					100.45	
		Arthropoda	*Bodotria pulchella*						100.45
			Brachyura					100.45	
			Cheirocratus sundevallii						301.36

			Decapoda					602.72	
		Cnidaria	Actiniaria					401.81	
		Echinodermata	Ophiura						200.91
		Mollusca	*Abra alba*						100.45
			Crepidula fornicata					200.91	
			Ensis (spec.)					100.45	

Appendix C. Organised table of the soft substrate communities.

Densities shown in bold represent species present in the communities of 66.7% of the stations, underlined values represent the presence of a species in a minimum of 90% of the total number of stations studied. Abbreviations: An - Anthozoa, Br - Bryozoa, Cr - Crustacea, Ech - Echinodermata, Mol - Mollusca, Ne - Nemertea, Ol - Oligochaeta, Ph - Phoronida, Pl - Platyhelminthes, Po - Polychaeta, Pyc - Pycnogonida and Tu - Tunicata.

n/m^2		A	B	C	D	E	F	G	H	I	J	Empty
Nudibranchia	Mol	0	0	0	0	0	0	0	0	0	**50.23**	0
Corophium spec.	Cr	0	0	40.18	0	0	0	0	0	**50.23**	0	0
Decapoda	Cr	0	0	5.02	**117.19**	0	0	0	0	**100.45**	0	0
Mytilus edulis	Mol	174.12	0	35.16	0	0	0	0	**50.23**	0	0	0
Actiniaria	An	80.36	8.37	**175.79**	**100.45**	0	0	**351.58**	0	0	0	0
Malmgreniella lunulata	Po	0	0	15.07	0	0	0	**50.23**	0	0	0	0
Asterias rubens	Ech	0	0	0	**50.23**	0	16.74	**50.23**	0	0	0	0
Ascidiacea	Tu	0	0	0	0	0	0	**50.23**	0	0	0	0
Photis spec.	Cr	0	0	0	0	0	0	**50.23**	0	0	0	0
Heteromastus filiformis	Po	**361.63**	**75.34**	527.38	**117.19**	0	**117.19**	0	0	0	0	0
Macoma balthica	Mol	40.18	8.37	10.05	**33.48**	0	16.74	0	0	0	0	0
Scoloplos armiger	Po	33.48	33.48	**482.17**	**535.75**	**150.68**	0	0	0	0	0	0
Nephtys spec.	Po	30.14	0	0	16.74	**100.45**	0	0	0	0	0	0
Spiophanes bombyx	Po	6.70	0	20.09	0	**100.45**	0	0	0	0	0	0
Nephtys hombergii	Po	56.92	**58.60**	**246.11**	0	**50.23**	0	0	0	0	0	0
Lanice conchilega	Po	16.74	0	35.16	**217.65**	**50.23**	0	0	0	0	0	0
Pygospio elegans	Po	0	8.37	5.02	0	**50.23**	0	0	0	0	0	0
Polychaeta	Po	0	0	15.07	0	**50.23**	0	0	0	0	0	0
Glycera tridactyla	Po	0	0	0	0	**50.23**	0	0	0	0	0	0
Abra alba	Mol	3.35	41.86	105.48	**217.65**	0	0	0	0	0	0	0
Ensis spec.	Mol	10.05	8.37	10.05	**33.48**	0	0	0	0	0	0	0
Anaitides mucosa	Po	0	0	35.16	117.19	0	0	0	0	0	0	0
Ampharete acutifrons	Po	0	0	90.41	33.48	0	0	0	0	0	0	0
Crangon crangon	Cr	6.70	25.11	5.02	33.48	0	0	0	0	0	0	0
Crepidula fornicata	Mol	0	8.37	35.16	33.48	0	0	0	0	0	0	0
Ophiura spec.	Ech	0	0	10.05	33.48	0	0	0	0	0	0	0
Echinocadium cordatum	Ech	10.05	0	0	16.74	0	0	0	0	0	0	0
Nereis diversicolor	Po	10.05	0	15.07	16.74	0	0	0	0	0	0	0
Nereis succinea	Po	6.70	0	0	16.74	0	0	0	0	0	0	0
Pseudopolydora pulchra	Po	0	0	5.02	16.74	0	0	0	0	0	0	0
Notomastus latericeus	Po	0	0	130.59	16.74	0	0	0	0	0	0	0

n/m^2		A	B	C	D	E	F	G	H	I	J	Empty
Phoronida	Ph	56.92	0	**125.57**	**1958.83**	0	0	0	0	0	0	0
Bivalvia	Mol	16.74	0	5.02	200.91	0	0	0	0	0	0	0
Cheirocratus sundevallii	Cr	0	0	0	50.23	0	0	0	0	0	0	0
Eumida spec.	Po	0	0	0	33.48	0	0	0	0	0	0	0
Autolytus spec.	Po	0	0	0	16.74	0	0	0	0	0	0	0
Bodotria pulchella	Cr	0	0	0	16.74	0	0	0	0	0	0	0
Brachyura	Cr	0	0	0	16.74	0	0	0	0	0	0	0
Malacoceros fuliginosus	Po	0	0	0	16.74	0	0	0	0	0	0	0
Syllis gracillis	Po	0	0	0	16.74	0	0	0	0	0	0	0
Oligochaeta	Ol	**1419.73**	**1841.64**	**1421.41**	**33.48**	0	0	0	0	0	0	0
Aphelochaeta marioni	Po	**545.79**	**175.79**	326.47	0	0	0	0	0	0	0	0
Nemertea	Ne	0	**75.34**	175.79	0	0	0	0	0	0	0	0
Aoridae	Cr	0	66.97	85.38	0	0	0	0	0	0	0	0
Streblospio benedicti	Po	93.76	117.19	60.27	0	0	0	0	0	0	0	0
Cossura longocirrata	Po	23.44	**334.84**	50.23	0	0	0	0	0	0	0	0
Exogone naidina	Po	0	25.11	30.14	0	0	0	0	0	0	0	0
Owenia fusiformis	Po	0	16.74	30.14	0	0	0	0	0	0	0	0
Anaitides spec.	Po	0	8.37	25.11	0	0	0	0	0	0	0	0
Hesionidae	Po	0	8.37	25.11	0	0	0	0	0	0	0	0
onbekend	-	3.35	**92.08**	25.11	0	0	0	0	0	0	0	0
Capitella capitata	Po	3.35	150.68	15.07	0	0	0	0	0	0	0	0
Ophiothrix fragilis	Ech	10.05	0	15.07	0	0	0	0	0	0	0	0
Carcinus maenas	Cr	10.05	0	10.05	0	0	0	0	0	0	0	0
Melita obtusata	Cr	3.35	0	10.05	0	0	0	0	0	0	0	0
Nereis spec.	Po	3.35	8.37	10.05	0	0	0	0	0	0	0	0
Venerupis senegalensis	Mol	0	25.11	10.05	0	0	0	0	0	0	0	0
Neoamphitrite spec.	Po	3.35	0	5.02	0	0	0	0	0	0	0	0
Stenelais boa	Po	0	0	**90.41**	0	0	0	0	0	0	0	0
Polycirrus spec.	Po	0	16.74	286.29	0	0	0	0	0	0	0	0
Pholoe minuta	Po	0	0	205.93	0	0	0	0	0	0	0	0
Polydora cornuta (ligni)	Po	10.05	0	130.59	0	0	0	0	0	0	0	0
Neoamphitrite figulus	Po	0	0	115.52	0	0	0	0	0	0	0	0
Caprellidae	Cr	3.35	0	90.41	0	0	0	0	0	0	0	0
Gattyana cirrosa	Po	0	0	75.34	0	0	0	0	0	0	0	0
Amphipoda	Cr	0	0	55.25	0	0	0	0	0	0	0	0
Corophium sextonae	Cr	0	0	50.23	0	0	0	0	0	0	0	0
Ampelisca brevicornis	Cr	0	0	45.20	0	0	0	0	0	0	0	0

n/m²		A	B	C	D	E	F	G	H	I	J	Empty
Ophiura albida	Ech	0	0	30.14	0	0	0	0	0	0	0	0
Aonides oxycephala	Po	0	0	25.11	0	0	0	0	0	0	0	0
Glycera spec.	Po	0	0	25.11	0	0	0	0	0	0	0	0
Eteoninae	Po	0	0	20.09	0	0	0	0	0	0	0	0
Kefersteinia cirrata	Po	0	0	20.09	0	0	0	0	0	0	0	0
Nereis longissima	Po	0	0	20.09	0	0	0	0	0	0	0	0
Bodotria scorpiodes	Cr	0	0	15.07	0	0	0	0	0	0	0	0
Eteone spec.	Po	0	0	15.07	0	0	0	0	0	0	0	0
Petricola pholadiformis	Mol	0	0	15.07	0	0	0	0	0	0	0	0
Plathynereis dumerilli	Po	0	0	15.07	0	0	0	0	0	0	0	0
Abra nitida	Mol	0	0	10.05	0	0	0	0	0	0	0	0
Aora typica	Cr	0	0	10.05	0	0	0	0	0	0	0	0
Bathyporeia spec.	Cr	0	0	10.05	0	0	0	0	0	0	0	0
Melita spec.	Cr	0	0	10.05	0	0	0	0	0	0	0	0
Platyhelminthes	Pl	0	0	10.05	0	0	0	0	0	0	0	0
Bryozoa	Br	0	0	5.02	0	0	0	0	0	0	0	0
Lepidonotus spec.	Po	0	0	5.02	0	0	0	0	0	0	0	0
Mysella bidentata	Mol	0	0	5.02	0	0	0	0	0	0	0	0
Nereis virens	Po	0	0	5.02	0	0	0	0	0	0	0	0
Nymphon spec.	Pyc	0	0	5.02	0	0	0	0	0	0	0	0
Perioculodes longimanus	Cr	0	0	5.02	0	0	0	0	0	0	0	0
Polynoidae	Po	0	0	5.02	0	0	0	0	0	0	0	0
Spio martinensis	Po	0	0	5.02	0	0	0	0	0	0	0	0
Tellina fabula	Mol	0	0	5.02	0	0	0	0	0	0	0	0
Mya arenaria	Mol	0	8.37	0	0	0	0	0	0	0	0	0
Gastropoda	Mol	3.35	0	0	0	0	0	0	0	0	0	0
Montacuta ferruginosa	Mol	3.35	0	0	0	0	0	0	0	0	0	0
Nephtys caeca	Po	3.35	0	0	0	0	0	0	0	0	0	0
Nephtys cirrosa	Po	3.35	0	0	0	0	0	0	0	0	0	0
Palaemon macrodactylus	Cr	3.35	0	0	0	0	0	0	0	0	0	0
Polydora spec.	Po	3.35	0	0	0	0	0	0	0	0	0	0
n/m²		3073.9	3248.0	5956.9	4135.3	602.7	150.7	552.5	50.2	150.7	50.2	0.0
Index		1.998	2.234	3.505	2.623	2.855	0.550	1.673	0.000	0.918	0.000	0.000
Evenness		0.650	0.647	0.780	0.671	0.952	0.550	0.720	0.000	0.918	0.000	0.000
Gemiddeld aantal soorten		8.3	10.5	23.8	15.0	8.0	1.7	5.0	1.0	2.0	1.0	0.0
Totaal aantal soorten		36	26	77	30	8	3	5	1	2	1	0

n/m^2	A	B	C	D	E	F	G	H	I	J	Empty
Aantal stations	15	6	10	3	1	3	1	1	1	1	1