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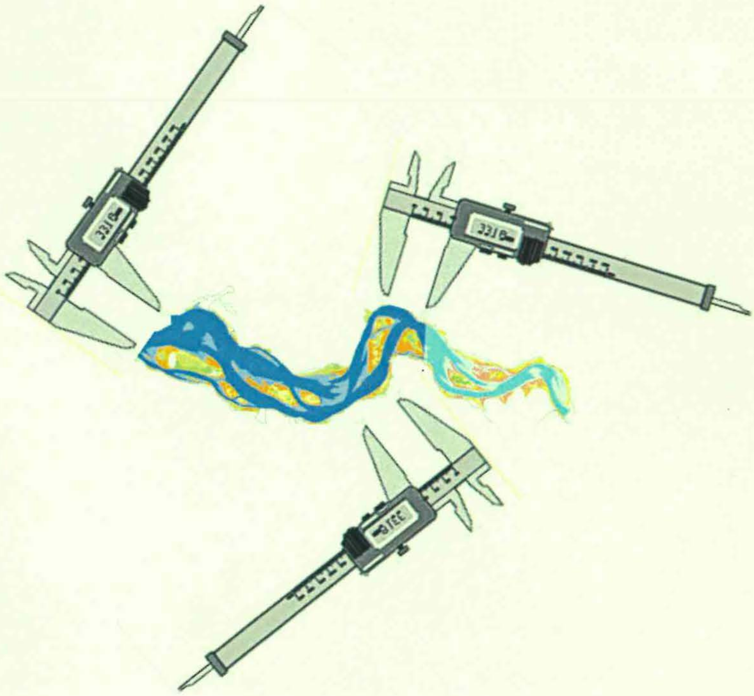

Vincent Escaravage, Tom Ysebaert and Peter Herman

November 2004

NIOO

Koninklijke Nederlandse Academie van Wetenschappen
Nederlands Instituut voor Ecologie

Centrum voor Estuariene en Mariene Ecologie (NIOO-CEME)
Korringaweg 7, 4401 NT Yerseke

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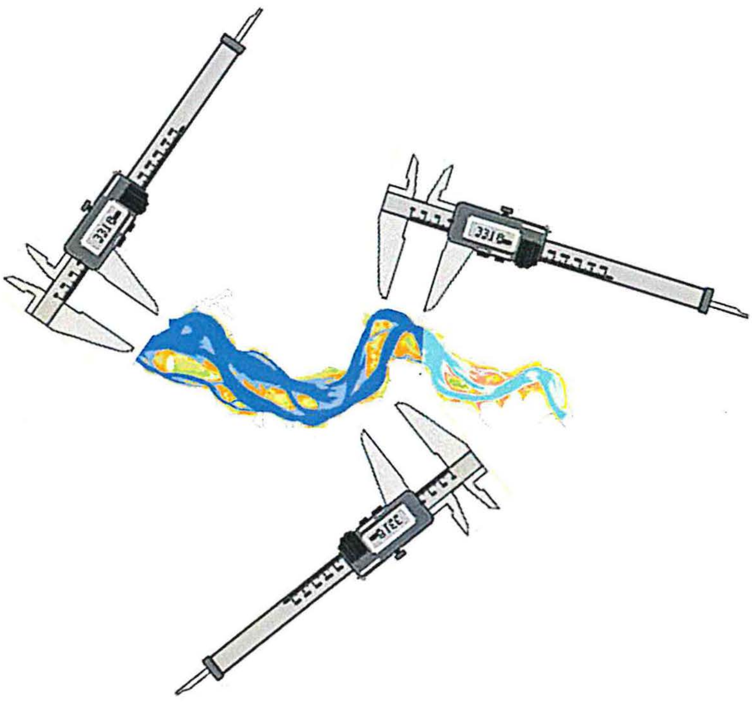

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Dankbetuiging

Dit rapport, opgesteld in opdracht van het RIKZ (Scaldit RKZ-1478) is mede tot stand gekomen in samenwerking met de volgende personen:

- Kirsten Wolfstein was de projectleider voor RIKZ
- Fred Twisk (RIKZ) heeft ons de GIS kaarten bezorgd samen met aanvullende informatie over mogelijke referentie gegevens voor de MEP
- Annette Wielemaker heeft gezorgd voor de GIS verweking van de gegevens

DESCRIPTION OF THE MAXIMAL AND GOOD ECOLOGICAL POTENTIALS (MEP / GEP) FOR THE BENTHIC MACROFAUNA FOR THE EUROPEAN WATER FRAMEWORK DIRECTIVE WFD, THE WESTERSCHELDE, Vincent Escaravage, Tom Ysebaert and Peter Herman (2004), 96 pp met illustraties in tekst en bijlagen.

NIOO-CEME Rapport 2004-04. KNAW-NIOO, Centrum voor Estuariene en Mariene Ecologie, Yerseke.
ISSN Nummer 1381-6519

Content

Executive Summary (in Dutch)

De Kaderrichtlijn Water (KRW)

De Kaderrichtlijn Water is vastgesteld op 22 december 2000. De lidstaten hebben ermee ingestemd om de kwaliteit van alle Europese wateren in een goede toestand te brengen en te houden. In 2015 moeten de oppervlaktewateren in een goede *ecologische* en een goede *chemische* toestand verkeren. De ecologische toestand wordt bepaald aan de hand van biologische kwaliteitselementen en bestaan uit vier soortgroepen die de basis van het voedselweb vormen: algen, waterplanten, bodemdieren en vissen. In de goede toestand moet de samenstelling van een soortgroep voldoende gevarieerd zijn en de soorten moeten in voldoende grote aantallen voorkomen om het ecosysteem duurzaam te laten functioneren.

Oppervlaktewateren worden onderverdeeld in verschillende categorieën, waaronder kustwateren en overgangswateren. De *status* van het water, ofwel de mate van natuurlijkheid, bepaalt de volgende stap in de indeling in waterlichamen. De Kaderrichtlijn Water onderscheidt natuurlijke, sterk veranderde en kunstmatige waterlichamen. Binnen een waterlichaam moet sprake zijn van één uniforme status. De Westerschelde behoort tot de overgangswateren en is aangeduid als sterk veranderd. *Een waterlichaam is sterk veranderd als de aard van het waterlichaam door menselijke ingrepen wezenlijk veranderd is. Herstel van de natuurlijke situatie in een sterk veranderd waterlichaam heeft verstrekkende gevolgen voor de gebruiksfuncties in het gebied of vergt extreem hoge kosten voor alternatieve maatregelen.*

De referentietoestand, ofwel de zeer goede ecologische toestand, beschrijft de ecologische toestand die een waterlichaam kan bereiken als er geen of slechts zeer geringe menselijke beïnvloeding is. De doelstelling van de Kaderrichtlijn Water, de goede ecologische toestand, wordt hieruit afgeleid. Voor sterk veranderde waterlichamen biedt een toestand zonder menselijke beïnvloeding vaak geen geschikte referentie. In dat geval biedt de Kaderrichtlijn de mogelijkheid om een *Maximaal Ecologisch Potentieel* vast te stellen. Het Maximaal Ecologisch Potentieel lijkt zoveel mogelijk op de Zeer Goede Ecologische Toestand maar houdt rekening met de beperkingen die de sterk veranderde of kunstmatige kenmerken met zich meebrengen. De beheerder van een sterk veranderd waterlichaam bepaalt zelf welke ecologische toestand maximaal haalbaar is, gelet op de functies.

Doel van dit rapport

Het rapport 'Beschrijving van het Maximaal Ecologisch Potentieel en het Goed Ecologisch Potentieel (MEP/GEP) voor benthische macroinvertebraten in de Westerschelde' heeft als doel:

- beschrijving van een indicator voor het Maximaal Ecologisch Potentieel (MEP) en het daarvan afgeleide Goed Ecologisch Potentieel (GEP) voor macrozoöbenthos in overgangswateren, met als voorbeeld de Westerschelde. De vraagstelling daarbij is hoe een goed ecologisch potentieel kan worden gedefinieerd, rekening houdend met de bestaande hydromorfologische veranderingen en aanpassingen van het systeem;
- Ontwikkelen van een kwantitatieve indicator, die toelaat vast te stellen of de grenswaarden voor het bereiken van het MEP en het GEP zijn gehaald en/of hoever ervan wordt afgeweken;

- Ontwikkelen van een aantal deel-indicatoren, die op een onderliggend niveau zoveel mogelijk informatie zullen behouden, zodat hieruit informatie kan worden afgeleid die sturend kan zijn voor het beleid, mochten de doelstellingen niet worden gehaald.

Het rapport gebruikt het hiërarchische, schaal-afhankelijke concept dat door Ysebaert & Herman (2004) werd uitgewerkt. Deze benadering werd in de STOWA rapportage (red. Van der Molen, 2004) 'Referentie en maatlatten voor overgangs- en kustwateren ten behoeve van de Kaderrichtlijn Water' gebruikt om een eerste aanzet te geven tot het ontwikkelen van een referentie en maatlatten voor de Westerschelde.

De Westerschelde als sterk veranderd waterlichaam

De Westerschelde behoort tot de categorie sterk veranderde natuurlijke wateren. Door de eeuwen heen is de Westerschelde onderhevig geweest aan inpolderingen, wat geleid heeft tot grote verliezen aan intergetijdengebieden en ondiepwatergebieden. Het grote belang van dit estuarium voor de scheepvaart van en naar Antwerpen heeft de laatste eeuw geleid tot een grote verandering in de hydromorfologie om de vaargeul op diepte te houden. Dit heeft er toe geleid dat het geulsysteem dieper is geworden, het volume platen tussen de geulen is toegenomen, het areaal ondiepwatergebied is afgenomen en het plaat-geul reliëf is versteilt.

In de 20ste eeuw was er tevens sprake van een verslechtering in de waterkwaliteit, maar de laatste jaren is er een verbetering merkbaar, zeker wat betreft nutriënten.

De hiërarchische, schaal-afhankelijke benadering (Ysebaert & Herman, 2004)

De hiërarchische, schaal-afhankelijke benadering geeft een beoordeling van het systeem op verschillende schaalniveaus:

Niveau 1: Op het niveau van het gehele ecosysteem kan worden geëvalueerd of het macrozoöbenthos de - naar heersende ecologische omstandigheden - te verwachten functionele rol vervult.

Niveau 2: Op het onderliggende niveau kan worden gecontroleerd of de verdeling van habitatten of ecotopen aan de (op geomorfologie gebaseerde) verwachtingen voldoet, en of areaalgrootte en connectiviteit van ecotopen geen beperkingen aan biodiversiteit oplegt.

Niveau 3: Binnen de habitatten tenslotte kan worden gecontroleerd of de te verwachten soorten aanwezig zijn, en kunnen indicatoren opgesteld worden die gevoelig zijn voor verschillende types stress die mogelijk een afwijking kunnen verklaren.

Het is mogelijk hier nog een vierde niveau (populatieniveau, inclusief genetische samenstelling) aan toe te voegen, maar de normen hiervoor zijn nog grotendeels onderwerp van fundamentele studie.

De benadering is multimetrisch, houdt rekening met van nature variërende niveaus van fysische en chemische stress, en kan, mits voldoende empirische basis kan worden verzameld, specifiek gemaakt worden voor verschillende typische stressoren. Zij is bovendien expliciet met betrekking tot ruimtelijke en temporele schalen. De multimetrische aanpak kan worden samengevat in gemakkelijk communiceerbare indicatoren, terwijl de onderliggende componenten zichtbaar kunnen blijven, en dus een interpretatie van de afwijking van de norm inzichtelijk kunnen maken.

Ecotopen typologie

Door Bouma et al. (2003) is een ecotopen typologie ontwikkeld. Uitgangspunt is dat de plaatselijk aanwezige fysische omgevingsfactoren via verschillende processen primair het voorkomen van levensgemeenschappen bepalen. Op basis van de meest belangrijke fysische omgevingsfactoren en processen zijn een aantal abiotische indelingskenmerken gekozen. Voor bodemdieren zijn dit saliniteit, substraat, diepte of hoogteligging, hydrodynamiek en slibgehalte. *Ecotopen* zijn ruimtelijk te begrenzen ecologische eenheden, waarvan de samenstelling en ontwikkeling worden bepaald door abiotische, biotische en antropogene condities ter plaatse. Een ecotoop is een herkenbare, min of meer homogene landschappelijke eenheid. Op basis van de parameters en de klassegrenzen worden de ecotopen beschreven. Deze zijn samengenomen in een ecotopenstelsel dat op een hiërarchische wijze is opgebouwd.

Ten behoeve van dit rapport is niet gewerkt met alle mogelijke ecotopen die in de Westerschelde voorkomen, maar zijn combinaties gemaakt om tot een werkbaar aantal ecotopen te komen. Combinaties zijn gemaakt op basis van ecologische kennis van de relatie tussen omgevingsfactoren en het voorkomen van bodemdieren en beschikbare data. Dertien ecotopen zijn onderscheiden, zes in de mariene zone en zeven in de brakke zone. Mosselbanken, een eco-element, zijn omwille van hun ecologisch belang als aparte categorie opgenomen

Definitie van het MEP/GEP voor de Westerschelde

Het opstellen van een historisch of ruimtelijk referentiekader / Maximaal Ecologisch Potentieel voor de Westerschelde is moeilijk. Historische data zijn niet beschikbaar, en binnen de tijd van het project bleek het onmogelijk om voldoende bruikbare gegevens te verzamelen van andere systemen. Dit wordt nog bemoeilijkt door het feit dat estuaria vaak specifiek zijn in hun eigenschappen. De hiërarchische benadering die hier gevolgd is volgt eerder een ecologisch referentiekader, dat uitgaat van een analyse van de toestand van het estuarien systeem in termen van fysische en chemische processen, morfologie, habitatten en structuur van het voedselweb (zie ook Van den Bergh et al., 2003, Van Damme et al., 2004).

Elk niveau van de hiërarchische benadering wordt beschouwd als een indicator en voor elke indicator zijn één of meerder sub-indicatoren en bijhorende maatlatten (en ecologische kwaliteitsratio's of EKR's) ontwikkeld.

<u>Indicator: Ecosysteem niveau</u>

Op deze grote schaal kan gekeken worden naar de functionele rol van het macrobenthos in het ecosysteem. Dit kan worden samengevat door eenvoudige indicatoren, zoals de gemiddelde totale biomassa, gecorrigeerd voor primaire productie (welke op haar beurt een functie is van de hoeveelheid licht en nutrienten). Herman et al. (1999) toonden, op basis van een vergelijking van verschillende systemen wereldwijd, een sterke relatie tussen systeem-gemiddelde totale bodemdierbiomassa en systeem primaire productiviteit. Deze relatie geeft aan dat in ondiepe, goed gemengde estuaria tussen 5% en 25% van de jaarlijkse primaire productie door bodemdieren geconsumeerd worden. Wij hebben gebruik gemaakt van deze relatie, aangevuld met nieuwe velddata, experimentele data en model data, voor het opstellen van een MEP voor de Westerschelde. Tevens zijn we in staat geweest om twee voorbeelden te vinden die tonen hoe systemen in onbalans kunnen komen onder invloed van bepaalde ingrepen of gebeurtenissen.

Van het MEP zijn dan de KRW maatlat klassen en bijhorende ecologische kwaliteitsratio's afgeleid als afwijking ten opzichte van de waargenomen relatie.

Indicator: Ecotoop niveau

Op het ecotoop niveau, dit is het niveau waar de verdeling van ecotopen beoordeeld wordt, is in dit rapport enkel uitgegaan van areaalgrootte. Ideaal zou de beoordeling moeten gebeuren aan de hand van de dertien onderscheiden ecotopen, maar dit bleek niet haalbaar omdat op dit moment geen ecotopenkaarten beschikbaar zijn voor de periode rond 1900, welke gekozen is als uitgangspunt. In de plaats van ecotopen is gewerkt met de grote geomorfologische eenheden of habitatten die in de Westerschelde voorkomen, namelijk schorren, slikken, platen, ondiepwatergebieden en geulen. Aangezien het in de huidige maatschappelijke context als niet realiseerbaar beschouwd wordt om dezelfde oppervlaktes en verhoudingen te bekomen in de huidige toestand, is gewerkt met een bijgestuurde beoordeling. Hiervoor is gebruik gemaakt van de voorstellen die in het kader van ProSes door Van den Bergh et al. (2003) geformuleerd zijn. Deze voorstellen hebben met name betrekking op het meer ruimte geven aan het estuarium, en omvatten in hoofdzaak ontpolderingsmaatregelen.
Voor het definiëren van het MEP is geopteerd om enkel te werken met de (bijgestuurde) verhoudingen aan habitatten, eerder dan met de werkelijke oppervlakte. Omwille van toekomstige socio-economische en maatschappelijke overwegingen die geen onderdeel vormen van dit rapport, lijkt het ons niet wenselijk om voor het MEP met oppervlakte te werken. Ook zegt oppervlakte alleen nog niets over ecologische functionaliteit, en moeten factoren zoals connectiviteit en minimum oppervlakte mee in beschouwing genomen worden. Dit vormt nog onderdeel van verdere studie. De beoordeling gebeurt ook enkel voor de volgende sub-indicatoren: slikken, platen en ondiepwatergebieden. Dit zijn ecologisch gezien de belangrijkste habitatten in de Westerschelde en evolueren mede in functie van het aandeel van de geulen. Een vierde sub-indicator wordt gevormd door de mosselbanken.
Van het MEP zijn dan de WFD maatlat klassen en ecologische kwaliteitsratio's afgeleid als afwijking (afname) ten opzichte van de waargenomen verhoudingen.

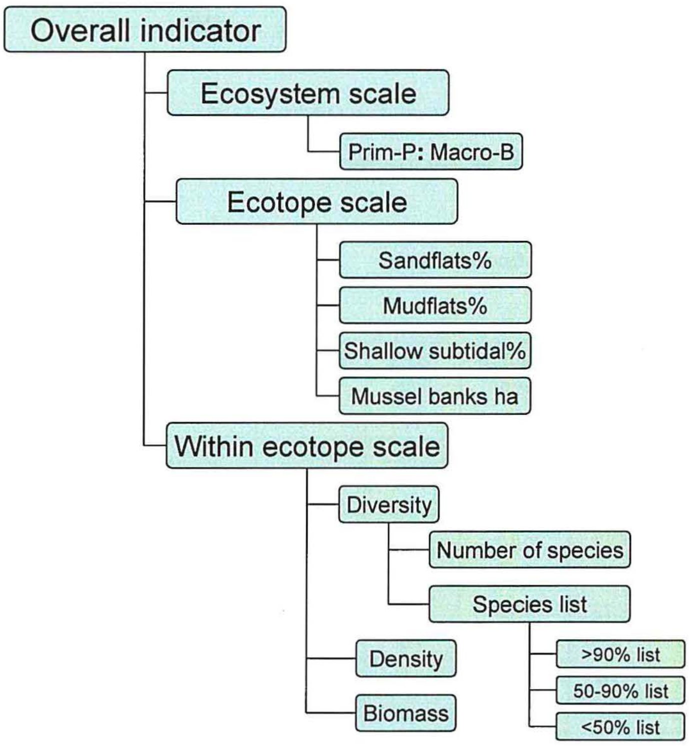
Indicator: Gemeenschap (Binnen-Ecotoop) niveau

Een Maximaal Ecologisch Potentieel is opgesteld voor de dertien verschillende ecotopen. Hiervoor is gebruik gemaakt van de grote data set die beschikbaar is voor de Westerschelde voor de periode 1978-1999. Er is geopteerd om enkel met najaarsgegevens te werken, om seizoensvariaties te beperken.
Voor het beoordelen van het voorkomen van bodemdieren binnen een ecotoop wordt gewerkt met drie sub-indicatoren: soortdiversiteit (aantal soorten en soortensamenstelling), biomassa en densiteit. Deze indicatoren worden in sterke mate beïnvloed door de bemonsterde oppervlakte en het aantal monsters dat genomen is. Tevens worden benthos monsters typisch gekenmerkt door een enorme ruimtelijke en temporele variabiliteit. Met deze onzekerheden is terdege rekening gehouden bij het opstellen van een Maximaal Ecologisch Potentieel per ecotoop.
Door middel van permutatie technieken is de range van het aantal te verwachten soorten in een gegeven bemonsteringsoppervlakte bepaald. In het kort, het vormen van alle mogelijke combinaties tussen de n beschikbare monsters in groepen van 1, 2,…,n levert voorkomingfrequenties van de verschillende aantallen soorten als functie van het bemonsterde oppervlak.

De MEP/GEP en bijhorende eocologische kwaliteitsratio's zijn opgesteld in functie van de afname ten opzichte van het minimum aantal te verwachten soorten. Hoe sterker de afname, hoe slechter het potentieel. De MEP en bijhorende beoordeling voor densiteit en biomassa is opgesteld in functie van de afwijking van de gemiddelde densiteit en gemiddelde biomassa. Hierbij wordt rekening gehouden met zowel de variatie aanwezig in de referentie data set als in de beoordelingsdataset. Aan de hand van een t-test wordt bepaald of de densiteit of biomassa gevonden in de beoordelingsdataset significant afwijkt van de referentie dataset. Omwille van de grote variabiliteit in densiteit en biomassa is het echter niet mogelijk om kleine veranderingen als significant te beoordelen. Hiervoor zouden grote aantallen monsters nodig zijn. Daarom is geopteerd om voor deze indicator geen gebruik te maken van de volledige KRW maatlat klasse-indeling, maar enkel een binaire benadering te hanteren, waarbij een beoordeling dan wel de maximale score (MEP) dan wel de minimale score (BAD) krijgt.

Integratie van de sub-indicatoren tot één indicator voor de Westerschelde

Onderstaand schema geeft een overzicht van de indicatoren en sub-indicatoren met hun onderliggende verbanden zoals ze hierboven beschreven werden. De overall indicator, dit is de overkoepelende indicator die één beoordeling geeft voor de volledige Westerschelde, zal het resultaat zijn van een combinatie van de indicatoren opgesteld voor de drie niveaus van onze hiërarchische benadering: Ecosysteem, Ecotoop en Gemeenschap (Binnen-Ecotoop). Deze indicatoren zijn op zich dan weer het resultaat zijn van een integratie van één of meerdere sub-indicatoren op onderliggende niveaus. Deze sub-indicatoren zijn simpelweg gemiddeld om een beoordeling per indicator te bekomen.



Op het hoogste niveau van integratie, d.i. de combinatie van de drie indicatoren tot een overkoepelende indicator, hebben we een wegingsfactor toegepast die rekening houdt met de gevoeligheid van desbetreffende indicator voor stressoren. Veranderingen in bodemdiergemeenschappen die binnen een ecotoop optreden kunnen een respons op stressoren zijn die niet van invloed zijn op het Ecotoop niveau.

Dat kan bijvoorbeeld een effect van een verslechtering in water- of sedimentkwaliteit zijn of een verandering in temperatuur. Veranderingen in de ecotopen distributie (grootte en verhouding) zullen ook veranderingen in de bodemdiergemeenschap induceren, maar dit eerder op het niveau van het volledige waterlichaam. Deze veranderingen zullen veeleer het resultaat zijn van ingrepen in de morfologische en hydrodynamische condities dan wel een verandering in waterkwaliteit weerspiegelen. De indicatoren die representatief zijn voor het Gemeenschapsniveau (Binnen-Ecotoop niveau) en het Ecotoop niveau kunnen dan ook veralgemenend beschouwd worden als tracers van verstoringen in waterkwaliteit dan wel morfodynamiek. Zij krijgen dan ook eenzelfde gewicht toegewezen in de overkoepelende beoordeling. Hierbij dient wel opgemerkt te worden dat factoren zoals habitatgrootte, ruimtelijke organisatie, connectiviteit, enz. ook een invloed kunnen hebben op populaties, maar hierover is momenteel te weinig kennis voorhanden.

De indicator op het niveau van het ecosysteem kan beschouwd worden als een interactieterm tussen de processen die plaatsvinden tussen en binnen de ecotopen, maar heeft ook een relatie met het functioneren van de rest van het ecosysteem, met het name het pelagische. Het integreert dan ook een scala aan interactieve processen waaraan het systeem zich tracht aan te passen. Enkel een overschrijding van een bepaalde buffercapaciteit (d.i. de resilience van het systeem) zal een significante shift in deze indicator veroorzaken. Als dusdanig is de $B_{macrof}:P_{prim}$ indicator (Macrofauna gemiddelde biomassa/Systeem jaarproductie) een relatief robuuste parameter, maar met een sterke signaalfunctie. Een significant waargenomen afwijking is een sterk signaal dat het systeem uit evenwicht is. Omwille van zijn robustheid wordt voorgesteld deze indicator een gewicht van 1 toe te kennen.

De uiteindelijke, overkoepelende indicator (ECO^3_{BEN}), wordt dan als volgt berekend:

$$ECO^3_{BEN} = [(1 * IND_{Ecosystem}) + (2 * IND_{Ecotope}) + (2 * IND_{Within\text{-}Ecotope})]/5$$

Een overzicht van de indicatoren en sub-indicatoren met bijhorende maatlatten staan weergegeven in onderstaande tabel. De weging wordt dus enkel toegepast op het hoogste integratieniveau, d.i. bij de integratie van de drie indicatoren.

SCALES	Ecosystem Scale		Ecotope Scale				Within Ecotope Scale			Ecological Quality Ratio
Weighing factor	1		2				2			
Eco-logical status	B_{macro}: P_{prim} GAFDW $m^2/gCyr^{-1}$		Mud-flats %	Shallow areas %	Sand flats %	Mussel banks ha	Macro. diversity	Macro. density	Macro. biomass	
MEP	>1/15 <2/15		>15	>15	>12	>200	S_{MEP}*	$t_{calc}<t_{table}$	$t_{calc}<t_{table}$	1
GEP	>2/15 <1/5	<1/15 >1/20	<15 >12	<15 >12	<12 >9	<200 >150	$>S_{MEP}$ x0.75			<1 <0.75
MODE-RATE	>1/5 <1/2.5	<1/20 >1/40	<12 >9	<12 >9	<9 >6	<150 >100	$>S_{MEP}$ x0.50			<0.75 >0.5
POOR	>1/2.5 <1/1	<1/40 >1/100	<9 >6	<9 >6	<6 >3	<100 >50	$>S_{MEP}$ x0.30			<0.5 >0.30
BAD	>1/1	<1/100	<6	<6	<3	<50	$<S_{MEP}$ x0.30	$t_{calc} \geq t_{table}$	$t_{calc} \geq t_{table}$	<0.30

S_{mep} = de MEP standaard die het minimaal aantal te verwachten soorten vertegenwoordigt voor een welbepaald ecotoop (zie Tabel 10 en 11 in het rapport)

Toepassing van de ECO^3_{BEN} indicator op een recente dataset van de Westerschelde

Als eerste toepassing en toetsing van de ontwikkelde indicatoren werd een recente benthos dataset van de Westerschelde gebruikt. Deze data set omvat de jaren 2000-2002 en werd niet gebruikt voor het opstellen van het MEP. Aan de bemonsterde lokaties werd een bepaald ecotoop toegekend. Enkel najaarsgegevens werden gebruikt. Voor de $B_{macrof}:P_{prim}$ indicator werden gegevens voor primaire productie uit 1994 gebruikt, aangezien meer recente data momenteel ontbreken. Op het niveau van het ecotoop is de verhouding van de verschillende habitatten uit het jaar 1996 gebruikt (uit Stikvoort et al., 2003).

Bij het beoordelen van de bodemdiergemeenschappen binnen de verschillende ecotopen, bleken enkele ecotopen slechts weinig monsters te bevatten. Eén ecotoop bevatte helemaal geen monsters en kreeg dan ook geen beoordeling.

De beoordeling per indicator en de ECO^3_{BEN} indicator staan vermeld in onderstaande tabel. De eindscore voor de Westerschelde is MATIG (MODERATE).

	Weighing factor	Ecological Status	Ecological score
Ecosystem scale	**1**	**MEP**	**100**
Ecotope scale	**2**	**MODERATE**	**55**
Within ecotope scale	**2**	**MODERATE**	**74**
Whole water body		**MODERATE**	**72**

Conclusie en vervolg

De aanpak die in dit rapport gevolgd wordt en de indicatoren die hierbij ontwikkeld zijn laten toe een kwantitatieve, ecologische beoordeling van de Westerschelde op basis van bodemdieren te maken. Tevens is de aanpak reproduceerbaar en traceerbaar (i.e. men kan steeds teruggaan naar de individuele sub-indicatoren).

De voorgestelde aanpak moet beschouwd worden als een volgende stap in een ontwikkeling, waarbij ook een aantal leemtes en mogelijke tekortkomingen naar voren zijn gekomen.

Een eerste kanttekening dient gemaakt te worden bij het definiëren van het MEP op het niveau van de bodemdiergemeenschappen per ecotoop (Binnen-Ecotoop niveau). Deze zijn bepaald aan de hand van een zeer grote data set verzameld in de afgelopen 25 jaar. Voordeel van deze benadering is dat we in het algemeen over een groot aantal monsterlokaties beschikten per ecotoop, wat toeliet om terdege rekening te houden met het effect van bemonsteringsinspanning en variabiliteit. Nadeel is dat er geen historische noch ruimtelijke (andere systemen) referentie data gebruikt zijn. Historische data ontbreken en vormen dus geen optie. Wel is het aangewezen om in de toekomst de MEP voor ieder ecotoop verder te verfijnen (valideren) aan de hand van beschikbare data van andere systemen. Dit vereist wel dat voor die systemen de abiotische randvoorwaarden beschikbaar zijn om lokaties tot een bepaald ecotoop te kunnen toekennen.

Een tweede kanttekening kan geplaatst worden bij het definiëren van de verschillende ecotopen. De gekozen indeling is deels gebaseerd op ecologische kennis, maar deels ook op beschikbare data, waardoor bepaalde ecotopen op een vrij hoog classificatieniveau zijn ingedeeld. Een bijkomend probleem hierbij is ook dat op het beoordelingsniveau van de ecotopen areaalgrootte van de verschillende ecotopen niet

beschikbaar is voor de referentieperiode rond 1900, maar enkel de grote geomorfologische eenheden zoals slikken, platen en ondiepwatergebieden. Tevens is er meer inzicht nodig naar de natuurlijke verhoudingen van ecotopen in een estuarium. Wij veronderstellen dat het mogelijk moet zijn, gebaseerd op geomorfologische theorie, om een verwachtingspatroon op te stellen over de verdeling van verschillende ecotopen in een onverstoord estuarium of kustgebied. Een dergelijke norm kan worden gebruikt om te testen of er een significant onevenwicht in de morfologie bestaat, bv. als gevolg van infrastructurele ingrepen (baggeren, constructie van een stormvloedkering, inpoldering etc.). Zulke benadering zou ook kunnen gebruikt worden om toekomstige ingrepen te gaan evalueren.
Een derde kanttekening kan geplaatst worden bij de indicatoren die ontwikkeld worden om de bodemdiergemeenschappen binnen een ecotoop te beoordelen. Hiervoor hebben we gebruik gemaakt van soortensamenstelling, densiteit en biomassa. In de toekomst moet verder geëvalueerd worden of deze aanpak voldoende is, en of bijv. ook dominantie van soorten als maat dient meegenomen te worden. Voorlopig is de indicator ook relatief ongevoelig voor het verschijnen van invasieve soorten in het systeem. De voorgestelde aanpak heeft ook gevolgen voor toekomstige monitoring. Hierop wordt kort ingegaan. De monitoring zal gestratificeerd moeten worden naar ecotopen. Verder moet een optimum gezocht worden in de bemonsteringsinspanning tegenover gevoeligheid tot waarnemen van veranderingen. Dit vereist een voldoende aantal monsters per ecotoop.

Abstract

The Water Framework Directive (WFD) from the European Union (December 2000) aims at the protection of all water types and defines a 'good ecological status' as the objective to be reached for all European waters by 2015. The 'good ecological status' corresponds with a more or less undisturbed status defined as the reference for the water system to be evaluated. The ecological status has to be measured on a five degrees scale from BAD to HIGH through the intermediary states, POOR, MODERATE and GOOD, the latter being the level that is required for the agreement with the WFD.

Under specific circumstances, the WFD allows Member States to identify surface water bodies which have been physically altered by human activity as "heavily modified". Irreversible (unfeasible) transformations in these systems are integrated within a customised referential status: the Maximum Ecological Potential (MEP). Slight variations from the MEP are defined in the Good Ecological Potential (GEP) that is the minimum objective to be reached by 2015. The Westerschelde is one of these heavily modified systems.

In this report we propose a quantitative indicator for the MEP/GEP for the benthic macrofauna of the Westerschelde. The indicator is based on a hierarchical classification system as that proposed by Ysebaert & Herman (2004). The indicator distinguishes three spatial scales for the assessment as the Ecosystem, the Ecotope, and the Within-ecotope scales. At the ecosystem scale the ratio between the average macrofauna biomass and the autotrophic year-production is used to scale the balance between the major carbon fluxes. At the ecotope scale, the relative proportions between the main habitat types are used to assess the integrity/ sustainability of the system. Eventually, macrofauna diversity, density and biomass are assessed within each of the 13 ecotopes defined for this study.

Due to the absence of a solid spatial (similar system elsewhere) or historical (pre-industrial records) reference for the Westerschelde, the MEP and corresponding classification scale is elaborated as a composite from knowledge's acquired from other systems (ecosystem scale) and from modern observations from the Westerschelde itself (at Ecotope and Within-ecotope scales).

A tentative assessment for the Westerschelde is made based on the most recent records that are available at the different scales considered for the present indicator. For the integration (averaging) between the three sub-indicators into the overall indicator for the whole system, the relative sensitivity of the indicators to stressors is considered as a weighing factor by the averaging.

The requirements for the Maximum Ecological Status are met at the ecosystem scale (i.e. no major unbalance among the carbon fluxes) whereas the ecological status at Ecotope and Within-ecotope scales are scaled as MODERATE. This qualifies the ecological status at the scale of the whole water body as MODERATE.

The proposed approach allows a quantitative, ecologically sound judgement of the ecological status of this heavily modified water body. At the same time the approach is reproducible and each step of the integration remains visible and editable for the purpose of management priorities.

The approach must be considered as a next step in the development of indicators that allow the classification of the ecological status of water bodies in a scientifcally-sound way. Further developments and refinements, together with a sound validation is needed in the future.

1 The Water Framework Directive and the Westerschelde

The Water Framework Directive (WFD) from the European Union (December 2000) aims at the protection of all water types and defines a 'good ecological status' as the objective to be reached for all European waters by 2015.
This 'good ecological status' corresponds with a more or less undisturbed status defined as the reference for the water system to be evaluated. It is the responsibility of the member states to define the 'good ecological status' for each of their water types/systems. This is achieved with the development of systems for ecological evaluation that are based on the integration of well defined biological quality criteria. Each of these quality criteria has to support a classification (bad to high) aiming at measuring the 'health' of the system against that described for reference (high level) conditions.

1.1 CLASSIFICATION SCALES

The WFD requires for the coastal and transitional waters the definition of classifications for phytoplankton, macrophytes (algae and angiosperms), benthic macrofauna and, additionally in transitional waters, fish. Each of these elements supports an evaluation of the ecological status for the water body under consideration. The ecological status has to be measured on a five degrees scale from bad to high. For the benthic invertebrates, the normative definitions proposed by the WFD for the ecological status are as below:

- **High**: The level of macrofauna diversity and abundance is within the range normally associated with undisturbed conditions. All the disturbance associated with undisturbed conditions are present.
- **Good**: The level of diversity and abundance of invertebrate taxa is slightly outside the range associated with the type-specific conditions. Most of the sensitive taxa of the type specific communities are present.
- **Moderate**: The level of diversity and abundance of invertebrate taxa is moderately outside the range associated with the type-specific conditions. Taxa indicative of pollution are present.
- **Poor**: Major alterations to the values of the biological quality elements for the surface water body type. Relevant biological communities deviate substantially from those normally associated with the surface water body type under undisturbed conditions.
- **Bad**: Severe alterations to the values of the biological quality elements for the surface water body type. Large portions of the relevant biological communities normally associated with the surface water body type under undisturbed conditions are absent.

The measure of the deviation in regard to a reference condition implies the latter to be measured on a quantitative scale. Quantifying normative values for an ecological status is, especially for coastal and transitional waters one of the most challenging aspects involved with the application of the WFD.

Ysebaert & Herman (2004) stress the requirements for an ecological assessment in coastal and transitional waters as:

- -specific, i.e. contain underlying indices allowing to relate disturbance effects to specific causes of anthropogenic stress
- commensurate, i.e. increase more or less linearly with the severity of stress
- sensitive, i.e. able to resolve effects of stress against a naturally varying background
- generally applicable across an ecoregion
- transferable, i.e. well described so that it can be applied elsewhere by others.

1.2 REFERENCE CONDITIONS

Since the ecological status classes measure the deviation from reference conditions, the latter form the anchor for the whole ecological assessment. As a consequence, it is of crucial importance to carefully define the reference conditions for the benthic invertebrate component at high ecological status.
There are three complementary approaches for this purpose:

- The historical frame of reference; where the reference conditions are set equal to those prevailing when anthropogenic influence was absent or negligible
- The spatial frame of reference; where the reference conditions are derived from a similar body of water but not (or not much) subjected to anthropogenic influences.
- The ecological frame of reference; where the reference conditions are subordinated to the optimisation of the ecosystem functioning. This approach implies an identification of the ecological bottlenecks and of the remedial processes to be strengthen.

1.3 APPLICATION OF THE WFD TO HEAVILY MODIFIED WATER BODIES

There is a clear cut-off for the WFD between the natural waters as lakes, rivers, coastal & transitional waters and the heavily modified and artificial water bodies. Under specific circumstances, the WFD allows Member States to identify surface water bodies which have been physically altered by human activity as "heavily modified". If the uses of such water bodies (i.e. navigation, hydropower, water supply or flood defence) would be significantly affected by the mitigation measures required to achieve good ecological status and if no other better environmental options exist, then these water bodies can be designated as "heavily modified". Whereas the WFD for natural waters proposes to estimate the ecological status relative to a reference as good as free from man-mad influences, irreversible (technically/financially unfeasible) transformations in heavily modified and artificial water bodies may be integrated within a customised referential status defined as the Maximum Ecological Potential (MEP). As for natural waters, slight variations from this referential status are allowed as defined in the Good Ecological Potential (GEP) that is the objective to be reached by 2015 for the WFD. As a consequence of this approach, water bodies that are considered heavily modified will have a classification that is based on a for that water body specific reference status.

The aim of the present project (Scaldit, RKZ-1478) is to describe a quantitative indicator for the MEP and derived GEP for the benthic macrofauna in heavily modified waters, with the Westerschelde estuary as a case study. The indicator is made for the Westerschelde and is as such specific to that water body.
This indicator will be based on sub-indicators that will remain explicitly defined allowing the identification of the disturbance sources in favour of the management decision-making.

The Westerschelde is a transitional water body type. Its main characteristics are:

- ✓ Fully mixed
- ✓ Polyhaline/mesohaline
- ✓ Mesotidal
- ✓ Sheltered
- ✓ Extensive intertidal flats

The Westerschelde is the Dutch part of the Schelde estuary, with the meso-/oligohaline zone and the freshwater tidal zone of this estuary being situated in Belgium. This report only deals with the Westerschelde.

1.4 SCALE-DEPENDENT APPROACH

Taking into consideration the large intrinsic variability of estuarine and coastal systems, Ysebaert & Herman (2004) advocate a hierarchical scale-dependent approach for the classification of the quality elements in coastal and transitional waters (Table 1). A habitat specific approach is furthermore strongly recommended by Prior et al (2004) in their guidance document for the application of the WFD to marine benthic invertebrate communities.
For ecological assessment to be carried out, each defined water body type requires biological reference conditions (high ecological status) to be established. These type-specific reference conditions form the anchor of the WFD ecological assessment with final evaluation being made at the scale of the whole water body, e.g. at the scale of the Westerschelde. Coastal waters and especially transitional waters are however characterised by highly variable physicochemical and hydro-morphologic conditions, resulting typically in a mosaic of different habitats. These habitats differ in (community) structure and function, and as such will show wide variations in statistics or measures between habitats. As such, A generic reference condition for the water body type alone will not be sufficient to derive the ecological status classes required by the Directive for benthic macrofauna. A range of habitat type-specific reference conditions is therefore necessary for the ecological assessment of such communities.
The classification system proposed by Ysebaert & Herman (2004) is based on a hierarchical approach with three hierarchical levels/scales. On the level of the whole ecosystem (e.g. a water body) one can evaluate if the benthic macrofauna fulfils the functional role one might expect given the current ecological circumstances. At this level also integration with other quality measures is most appropriate, and information on the water body can be summarised.
On the subsequent level the distribution of sub-areas (e.g. ecotopes/habitats) can be evaluated. The size, shape, and spatial relationships of these ecotopes influence the dynamics of populations, communities, and ecosystems.

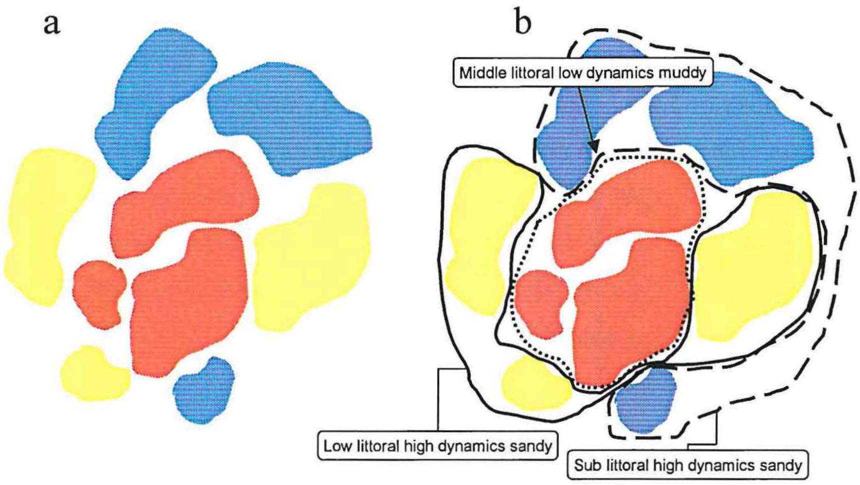
Finally the quality of each distinguished ecotope (e.g. based on the diversity, abundance or biomass of the associated benthic macrofauna) can be evaluated, with indicators that are sensitive to different types of stress and that can explain possible deviations. It is possible to add a fourth level, situated at the population level (including genetic composition and diversity), but standards are still subject to fundamental research. The approach is multimetric, takes into account the natural physical and chemical variability at different scales, and can be made specific for the different types of stressors, when sufficient empirical evidence exists. Moreover the approach is explicit with respect to spatial and temporal scales. The conceptual mode/understanding behind the approach can set the background for the development of a monitoring strategy that satisfies the WFD needs.

Table 1
Hierarchical scheme illustrating the different levels of the classification system and the associated indicators and links at each level as proposed by Ysebaert & Herman (2004).

Level	Evaluations for macrobenthos	Used to assess	Links to
Whole water body	Functional: biomass, feeding types,...	System integrity, functions performed in land-ocean interaction, functions for carbon and nutrient dynamics, production for higher trophic levels	Other quality elements (chemical, phytoplankton,...): aims at integrating view Provides constraints for functions related to nature conservation, relevant to Bird and Habitat Directives
Ecotope	Spatial organisation: surface area, connectivity,...	System completeness in terms of habitats and community development Possible developments under appropriate management Morphodynamic equilibrium and impact of physical stressors	Morphodynamic information Evaluations of habitats and their persistence/conservation (Habitat Directive)
Within-Ecotope	Community structure, based on species composition (diversity), abundance, biomass	Completeness and full development of the biological communities within the ecotopes Occurrence of stress symptoms, comparing species indicator values to expectations valid for the specific habitat	Local stressors Biogeochemical stressors Effects of invasive species

The hierarchical approach pictured in Table 1 decomposes the variation in the water body quality elements between its main driving factors. Processes are addressed at their largest spatial scale to allow their offset against the underlying levels and associated sources of variation.

Figure 1
Fictive example of macrofauna distribution **a.**-without knowledge on the environmental constraints, **b.**-after delimitation of ecotopes.



For example, distribution patterns in macrofauna communities are different among habitats (Figure 1a) and as such are easier to identify and to monitor when the physical environment as depth, granulometry, hydrodynamics is explicitly defined (Figure 1b). This approach allows to distinguish between the community changes within and between these environmental units. Community shifts occurring within an ecotope are a response to a change in a parameter that is not used for the definition of the ecotope; that could be for example sediment and or water chemistry, temperature. On the other hand, changes in the ecotope distribution (size and proportion) will also induce changes in community at scale of the water body but should then be rather interpreted as response to changes in the morpho-/hydrodynamic conditions than to an effect of deteriorated water quality.

1.5 ECOSYSTEM SPATIAL CLASSIFICATION

It is worthwhile to pay attention to the terminology in use with respect to the geomorphologic units that are distinguished within ecosystems. A substantial literature exists on the definition of 'habitat' and related concepts, such as ecotope or biotope (Klijn 1994). Moss & Wyatt (1994) simply synonymies biotope to habitat in a paper describing the CORINE (now pursued as EUNIS) effort to create a harmonised European habitat classification and database (http://www.gsf.de/UNEP/corine.html).

The EC habitat directive (92/43/EEC) proposes the definition of habitat as 'natural habitats means terrestrial or aquatic areas distinguished by geographic, abiotic and biotic features, whether entirely natural or semi-natural' (http://europa.eu.int/comm/environment/nature/nature_conservation/eu_nature_legislation/habitats_directive/index_en.htm)

EUNIS (the European Nature Information System of the European Environment Agency.-EEA) offers a different, more specified, text: 'Plant and animal communities as the characterising elements of the biotic environment, together with abiotic factors (soil, climate, water availability and quality, and others), operating together at a particular scale.' (http://eunis.eea.eu.int/index.jsp). In this report the term habitat is used for the large geomorphological structures in estuarine systems, such as salt marshes, mud flats, sand flats, shallow subtidal areas and deep subtidal areas.

Ruiter & de Jong (1997) identify an ecotope as 'the environment of a community that is defined similarly as habitats by a combination of several abiotic parameters. Aiming at clarity, the term of ecotope will be exclusively used in the present report for the geomorphological units whose definitions are based on environmental characteristics known as constraints for the macrobenthic communities.

In the case of coastal and transitional waters, a consistent definition of the reference conditions for the benthic invertebrate communities requires to take into account the salinity, the position relative to the tidal movements, the granulometry and the hydrodynamics. That is a whole range of ecotopes that needs to be delimited for the definition of the reference conditions and for the assessment of the present conditions. With regard to the application of the WFD, there is a need for ecotope definitions that could be easily transposable from one system to another. National or local ecotope definitions should be preferably referenced against existing nomenclatures such as the European Nature Information System (EUNIS) of the European Environmental Agency (http://eunis.eea.eu.int/index.jsp).

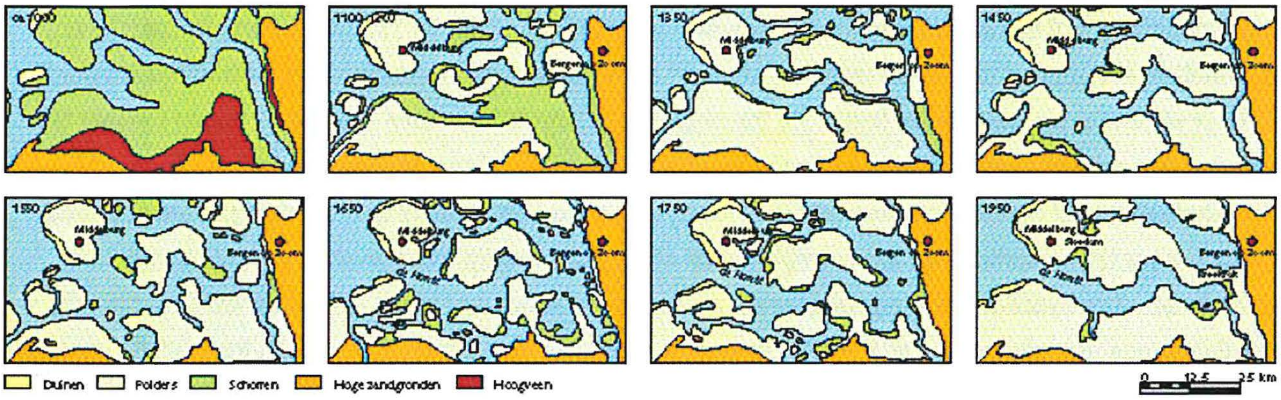
2 Approach used in the MEP-definition for the Westerschelde

2.1 SPECIFIC CONSTRAINTS DUE TO THE HIGHLY MODIFIED STATE OF THE WESTERSCHELDE

2.1.1 Westerschelde: a man made estuary

The Westerschelde should be considered as a heavily modified water body regarding the records of systematic land-reclamation's back to the first millennium of our era (Figure 2).

Figure 2
Development of ' Westerschelde' region from 1000 to 1950 (from van Eck (1999). Note that the light green surfaces represent man-made polders.



When ecological monitoring in general and monitoring of benthic macrofauna in particular is considered, the Dutch Delta waters in SW-Netherlands have systematically been monitored only since the beginning of the 1980's, i.e. long after the accomplishment of tremendous man-made transformations on the hydrodynamics and water quality of the estuary. It is therefore not possible to describe what the natural macrobenthic communities of the Westerschelde should have been today without the influence of man.
Alternatively, in essence similar but not or far less modified systems could be used as a proxy for the definition of the state of a 'free of man' Westerschelde. Estuaria are complex and variable systems that result from highly specific interfaces between the sea and continental waters. Two estuarine systems reproducing the same abiotic environment are not easily found and it becomes even more difficult when one of them has to be free from man influence, as most of the transitional waters in NW-Europe are impacted to some extent. This task is furthermore hampered by the unbalanced monitoring efforts among the different systems and the difficulty to access rough monitoring data from elsewhere. As a consequence it is not feasible to find a system that may serve as a reference as a whole for the Westerschelde when man-made influences were reduced at their minimum possible level.
In the absence of historical or spatial comprehensive frames or reference, the maximum ecological potential (what could be possibly reached given the irreversible constraints) has to be based on knowledge dealing with the ecosystem functioning. That is, given all the human activities around and within the estuary, to identify the bottlenecks that may hamper the maintenance or improvement of the ecological value of the estuary. This concept is worked out in detail by Van den Bergh et al. (2003). The starting point is the maintenance/restoration of the natural physical, chemical and ecological processes. Therefore, the ecological status is based on knowledge about the physical and chemical processes, morphology, habitats

and structure of the food webs. One of the most important factors for optimalisation of these processes is space (Van den Bergh et al. 2003).

2.1.2 The geomorphological constraints

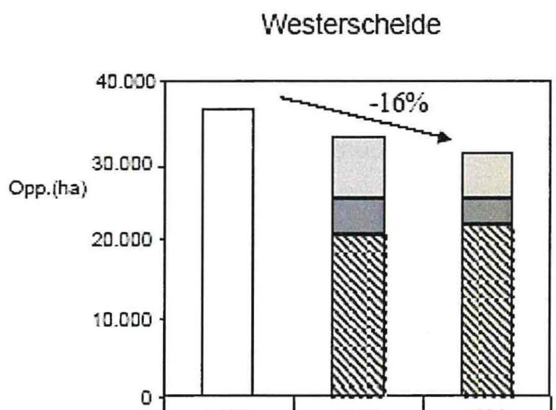
Since the beginning of the middle-age, land was systematically claimed on the Scheldt estuary through the building of dykes and polders (Figure 2). The present overall form and circulation pattern of the Westerschelde as only outflow for the river Scheldt was eventually reached after the embankment of the Kreekrak (1867) and the raising of the Sloedam (1871). As a consequence it could be stated that the geographical extent and functionality of the Westerschelde estuary as we know it today date from the beginning of the twentieth century (Figure 2). The year 1900 could then be reasonably be used as a 'natural' reference for the geomorphologic characteristics for the estuary.

The embankment of the Braakman, a large sea-arm west of Terneuzen, in 1952 was the last major land reclamation executed in the Westerschelde whereas thresholds in the navigation channels to the Antwerp harbour were/are regularly deepened since the beginning of the 20th century. Especially during the last two decades this dredging and subsequent dumping of dredged material has increased substantially.

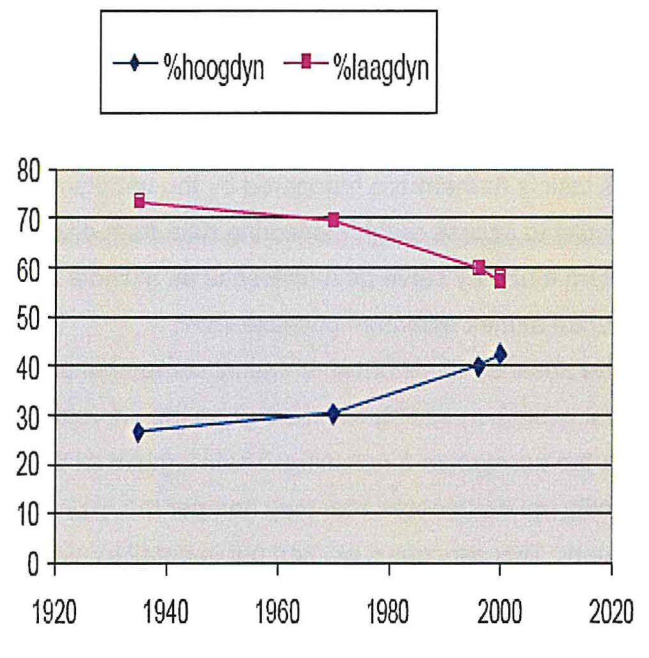
The whole extent of human activities on the estuary, occurring concurrently with the rising of the sea level may have somehow contributed to an amplification of the tidal energy with elevated current speeds and water levels. The hydro-morphological developments observed actually in the Westerschelde (decreasing intertidal areas and shallow subtidal areas, raising of sand flats) could then partly result from adjustments to this, at a geological scale, new situation (van den Bergh et al. 2003). What the human share represents for the ongoing developments remains uncertain, but it is a fact that huge areas of intertidal mudflats and shores have been deliberately obliterated (Figure 2).

Figure 3

Left.-Development of the main habitats areas in the Westerschelde since 1900. Right.-Proportions of low- and high-dynamical littoral areas from unpublished work by D. de Jong based on geo-morphological maps and aerial photographs (from van den Bergh et al., 2003).



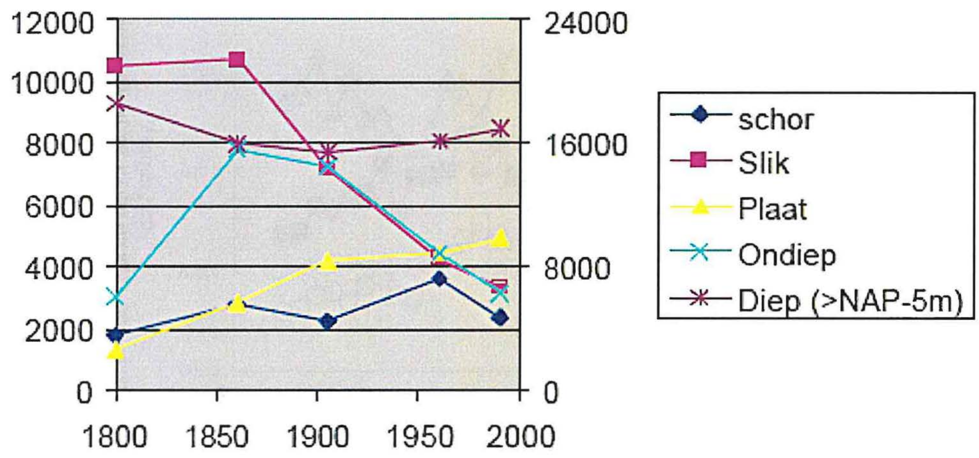
	1900	1960	1990
Oppervlakte (ha)	36.637	32.880	30.930
Slikken & schorren		24%	19%
Ondiep water		14%	10%
Geul & platen		62%	71%



A quantification of the habitat areas that has been lost since 1900 is given by van den Berg et al (2003) as shown in Figure 3. These data illustrate actual trends as the decrease of the shallow areas, the reduction of the mudflats and the extension of the deepwater areas. Parallel to these processes, an increase of high dynamic littoral areas to the detriment of low dynamic counterparts seems to intensify during the second half of the 20th century (Figure 3). This accelerated change seems to continue during last years (pers. comm. F. Twisk).

The main consequence of these developments is a drastic reduction of the low dynamic shallow and littoral zones that constitute a preferential habitat for most of the macrobenthic fauna (think about mussels and cockles) and connected food web (birds, fish, seals) (Ysebaert et al., 2003). The 16% decrease quoted in Figure 3 represents the area loss with all habitats included. When only the intertidal mudflats, salt marshes and shallow areas are considered, about 46% or 7660 ha of these habitats has been lost between 1900 and 1990 (Figure 4). The relatively small changes in salt marsh surface in the Westerschelde is due to the fact that, during the considered period, salt marshes were both lost (mainly in the polyhaline part of the Schelde estuary) and created at the same time. The introduction of *Spartina anglica* to Saeftinghe led to the development of one of the largest brackish marshes in Western Europe.

Figure 4
Changes in the area of five dominant habitat classes in the Westerschelde since 1800. Note the linear decrease of both the mudflats and the shallow areas between 1900 and present, whereas deep areas and sandbanks slightly increase over the same period. Unpublished data by D. de Jong presented in van den Bergh et al (2003).



From the data presented in Figure 3 and Figure 4, the geo-morphological reference conditions (1900) for the Westerschelde could be estimated by the figures in Table 2.

Table 2
Estimated geo-morphological reference conditions (1900) for the Westerschelde from data in van den Bergh et al (2003), habitat relative proportions and areas (ha)

Habitat	Proportion (%) / Area (ha)
Salt marshes (Schor)	6.5 / 2300
Mudflat (slik)	20 / 7350
Sandbank (platen)	11 / 4050
Shallow areas	20 / 7350
Deep areas (>NAP-5m)	42.5 / 15550

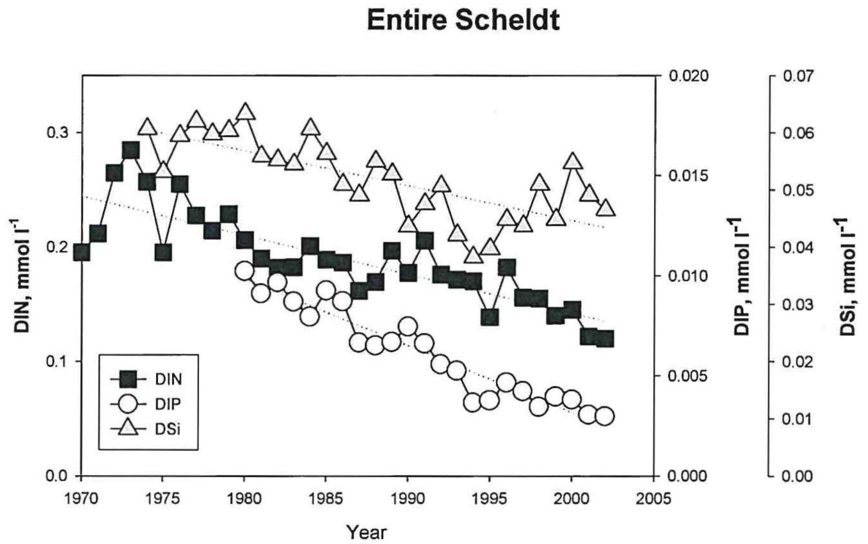
Beside the extent of the large geo-morphological structures listed above, the occurrence of mussel beds in estuaries like the Westerschelde should be given a separate status because of their ecological importance (see further).

2.1.3 Water quality trends

Before the seventies, most effluents from industrial and domestic sources were discharged both directly to the Scheldt river and estuary and indirectly via the sewage systems. In the Belgian part of the Scheldt, nutrient concentrations increased at a rate higher than 10% per year during the second half of the seventies (Soetaert et al. in press) By the end of the seventies, symptoms such as temporal anoxia and massive mortality events were a common feature in the upstream part of the Scheldt. Since that period, major and still ongoing efforts were/are undertaken to reduce this load. This mostly concerns the point sources of nutrient pollution whereas diffuse sources remain more resilient to treatment.

Data compiled by Soetaert et al (in press) show tremendous improvements in the water quality in the Westerschelde over the last two decades (Figure 5).

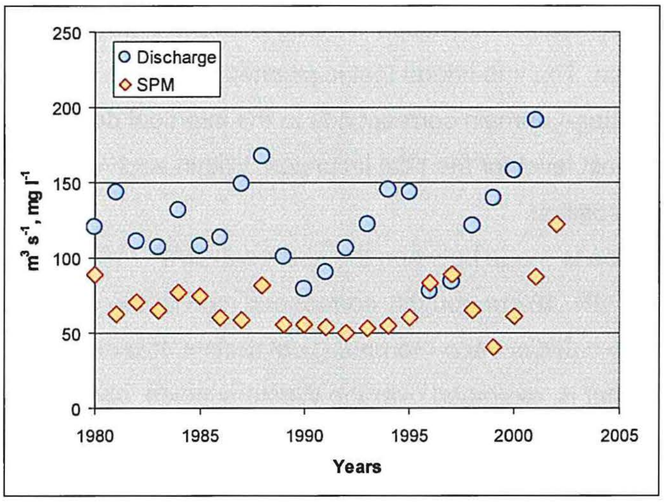
Figure 5
Long term changes in the annually averaged nutrient concentrations for the entire Westerschelde (Gent-Vlissingen) from Soetaert et al (in press).



For the whole estuary the decrease in nutrient concentrations reach 1%, 1.3% and 5.4% per year for Dissolved Silicium (DSI), Dissolved Inorganic Nitrogen (DIN) and Dissolved Inorganic Phosphorus (DIP) respectively. Diffuse sources should continue to supply the estuary with the nutrients needed for the primary production that is and should remain mostly light limited. Indeed, whereas important decreases in nutrient concentrations were observed turbidity remained at a rather unchanged level over the last twenty years (Figure 6, data friendly communicated by Karline Soetaert).

The trends in water quality described here have serious consequences for the choice of the data to be used for the reference status. When seeking for information on the community at level of ecotope in the Westerschelde, records from the 80's are possibly representative for more disturbed conditions (with respect to water quality) than observations made during the nineties or the years 2000.

Figure 6
Yearly average discharge (measured at Schelle) and suspended matter concentration (estuary average) (data friendly communicated by Karline Soetaert).



2.2 THE ECOTOPE TYPOLOGY

As stated above, the second and third level of our hierarchical approach is situated at the ecotope level; an ecotope is a spatial unit where the main ecological relevant constraints for the macrobenthos (salinity, substrate, elevation, hydrodynamic conditions, sediment characteristics) are rather homogeneous.
The ecotope system used in the present rapport has been derived from the ZES-ecotope system (Zoute Wateren Ecotopenstelsel) developed by RIKZ for the Dutch coastal and transition waters (Bouma et al. 2003). This system has a hierarchical structure that includes the five following strata:
Salinity<Substrate<Elevation<Hydrodynamics<Sediment characteristics.
Threshold values defined for each parameter delimit condition classes wherein rather homogeneous benthic community are expected to occur. Besides, care was also taken to set the parameter thresholds at values close to those in use in existing national and international classifications (RWES, EUNIS).

2.2.1 Hierarchy and threshold values used in the ZES-ecotope classification

Only the parameters and variables relevant for this report are presented here; for a full description of the ZES-ecotope classification see Bouma et al. (2003). Variables belonging to different parameters such as 'hard substrate', 'variable salinity' or 'supra- littoral' are not considered here.

Salinity
At the highest level, the water body is divided according to its salinity into a saline and a brackish area; The threshold between the marine and the brackish areas has been chosen according to the Venice system. Water with an average salinity (ppt) between 5.5 and 18 (3-10 g Cl-/l) is called brackish (mesohaline) whereas marine water has a salinity higher than 18 (10 g Cl-/l) and is called marine (poly- and euhaline). Oligohaline waters with a salinity between 0.5 and 5.4 (0,3-3 g Cl-/l) are not considered within the ZES-ecotope system.

Substrate

The second level in the ZES system deals with the nature of the substrate, whether hard substrate or soft sediment. In the present case (Westerschelde) only the second category has to be considered.

Elevation

At the third level of the ZES classification distinction is made between areas as function of their vertical position relative to the tidal range. The sub-littoral that is situated under the intertidal zone, remains permanently submerged. The littoral domain corresponds to the intertidal domain up to the waterline of high water by spring tide as the highest level for the tidal incursion. Within each of these areas sub-divisions are made according to the vertical position.

Within the sub-littoral a distinction is made between the shallow (>NAP-718 cm) and the deep (<NAP-718 cm) sub-littoral. The depth of NAP-718 cm, roughly corresponding with the upper edge of the gullies, materializes the limit between two distinct eco-morphological realms. It is also about the 5 m line below the average spring tide low water that is, averaged over the Westerschelde, about NAP-218 cm.

Within the littoral three sub-areas are distinguished according to the frequency of exposure with the lower-littoral being exposed from 0 up to 25% of the time, the middle-littoral with emergence frequencies between 25 and 75% and the upper-littoral that are exposed to air more than 75% of the time.

Hydrodynamics

In the present case of a tide dominated system only the linear current speeds by either flood or ebb are considered whereas in other (coastal) environments wave actions may be considered. The maximum current speed averaged over all tides is used as an indicator for the intensity of hydrodynamics. Average speed lower than 0.5 m s^{-1} are representative for low hydrodynamic conditions whereas high hydrodynamics conditions are depicted with average speeds higher than 0.5 m s^{-1}.

Sediment characteristics

At the last level of the ZES classification (also the closest to the benthic fauna), the ecotopes are divided according to their sediment composition. Four sediment classes are distinguished in the ZES ecotope classification as muddy, fine and rough sand and gravel. The distinction between muddy sediment and fine sand is based on the silt (fraction <63 µm) content as mud with silt content >=25% and sand with silt content <25%.

Eco-element: Mussel beds

Because of their ecological importance, mussel beds get a separate status in the classification system. Mussel beds provide substratum for epiflora and epifauna, while the mussel matrix provides interstices and refuges for a diverse community of organisms. The build up of mussel biodeposits under the bed supports a rich and dense infaunal community. Mussel beds are biogenic structures (reefs) that stabilise the sediment, profoundly modify the substratum and increase the turnover of nutrients and organic carbon in estuarine environments. This makes from *Mytilus edulis* an ecotope engineer that could play a key-role in the ecosystem functioning.

2.2.2 Customised ecotope-set

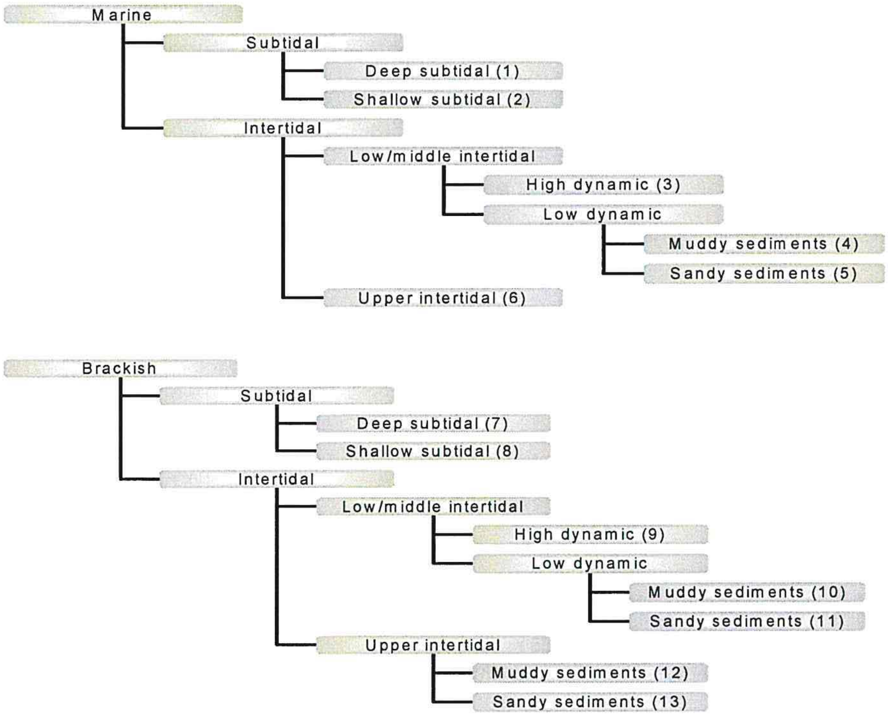
Due to the hierarchical structure of the ecotope classification, the combination of the different levels within each stratum leads to the distinction of ($2_{Sal.}$ x$1_{Subst.}$ x$5_{Elev.}$ x$2_{Hydr.}$ x$2_{Sedim.}$) not less than 40 different ecotopes! But within the Westerschelde not all of them exist. Due to the minimalist sampling effort that is usually deployed in monitoring activities, it is reasonable to expect that many of these ecotopes will not be quantitatively sampled (i.e. less than ≈30 records) on a regular basis. A selection of the ecotopes (possibly lumped) that are quantitatively well represented in the available data will be required.
Based on existing knowledge of the ecological functioning of the Westerschelde, the availability of (reference) data and practical considerations regarding evaluation and (future) monitoring, 13 different ecotopes were considered, six in the polyhaline (marine) zone and seven in the mesohaline (brackish) zone. Mussel beds get a separate status.

Table 3
The 13 ecotopes that are distinguished in the Westerschelde for the present study

Eco.#	Ecotope name
1	Brackish, littoral, low/middle, high-dynamic
2	Brackish, littoral, low/middle, low-dynamic, muddy sediments
3	Brackish, littoral, low/middle, low-dynamic, sandy sediments
4	Brackish, sublittoral, deep
5	Brackish, sublittoral, shallow
6	Brackish, littoral, upper, muddy sediments
7	Brackish, littoral, upper, sandy sediments
8	Marine, littoral, low/middle, high-dynamic
9	Marine, littoral, low/middle, low-dynamic, muddy sediments
10	Marine, littoral, low/middle, low-dynamic, sandy sediments
11	Marine, sublittoral, deep
12	Marine, sublittoral, shallow
13	Marine, littoral, upper

The differentiation is more detailed in the littoral (intertidal) zone as compared to the sublittoral (subtidal) zone.
In the sublittoral zone only a distinction is made between the deep subtidal and shallow subtidal. No further divisions are considered, as these ecotopes are generally characterised by relatively high currents and sandy environments.
In the littoral zone a distinction is made between the low/middle intertidal zone characterised by low to intermediate levels of exposure to air, and the upper intertidal zone with high exposure times. No further distinction is made for the upper littoral zone in the polyhaline part, as this zone is generally characterised by sandy environments (probably due to wave actions).
In the mesohaline, more sheltered part of the Westerschelde, both sandy and muddy environments are observed in the upper littoral, and here a muddy and a sandy ecotope are being considered.
In the low/middle intertidal a further distinction is made between high and low hydrodynamic conditions respectively. High hydrodynamic conditions are mostly resulting in sandy environments, therefore no further distinction based on sediment characteristics was considered for this ecotope. For the low hydrodynamic conditions a further distinction was made between sandy and muddy environments, as both environments occur regularly under these conditions. For more details on the role of environmental variables in structuring macrobenthic communities in the Westerschelde we refer to Ysebaert et al.(2002, 2003)

Figure 7
The hierarchic classification of the 13 ecotopes distinguished in the Westerschelde for the present study



2.2.3 Comparison with the EUNIS classification

Eunis is a habitat classification established in 1996 to link all the major habitats, both terrestrial and aquatic, In Europe. With regards to marine habitats, it is cross-referenced with the Habitats Directive (92/43/EEC) and has been developed in collaboration with the Oslo-Paris Commission (OSPARCOM) and the International Council for the Exploration of the Sea (ICES). The definition of a unique system of ecotope classification system for all European countries is one of the challenging objectives that is intended to be reached through this action. With the aim at easing further comparisons between present results and observations from other systems, the correspondences between our thirteen ecotopes (Table 3) and the EUNIS classification are described here.

Table 4
The first (highest) level of clustering for the marine ecotopes in the EUNIS classification system. Distinction is made on basis of the substratum nature and the position relative to the tidal movements.

1st level Code	Description for the first level	2nd level code	Description for the second level
A	marine habitats	A1	littoral rock and other hard substrata
..	..	A2	littoral sediments
..	..	A3	sublittoral rock and other hard substrata
..	..	A4	sublittoral sediments

Since no hard substratum has been considered in the present study, all the thirteen SCALDIT ecotopes belong either to type A2 or A4 in the EUNIS classification.

Table 5
Correspondences between the EUNIS and the SCALDIT (this report) ecotope classifications.

#	SCALDIT	EUNIS
1	Brackish, littoral, low/middle, high-dynamic	*- no equivalence found -*
2	Brackish, littoral, low/middle, low-dynamic, muddy sediments	*- no equivalence found -*
3	Brackish, littoral, low/middle, low-dynamic, sandy sediments	*- no equivalence found -*
4	Brackish, sublittoral, deep	A4.43 - Variable and reduced salinity sublittoral mixed sediments A4.26 - Animal communities in variable or reduced salinity muddy sands
5	Brackish, sublittoral, shallow	A4.24 - Animal communities in variable or reduced salinity shallow clean sands A4.26 - Animal communities in variable or reduced salinity muddy sands A4.32 - Variable or reduced salinity sublittoral muds
6	Brackish, littoral, upper, muddy sediments	*- no equivalence found -*
7	Brackish, littoral, upper, sandy sediments	*- no equivalence found -*
8	Marine, littoral, low/middle, high-dynamic	A2.23 - Sandy and muddy sand shores with <70% air exposure
9	Marine, littoral, low/middle, low-dynamic, muddy sediments	A2.33 - Muddy shores with <70% air exposure (Corophium)
10	Marine, littoral, low/middle, low-dynamic, sandy sediments	A2.23 - Sandy and muddy sand shores with <70% air exposure
11	Marine, sublittoral, deep	A4.23 - Communities of well sorted fine sands
12	Marine, sublittoral, shallow	A4.21 - Animal communities in fully marine shallow clean sands A4.25 - Animal communities in fully marine shallow-water muddy sands A4.31 - Shallow fully marine mud communities
13	Marine, littoral, upper	A2.22 - Sandy and muddy sand shores with 70-90% air exposure

There are clear differences between the EUNIS classification and the system proposed here for the Westerschelde (called SCALDIT hereafter). The EUNIS application has been mainly defined for coastal systems whereas the SCALDIT system aims at the characterisation of an estuary. Both systems being build up on a hierarchical framework, the levels occupied by the classification factors depend on their relative importance in the field: elevation> sediment> salinity in the coastal zone (EUNIS) and salinity> elevation> +hydrodynamic >sediment in the estuarine environment (SCALDIT). Furthermore, when hydrodynamic is treated as a full classification factor in SCALDIT, it is subordinated to sediment characteristics in EUNIS. Many links are found for marine sediments between SCALDIT and EUNIS, whereas brackish sediments are underrepresented in EUNIS when compared with SCALDIT. This is mostly due to the origin of EUNIS that has mostly been developed for application to coastal systems.

3 Definition of the MEP/GEP for the Westerschelde

3.1 DATASETS USED FOR THE DEFINITION OF THE MEP

3.1.1 Ecosystem scale

For the study at the scale of the ecosystem where the average macrobenthic biomass is compared to the level of system primary production, data compiled by (Herman et al. 1999) are completed with more recent publications and output from models and experimental works.

3.1.2 Ecotope scale

At the second level, i.e. the evaluation of the surface area of the different ecotopes, it is not possible to keep working with the 13 ecotopes that are listed in Table 3. When comparisons have to be made with the reference year 1900, only five habitat types can be distinguished in the Westerschelde based on available data: salt marshes, mud flats, sand flats, shallow subtidal areas (-2 – -5 m NAP), deep subtidal areas (>NAP-5m).

For mussel banks no real historical data exists for the Westerschelde but within the framework of WSV (WaterSysteem Verkenningen) an estimation of potential mussel bed area was made and this estimation is further used as a reference.

As a consequence of this discrepancy, in this report only an evaluation is made for the following habitat types (at the second level):

- mud flats
- sand flats
- shallow subtidal areas
- deep subtidal areas
- mussel banks

To define the maximum ecological potential (MEP) we used the work by (van den Bergh et al. 2003) where economically feasible compensatory measures are described.

3.1.3 Macrobenthic communities scale (within ecotope)

At the third level, i.e. the benthic macrofauna community structure within an ecotope, reference conditions and ecological assessments are established for all 13 ecotopes from Table 3. Mussel beds are not considered at this third level, but only at the second level. The characteristics of the macrofauna communities within the thirteen ecotopes were derived from a database compilation of all macrofauna records (autumn) available for the Westerschelde between 1978 and 1999 (Ysebaert et al. 2000). The selection of samples belonging to one single season was aimed at retrieving the seasonal effect from the dataset. The Autumn period was chosen for this season is the most intensively sampled in this dataset. The Autumn is also the period when the highest numbers of species and biomass are found.

3.2 INDICATORS AT SCALE OF ECOSYSTEM

For benthic macroinvertebrates, simple indicators can be used at this level, such as the mean total biomass (adjusted for primary production, which in turn is a function of the amount of light and nutrients).

Parsons et al. (1977) showed a dependence of system-averaged benthic biomass on the magnitude of the spring phytoplankton bloom. This relation strongly suggests dependence between benthic biomass and system productivity.Herman et al. (1999) compiled data on benthic biomass and system productivity from the own database on the Dutch delta area and from published estimates (Figure 8). A robust relationship was found between the system-averaged macrofauna biomass (B, g AFDW m^{-2}) and the system primary production (g C m^{-2} $year^{-1}$) as B=-1.5 + 0.105 P (r^2=0.77). This relation implies that for these shallow estuarine systems between 5% and 25% of the annual primary production is consumed by macrobenthos. The rest of the production is either consumed by pelagic grazers or directly incorporated in the microbial food web after decaying of the algal bloom.

The selection made by Herman et al. (1999) has been completed with additional data found in the literature for the Somme (Rybarczyk et al. 2003) and the Wadden Sea (Beukema et al. 2002), respectively OS and WS2 in Figure 8. After introduction of these new data to the dataset, the relation becomes [B=2.85 +0.08 P] what remains close to the [B:P=1/10] line (Figure 8) that could be reasonably kept as the standard ratio between the system primary production and the macrobenthic biomass.

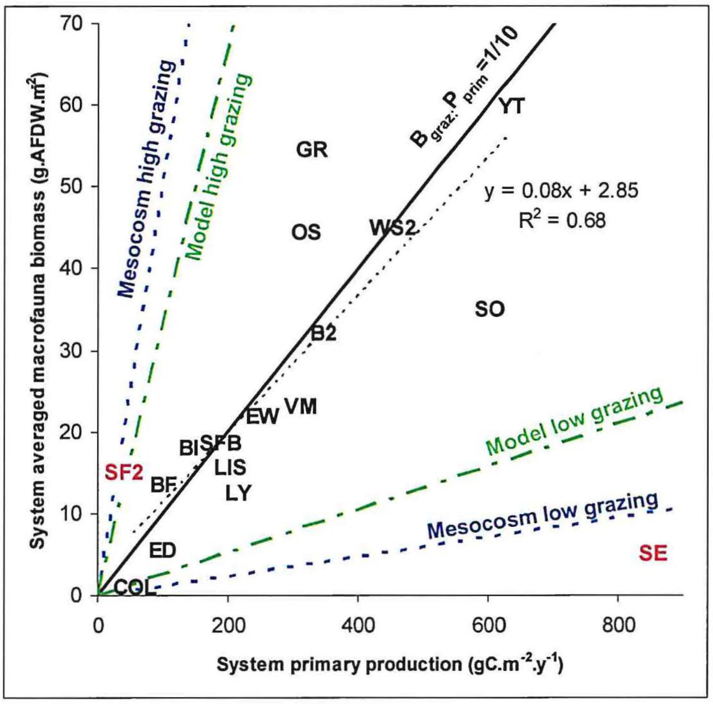
This ratio may represent a state of equilibrium where the sum of pelagic and benthic production is adequately matched by the biomass of grazers that are present in the system (i.e. macrobenthos and zooplankton). Deviations from this relation could point at unbalanced ecosystem functioning. Such unbalance is illustrated with two examples in the literature from the upper estuary of the San Francisco Bay after the invasion by the Asiatic clam (*Potamocorbula amurensis*) after 1987 (Nichols et al. 1990, Alpine & Cloern 1992) and the Seine estuary (Rybarczyk & Elkaim 2003). These data were plotted on graph in Figure 8 but left out of the regression estimate.

The introduction of *Potamocorbula* to San Francisco Bay resulted in a clear top-down effect through the grazing of the phytoplankton by this suspension feeder. As a result a massive reduction in chlorophyll *a* was observed in the nineties.

The Seine estuary illustrates the alterations to estuaries due to human activities: heavy releases of pollutants of various origins and significant morphological changes beginning in the middle of the 19^{th} century. The present estuarine morphology is mostly artificial, resulting from man-made modifications. The extensive activities/public works operations have led to a decrease in the river channel section as well as in the exchanges of seawater. The Seine has been canalized and dredged 120 km upstream from the mouth to allow navigation from the sea to the inland port of Rouen. At the mouth, intensive dredging (≅ 5 million tons y^{-}1) is necessary to maintain water depth at 5-6 m below the zero sea level. Due to the successive construction of dykes, the intertidal zone had been reduced from 130 km^2 at the middle of the 19^{th} century to < 30 km^2 in 2000.

The escape of primary producers from grazing control was also studied in mesocosm experiments (one month summer incubation) where mussel biomass was experimentally manipulated (Prins et al. 1995). In mesocosms with mussel biomass set as 0.5, 1.92 and 3.84 g AFDW m^{-2} primary production reached 42, 18 and 7.5 g C m^{-2}. Ambient concentrations of the nutrients (mostly phosphate) that were added at a constant rate to these mesocosms were either exhausted for the highest mussel biomass or increased as they were not used in the mesocosm with the lowest mussel biomass. In the mesocosm with the intermediate mussel biomass nutrient concentrations remained rather steady during the bloom period. The pattern in nutrient concentration points out that phytoplankton was either heavily controlled by the highest mussel biomass or escaped grazing by the lower biomass. In the intermediate treatment, phytoplankton growth was in equilibrium with the grazing pressure. The Bgraz : Pprim ratio corresponding to this last situation was equal to 1/9 and thus rather close to the relation shown by the systems in Figure 8. Conversely, the situations with excess and lack of grazers gave Bgraz : Pprim ratio's as about 1/2 and 1/83. The lines supporting these ratios that are plotted on the graph in Figure 8 are close to the data from San Francisco Bay (SF2) and from the Seine.

Figure 8
Relation between system-averaged macrobenthic biomass and primary production of shallow well-mixed estuarine systems adapted from Herman et al. (1999). The regression line is a predictive linear least-squares line. Data are indicated by the abbrevation of the name of the system: YT-.Ythan estuary, GR-.Grevelingen, OS-.Oosterschelde, , BI-.Balgzand (70's), B2-.Balgzand (80's), BF-.Bay of Fundy, EW-.Eems outer side, ED-.Eems inner side, VM-.Veerse Meer, SFB-.San Francisco Bay, SF2-.San Francisco Bay after invasion by *Potomocorbula*, LY-.Lynher estuary, WS2-.Wadden Sea, COL-.Columbia river, LIS-.Long Island Sound, CB-.Chesapeake Bay, SO-.Somme estuary, SE Seine estuary, the labelled lines materialise the B_{graz}: P_{prim} ratio value of 1/10 and the outputs of mesocosm and model experiments (see text for details).

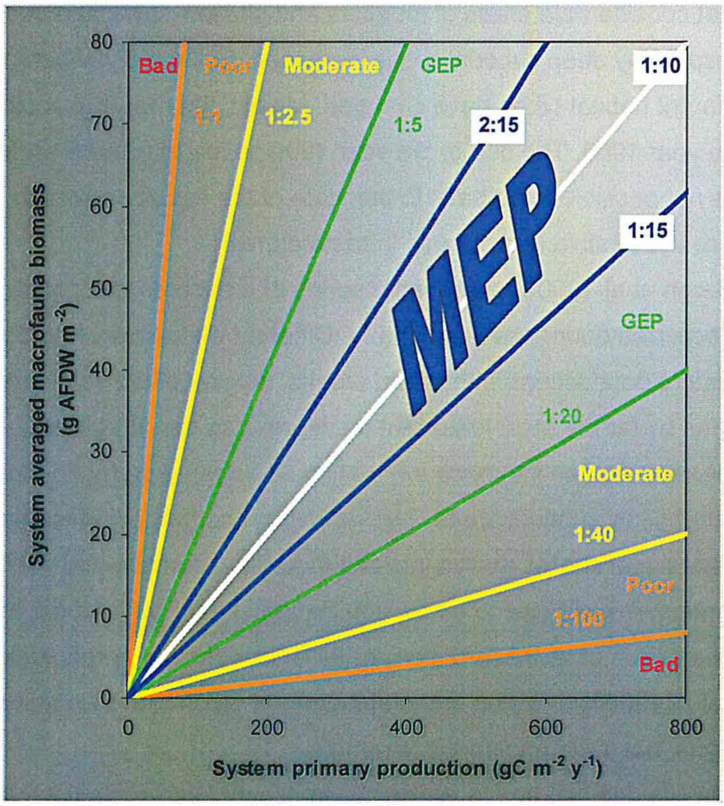


The correspondence between the field and the mesocosm data points at the fundaments ruling the interaction between primary producers and their grazers.

Conditions under which phytoplankton production was either controlled by or escape from benthic grazers was inpected in numerical models by Herman & Scholten (1990). For grazing rates as 0.04 or 0.2 d^{-1} phytoplankton biomass (primary production rate=0.2 d^{-1}) either increased or not. Subsequent calculations on this example when assuming a P:B ratio of 1 and trophic efficiency of 1/3 for the macrofauna produced Bgraz : Pprim ratios as 1/38 and 1/3 for the runs with low (phytoplankton escape) and high (phytoplankton control) grazing pressure respectively. These ratios are close to those found in the previous mesocosm experiments in similar situations with respect to the producer/grazer relationships as illustrated with the proximity of the corresponding lines as plotted on Figure 8.

The linearity of the relationships between the primary production and the macrofauna biomass points at the high capacity by these systems to absorb the effects of nutrient enrichments without noticeable alteration of the ecosystem functioning. As a result, shifts of the Bgraz : Pprim equilibrium along the 1:10 line should not be considered as indications of unbalance but rather as a translation towards a new equilibrium. Conversely, systems that are shifting away from the line could become unbalanced. From the field observations, model and experimental results, extreme Bgraz : Pprim ratios could be considered as 1/1 and 1/100.
The model outputs by Herman & Scholten (1990) supply two limits (about 1/2.5 and 1/40) for the areas of poor functioning where overgrazing and phytoplankton escape leads to states of critical unbalance. These are the areas where the San Francisco Bay after the invasion by *Potamocorbula* and the Seine are found. Around the 1:10 line standing for the optimal ratio between the macrofauna biomass and the primary production, the interval delimited by the 1:5 and 1:20 ratios corresponds with areas where systems are properly functioning (GEP). The Grevelingen and the Somme are two systems that are close from the outer limits of this interval with ratio's as 1/6 and 1/18 respectively. The MEP, situated around the line of optimal functioning (1:10), was arbitrarily extended on both sides of this line at half distance (2:15, 1:15) from the outer limits of the GEP (Figure 9).

Figure 9
Scaling of the Bmacrof : Pprim relation to be used as classification for the ecosystem scale



The Bmacrof. : Pprim. relation in Figure 9 has been scaled as an indicator usable for the classification for the Westerschelde at the ecosystem scale, following the prescriptions of the WFD for heavily modified water bodies.

3.3 INDICATORS AT THE ECOTOPE SCALE

As said above, the geographical extent and functionality of the Westerschelde estuary as we know it today date from the beginning of the twentieth century (Figure 2). The year 1900 could then be reasonably be used as a 'natural' reference for the geomorphologic characteristics for the estuary. Data collected in the reports by van den Bergh et al (2003) and Stikvoort et al. (2003) have been used to construct Table 6 with areas proportions and areas of the main habitats in the Westerschelde around 1900 and in 1996.

Table 6

Main habitat areal proportions and total area as in the Westerschelde around 1900 (van den Bergh et al. 2003) and 1996 from Stikvoort et al. (2003).

Habitat type	Areal proportion (area in ha) 1900	Areal proportion (area in ha) 1996
Salt marshes	6.5 *(2300)*	7 *(2390)*
Mudflats	20 *(7350)*	11 *(3550)*
Sand flats	11 *(4050)*	15 *(4800)*
Shallow subtidal areas	20 *(7350)*	10 *(3000)*
Deep subtidal areas (>NAP-5m)	42.5 *(15550)*	56 *(17300)*

It is clear from Table 6 that considerable areas of mudflats and shallow subtidal areas have disappeared, whereas sand flats and especially deep subtidal areas increased during the last century. As a consequence, the proportions of the different habitat types have changed. Ideally, the maximal ecological potential (MEP) would be the status of the year 1900. The use of the year 1900 as the maximum ecological potential is however not feasible. It is not possible to go back to the state of the estuary as it was around 1900, as some changes are considered as irreversible (e.g. certain infrastructures).

Nevertheless, Van den Bergh et al. (2003) proposed a series of measures that could partly compensate for the habitat loss that has occurred during the last century. Different measures are proposed, going from constructing sluices to restore connections with inland creeks, digging of old salt marshes, to depoldering, etc. Regarding depoldering, by far the most important measure, Van den Bergh et al. (2003) inventory 4610 ha (i.e. all depoldering measures taken into account) that could be reintegrated to the estuary in the form of salt marshes, mud flats or shallow subtidal areas. The relative proportions of these habitats are not well defined but we assume that equal shares evolve into salt marshes, mudflats and shallow subtidal areas.

The realisation of these measures will lead to a new equilibrium state. For the moment it is difficult to estimate what the implementation of all these measures will mean for the morphological developments of the Westerschelde. Jeuken et al. (2004) describe some of the morphological developments under different scenarios of human impacts, but large uncertainties remain.

Due to these uncertainties, we decided to use as the maximal ecological potential (MEP) the relative proportions of the different habitats by using the year 1900 as a starting point, but taking into account that not all of the areas of mud flats and shallow subtidal areas can be restored, but only the surface area proposed by Van den Bergh et al. (2003). The MEP shows as such relatively more salt marshes, less mudflats and shallow subtidal areas, more or less equal sand flats and more deep subtidal areas as compared to 1900 (Table 7).

Table 7
Main habitats areal proportions in the MEP for the Westerschelde

Habitat description	Areal proportion 1900	Areal proportion% MEP
Salt marshes	6.5	12
Mudflat	20	15
Sandbank	11	12
Shallow areas	20	15
Deep areas (>NAP-5m)	42.5	47

For mussel banks no real historical data exists for the Westerschelde but within the framework of WSV (WaterSysteem Verkenningen) an estimation of 200 ha potential mussel bed area was made and this estimation is further used as the MEP for this indicator.

The choice of the habitats to be used as indicators was made according to the following rationale. As shown in Figure 4, mainly mudflats, sandflats and shallow areas that have shown the most intense dynamics during the last 200 years whereas the changes in the extent of the salt marshes and gullies were less marked at the scale of the estuary. The tremendous changes observed by these habitats result both from active land-claims and from their sensitivity to the changing hydrodynamic conditions that are possibly related with man-made activities. Furthermore these habitats are of high ecological importance for benthic macrofauna and the related higher trophic levels. These three habitats have to be included in the indicator. Salt marshes are for the moment not included into the assessment, as this habitat type is part of another quality element of the Water Framework Directive. However, a link to this quality element could be made in the future. Due to socio-economic considerations that are beyond the scope of the present report, it seems not appropriate to introduce the area of the gullies in the definition of the MEP. Furthermore changes in the gullies areas mostly occur to the profit or detriment of shallow areas and will be consequently indirectly tracked with our indicator. Four sub-indicators will then be used at the scale of the ecotope, the area proportion represented by the mudflats, sand flats and shallow areas and the total mussel bank area (Table 8). The divisions separating the different ecological status on these scales have been set at constant intervals to allow a representative tracking of the changes.

Table 8
Assessment scale for: 1.-the proportion of both intertidal mudflats and shallow areas in the Westerschelde
2.-the proportion of sandflats in the Westerschelde
3.-the total mussel banks area (ha) in the Westerschelde

(1)

>15%	15% >...> 12%	12% >...> 9%	9% >...> 6%	6%>...
MEP	GEP	MODERATE	POOR	BAD

(2)

>12%	12% >...> 9%	9% >...> 6%	6% >...> 3%	3%>...
MEP	GEP	MODERATE	POOR	BAD

(3)

>200 ha	200 ha >...> 150 ha	150 ha >...> 100 ha	100 ha >...> 50 ha	50 ha>...
MEP	GEP	MODERATE	POOR	BAD

The assessment scales in Table 8 are usable as classification for the Westerschelde at the ecotope scale, following the prescriptions of the WFD for heavily modified water bodies.

3.4 INDICATORS WITHIN THE ECOTOPE SCALE

For the macrofauna within the ecotope scale, three indicators have been selected, the diversity expressed as the number of species and the individual species that are expected to occur, the total macrofauna ranges in density and biomass that should be present.

3.4.1 Number of species

The number of species that is to be found in monitoring data is strictly dependent upon the sampling effort that is deployed. The latter is at best represented with the sediment surface that has been sampled rather than with the number of samples. Therefore the range for the number of species has been calculated per ecotope from permutations (software customised by Peter Herman) executed over increased sampling surfaces. This allows to estimate, for any given sampling surface, the range in the number of species that can be expected to be collected.

In order to account for the variability within the reference conditions and to avoid adopting a too restrictive criterion, the number of species corresponding to the 5th percentile is used as the lowest number of species to be expected for the MEP. Any further reductions in the number of species from this point would correspond with a transition to the GEP, Moderate, Poor and eventually Bad ecological status.

Decreases in the number of species have been for a long time used as an indicator for disturbances (Pearson & Rosenberg 1978). The widely accepted concept behind this relation is that sensitive species disappear from disturbed environment whereas tolerant species survive. Several indicators have been developed that aim at tracking this shift in species composition (Grall & Glemarec 1997, Solimini et al. 2000, Simboura & Zenetos 2002).

It remains however generally true that the intensity of stress can adequately been described with a decrease in the number of species between the reference and the affected areas.

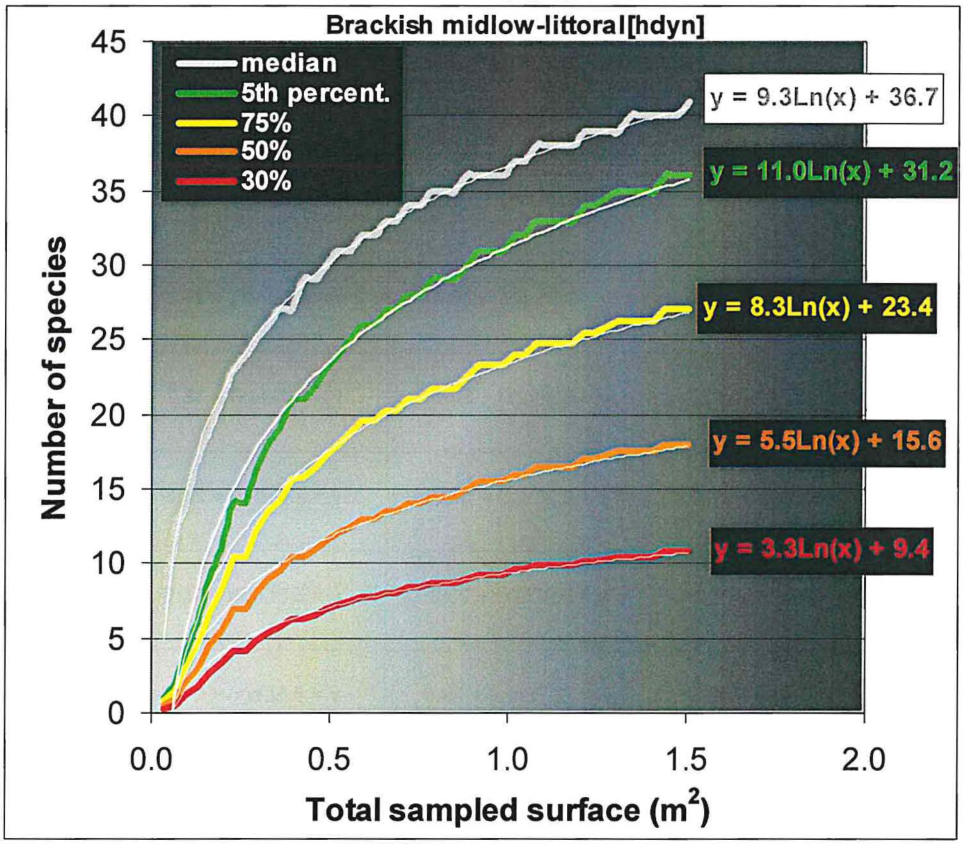
As a direct consequence, the ecological classes defined for the assessment of the WFD could also be scaled against the decrease in the number of species with respect to the species richness measured for the HIGH or Maximum potential ecological status. This view is supported by a literature survey on articles dealing with the assessment of the WFD to soft sediment macrofauna where species richness is supplied (as numbers or graphs) by the authors together with the ecological classification for the corresponding sites. The results for this survey are exposed in (Table 9).

Table 9
Correspondences between the WFD classification and the number of species of soft sediment macrofauna: Average number of species (*italic*) for the sites assigned to the five classes of ecological status as defined for the application of the WFD, corresponding percentage **%** with respect to the number of species in the reference conditions (HIGH or MEP) as lower boundary for each of the five classes. Results as in the literature (first 5 rows) and (rounded) average percentage values (last row) as used for the present assessment.

Authors	HIGH/MEP	GOOD/GEP	MODERATE	POOR	BAD
(Grall & Glemarec 1997)	*(>79)* **100%**	*(68)* **80%**	*(64)* **70%**	*(47)* **40%**	*(15)* **0%**
(Borja et al. 2000)	*(>27)* **100%**	*(24)* **81%**	-	-	-
(Borja et al. 2003)	*(>60)* **100%**	*(53)* **75%**	*(38)* **50%**	*(23)* **25%**	*(8)***0%**
(Rosenberg et al. IN PRESS)	*(>60)* **100%**	*(53)* **75%**	*(38)* **50%**	*(23)* **25%**	*(8)***0%**
(Simboura & Zenetos 2002)	*(124)* **100%**	*(90)* **67%**	*(79)* **46%**	*(36)* **21%**	*(0)* **0%**
This study	**100%**	**>75%**	**>50%**	**>30%**	*(0)* **0%**

From each of these studies the boundaries for the WFD classes can be expressed as number of species present expressed as the percentage relative to the species richness measured in the reference conditions (Table 9). These threshold values were averaged and rounded up to the following percentages for the lower boundaries for the MEP, GEP, Moderate, Poor and Bad as respectively: 100%, 75%, 50%, 30% and 0%. In the case of the MEP for the Westerschelde, the lowest number of species to be expected at the highest ecological status (100%) corresponds to the 5th percentile out of the permutations processed from the samples used to define the reference conditions. The boundaries of the five classes for the WFD ecological status will then be estimated as the 100%, 75%, 50%, 30% and 0% fractions of this value. The threshold values obtained for the ecotope 'Brackish, littoral, low/middle,high-dynamic' are given in Figure 10 as illustration.

Figure 10
Number of species to be expected by sampling various surfaces within the ecotope 'Brackish, littoral, low/middle,high-dynamic'. The median of the distribution from 1000 permutations on the reference samples is plotted together with the 5th percentile and corresponding 75%, 50%, 30% that represent the lower boundaries of the classes for High, Good, Moderate and Poor ecological status. Each of these functions is fitted with a logarithmic relation that describes the expected number of species for any given sampling surface (m^2).



The log functions (drawn in Figure 7) that have been found between the sampled surface and the number of species in the MEP, GEP and the lower ecological status for each ecotope are given in Table 10. These relations will be used to calculate the number of species to be expected in the assessment samples as a function of the total sampling surface.

Table 10
Relations describing the number of species to be expected in each ecotope as a function of the sampled surface. Given the surface sampled x (m^2), the functions estimate the number y of species to be exceeded for the ecotope to be qualified within the corresponding ecological status. The graphs illustrating these results are all given in the appendix section.

Ecotope \ Status	MEP	GEP	MODERATE	POOR
1.-Brackish, littoral, low/middle, high-dynamic	y = 11.0Ln(x) + 31.2	y = 8.3Ln(x) + 23.4	y = 5.5Ln(x) + 15.6	y = 3.3Ln(x) + 9.4
2.-Brackish, littoral, low/middle, low-dynamic, muddy sediments	y = 6.5Ln(x) + 22.7	y = 4.9Ln(x) + 17.1	y = 3.2Ln(x) + 11.4	y = 1.9Ln(x) + 6.8
3.-Brackish, littoral, low/middle, low-dynamic, sandy sediments	y = 8.6Ln(x) + 30.6	y = 6.4Ln(x) + 23.0	y = 4.3Ln(x) + 15.3	y = 2.6Ln(x) + 9.2
4.-Brackish, sublittoral, deep	y = 9.0Ln(x) + 23.9	y = 6.7Ln(x) + 17.9	y = 4.5Ln(x) + 12.0	y = 2.7Ln(x) + 7.2
5.-Brackish, sublittoral, shallow	y = 10.7Ln(x) + 24.7	y = 8.1Ln(x) + 18.5	y = 5.4Ln(x) + 12.3	y = 3.2Ln(x) + 7.4
6.-Brackish, littoral, upper, muddy sediments	y = 3.8Ln(x) + 16.4	y = 2.9Ln(x) + 12.3	y = 1.9Ln(x) + 8.2	y = 1.1Ln(x) + 4.9
7.-Brackish, littoral, upper, sandy sediments	y = 7.6Ln(x) + 25.5	y = 5.7Ln(x) + 19.1	y = 3.8Ln(x) + 12.8	y = 2.3Ln(x) + 7.7
8.-Marine, littoral, low/middle, high-dynamic	y = 13.2Ln(x) + 42.6	y = 9.9Ln(x) + 32.0	y = 6.6Ln(x) + 21.3	y = 4.0Ln(x) + 12.8
9.-Marine, littoral, low/middle, low-dynamic, muddy sediments	y = 8.2Ln(x) + 37.3	y = 6.2Ln(x) + 28.0	y = 4.1Ln(x) + 18.7	y = 2.5Ln(x) + 11.2
10.-Marine, littoral, low/middle, low-dynamic, sandy sediments	y = 10.9Ln(x) + 47.6	y = 8.2Ln(x) + 35.7	y = 5.4Ln(x) + 23.8	y = 3.3Ln(x) + 14.3
11.-Marine, sublittoral, deep	y = 13.2Ln(x) + 31.1	y = 9.9Ln(x) + 23.3	y = 6.6Ln(x) + 15.6	y = 4.0Ln(x) + 9.3
12.-Marine, sublittoral, shallow	y = 16.1Ln(x) + 40.0	y = 12.7Ln(x) + 29.9	y = 8.5Ln(x) + 19.9	y = 5.1Ln(x) + 12.0
13.-Marine, littoral, upper	y = 11.0Ln(x) + 46.0	y = 8.2Ln(x) + 34.5	y = 5.5Ln(x) + 23.0	y = 3.3Ln(x) + 13.8

The assessment scales in Table 10 are usable as classification for the number of species in the Westerschelde at the 'within ecotope' scale, following the prescriptions of the WFD for heavily modified water bodies.

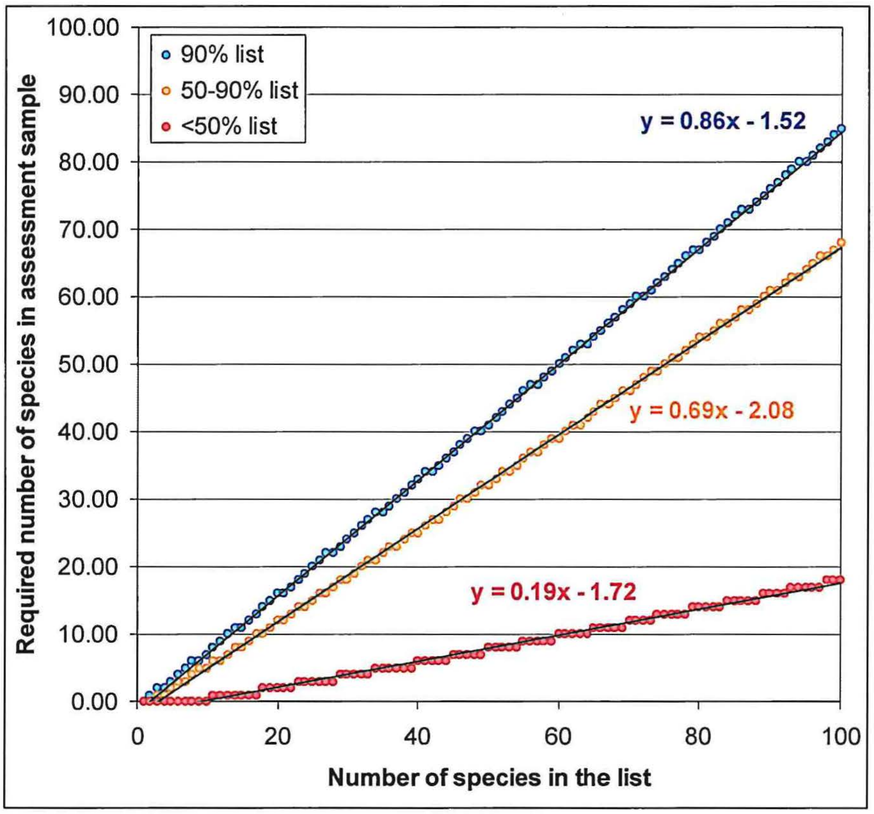
3.4.2 Species list per ecotope

The same permutation technique as previously has been used to derive from the monitoring data the individual species that were expected to occur in each of the thirteen ecotopes as a function of the sampling surface. Distinction is made between species occurring in at least 90% of the samples, between 90% and 50% and in less than 50% of the samples.

The species list defined for each one of the 13 ecotopes are given in the appendix section

These lists have a certain degree of tolerance when applied for assessment. When n is the number of species that has been found for the reference conditions, the probability to find n, n-1, n-2 species in the assessment sample roughly follows a random distribution. This characteristic is used to define the number of species that should be found from a n species list, each with an individual probability to appear as >90%, 90-50% and <50% (Figure 11).

Figure 11
Minimum required number of species in the <90%, 90-50% and <50% species list as a function of the number of species in these lists.



The classification against the ecological status is given in Table 11. The tolerated number of species (full list decrease by probability of missing) supports the lower boundary for the High ecological status. The other classes are defined following the same rationale as for the total number of species by decreasing the lower boundary of the High ecological status by 75%, 50% and 30% for the lower boundaries of the Good, Moderate and Poor status respectively.

Table 11
Fraction of the species from the different species list that are found in samples against the ecological status as defined for the application of the WFD.

Species list percentiles	MEP	GEP	MODERATE	POOR	BAD
90%	>0.86n-1.52	>75% of HIGH	>50% of HIGH	>30% of HIGH	<30% of HIGH
50-90%	>0.69 n-2.08	>75% of HIGH	>50% of HIGH	>30% of HIGH	<30% of HIGH
<50%	>0.19n-1.72	>75% of HIGH	>50% of HIGH	>30% of HIGH	<30% of HIGH

The assessment scales in Table 11 are usable as classification for the species found in the Westerschelde at the 'within ecotope' scale, following the prescriptions of the WFD for heavily modified water bodies.

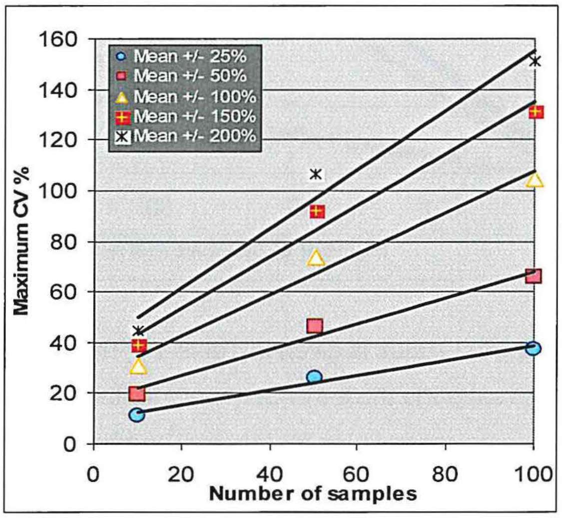
3.4.3 Macrofauna biomass and density

Both the macrofauna biomass and density are treated in a similar way and the description below that is referring to biomass fully applies to densities.

The average macrofauna biomass ($\overline{x}$) and the standard deviation (s) have been calculated from the log-transformed biomass records for each one of the 13 ecotopes. The 5% confidence interval around the average ($\pm$ 1.96 $\sigma/\sqrt{n}$) represents the boundaries for the High ecological status. As a consequence, the width of this interval i.e. the tolerance for the assessment depends on the number of samples taken. All graphs and corresponding tables are given in the appendix section.

Departure from the high ecological status could then be assessed by comparing the average and standard deviation in the assessment sample ($\overline{x}_s$, s_s) with those in the reference ($\overline{x}_r$, s_r), The comparison is done by using a standard t-test where the value of t: $(\overline{x}_r-\overline{x}_s)/\sqrt{(s_r^2/n_r+ s_s^2/n_s)}$ is compared with the values in the tables for the corresponding degree of freedom (n_r+n_s-2) at a 5% risk.

Figure 12
Maximum coefficient of variation that is required for a given number of samples (in both the reference and assessment series) to detect various levels of change in biomass (±25%, ±50%, ±100%, ±150%, ±200%) at the 5% risk to commit a type I error.



A test was run to investigate the sensitivity of this indicator to differences in biomass between the assessment samples and the reference. The coefficients of variation (CV=s/$\overline{x}$%) measured in the reference dataset are between 20 and 160 with an average of 112. For such levels of variations, about 100 samples (in both the reference and the assessment dataset) are required to allow the detection of a 100% change in the average biomass (Figure 12).

As a consequence of this rather low power of detection, it seems not advisable to attempt the full scaling of this indicator against the WFD classification. The biomass indicator will then be rather scaled as a binary variable with the maximum score (MEP) when no differences are found and the minimum score (BAD) when significant differences in biomass are detected between the assessment and the reference datasets.

Table 12
The classification for the total macrofauna biomass and density and the numerical values attributed for the integration of the sub-indicators

WFD classes	MEP	BAD
Classes values	100	0
Classes boundaries	tcalc $\leq$ ttable	tcalc > ttable

The assessment scales in Table 11 are usable as classification for the total macrofauna biomass and density in the Westerschelde at the 'within ecotope' scale, following the prescriptions of the WFD for heavily modified water bodies.

3.5 INTEGRATION OF THE SUB INDICATORS INTO ONE INDICATOR FOR THE WATER BODY

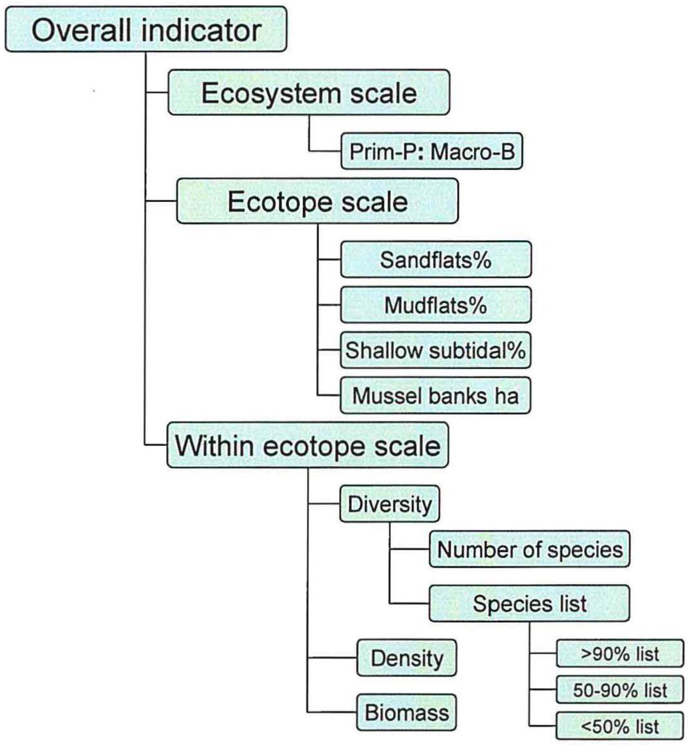
For the integration of the different sub-indicators in one overall indicator priority is given to both transparency and simplicity. Each step of integration will remain visible and editable for the purpose of management priorities. The integration of the sub-indicators into the indicator at the higher level will be done by averaging. This is allowed through the attribution of numerical scores to the five different classes presented in Table 13. The position of the averaged scores on the scale of ecological status is obtained with respect to classes boundaries that are also presented in Table 13.

Table 13
The five classes of ecological status for the WFD assessment with the numerical values attributed for the integration of the sub-indicators

WFD classes	MEP	GEP	MODERATE	POOR	BAD
Classes values	100	85	60	40	0
Classes boundaries	≥100	100> - ≥75	75> - ≥50	50> - ≥30	30> - ≥0

The overall indicator will result from averaging of the sub-indicators at the three levels of our hierarchical approach, Ecosystem, Ecotope and Within ecotope scales. Each of these indicators possibly results from the integration of several sub-indicators at underlying levels that are averaged following the scheme given in Figure 13.

Figure 13
Hierarchical structure of the sub-indicators and indicator used for the WFD assessment.



At the highest level of integration between our three main indicators, the relative sensitivity of the indicators to stressors is considered as a weighing factor by the averaging into the overall indicator for the whole system. As said earlier, Community shifts occurring within an ecotope are a response to a change in a parameter that is not used for the definition of the ecotope; that could be for example sediment and or water chemistry, temperature. On the other hand, changes in the ecotope distribution (size and proportion) will also induce changes in community at scale of the water body but should then be rather interpreted as response to changes in the morpho-/hydrodynamic conditions than to an effect of deteriorated water quality.

The indicators representative for the Ecotope and the Within ecotope scale could then be interpreted as tracers for disturbances either related with morpho-/dynamic or water quality conditions. As such, both indicators should have an equal contribution to the overall indicator.

The indicator at the scale of ecosystem represents the interaction term between the processes acting at and within the ecotope scale but also in relation with the rest of the ecosystem (mostly the pelagic system). As such it integrates the whole spectrum of interactive processes that tend to buffer the various disturbances affecting the system. As a consequence, the B_{macrof} : P_{prim} is rather robust as disturbances will have to exceed the buffer capacity of the system (its resilience) before to induce a significant shift in this indicator. With respect to its rather low sensitivity the indicator at the ecosystem scale should have a lower contribution to the overall indicator than the indicators at and within the ecotope scales. This lower sensitivity should not be interpreted as a lower informative value for this indicator that has clear signal function for the whole system through its integration of the main functional processes at play in the ecosystem.

Finally we propose to attribute a weighing factor equal to 2 for the indicators at and within the ecotope scale and equal to 1 for the indicator at the ecosystem scale.

Table 14

Overview of the indicators and sub-indicators with their classification scaling. The weighing factor is applied by the highest intergration step from the three Scales to the scale of the whole water-body. S_{mep} represents the MEP standard estimated for the required number of species and individual species as defined in Table 10 and Figure 11.

SCALES	Ecosystem Scale		Ecotope Scale				Within Ecotope Scale			Ecological Quality Ratio
Weighing factor	**1**		**2**				**2**			
Eco-logical status	B_{macro}: P_{prim} gAFDW m^2/gCyr^{-1}		Mud-flats %	Shallow areas %	Sand flats %	Mussel banks ha	Macro. diversity	Macro. density	Macro. biomass	
MEP	>1/15 <2/15		>15	>15	>12	>200	S_{MEP}*	t_{calc}<t_{table}	t_{calc}<t_{table}	1.00
GEP	>2/15 <1/5	<1/15 >1/20	<15 >12	<15 >12	<12 >9	<200 >150	>S_{MEP} x0.75			<1.00 <0.75
MODE-RATE	>1/5 <1/2.5	<1/20 >1/40	<12 >9	<12 >9	<9 >6	<150 >100	>S_{MEP} x0.50			<0.75 >0.50
POOR	>1/2.5 <1/1	<1/40 >1/100	<9 >6	<9 >6	<6 >3	<100 >50	>S_{MEP} x0.30			<0.50 >0.30
BAD	>1/1	<1/100	<6	<6	<3	<50	<S_{MEP} x0.30	$t_{calc} \geq t_{table}$	$t_{calc} \geq t_{table}$	<0.30

4 Assessment of Westerschelde ecological status based on recent monitoring data

4.1 DATASETS USED FOR THE ASSESSMENT

The present assessment of the ecological status of the Westerschelde is mainly based on two independent sources of data: Firstly, a map of distribution of the ZES-ecotopes in the Westerschelde (including the underlying variables) that was supplied by RIKZ (Dick de Jong, Fred Twisk, pers comm.) for the year 2001 (map is shown in the appendix section). Secondly, macrofauna records that were collected for the same area in the framework of the MWTL biomonitoring programme. The years that were selected for the monitoring data (2000-2001-2002) were within a period of three years around the time when the ecotope map was established. This was due to promote the agreement between both the ecotopes and the macrofauna distributions. The selection was restricted to the observations made in autumn to promote the comparisons with the data from the reference dataset.

The data processing that was required for the assessment of the ecological potential for the Westerschelde is further described for each scale used for this assessment.

Some technical problems that were encountered and solved during this process are described in the appendix section.

4.2 ECOSYSTEM SCALE

The assessment at the 'Ecosystem' scale consisted of the following steps:

- Literature research for system production estimates for the Westerschelde
- Estimate the average macrofauna biomass in the Westerschelde from the MWTL biomonitoring data (2000-2002).
- Construction of the ratio B_{macro}: P_{prim} and estimate of status and score from scales in Table 13 and Table 14.

System primary production

The most recent estimate for the system production in the Westerschelde that was available when writing this report was from Soetaert & Herman (1995). They estimated the pelagic and benthic primary production as 41 and 24.6 gC m^{-2} y^{-1} respectively. Whereas these authors warned upon a possible overestimation for the benthic production Stapel & de Jong (1998) found a very close value for the benthic primary production in the Westerschelde in 1996 as 7 10^6 kg C y^{-1} to be compared with the 6 10^6 kg C y^{-1} found by Soetaert & Herman (1995).

Average macrofauna biomass

The average macrofauna biomass from the Westerschelde monitoring was for the years 2000 to 2002 estimated as 5.5 g AFDW m^{-2}. This value corresponds to a plain average of all sampling points considered in the present study. A more representative estimate could be obtained by first averaging the biomass per ecotope and second by averaging over the ecotopes after weighing for their respective areas. This second approach produces a lower estimate as 3 g AFDW m^{-2}. The difference between both estimates is mainly due to the large extent of the gullies where the macrofauna biomass is relatively low.

Whenever this second estimate should be closer from the true system average biomass, the assessment scale used for this level (Figure 9) is based on literature data where macrofauna biomass are calculated without consideration for habitat areas (Figure 8). As a consequence, aiming at the agreement among the data, that is the first estimate (plain average) that will be used for the estimate of the ecological status.

Estimate of the ecological status and score

Table 15
Evaluation of the ecological status and score at the scake of the ecosystem

System primary production (gC m^{-2} y^{-1})	Average macrofauna biomass (g AFDFW m^{-2})	B_{macro}: P_{prim} ratio in data	B_{macro}: P_{prim} ratio in MEP (Table 14)	Ecological status	Ecological score
65.6	5.5	11.9	1/15< <2/15	MEP	**100**

4.3 ECOTOPE SCALE

The assessment at the 'Ecotope' scale consisted of the following steps:

- Definition of the extents of the different habitats
- Estimate of status and corresponding score for each habitat and average of the habitat individual scores in one score representative at the ecotope scale (Table 13, Table 14).

Areas and proportions in habitats

The areas and proportions covered by the different habitats (1996, revised areas) were obtained from Stikvoort et al. (2003).

Table 16
Areas and proportions of the different habitats selected for the assessment.

Habitat description	Area proportion / Area (ha)
Mudflat	11.4 *(3554)*
Sand flat	15.5 *(4781)*
Shallow areas	9.7 *(3001)*
Mussel banks	0

Estimate of the ecological status and score

The ecological status corresponding to the proportions and areas (mussel banks) of the habitats (Table 16) are calculated by comparing these values with the MEP values given in Table 8. The ecological status per habitat and at scale of the ecotope level is given in

Habitat description	Area proportion/ Area (ha) in 1996	Area proportion/ Area (ha) in MEP	Ecological status per habitat	Score per habitat
Mudflat	11.4%	15%	MODERATE	**60**
Sand flat	15.5%	12%	MEP	**100**
Shallow areas	9.7%	15%	MODERATE	**60**
Mussel banks	0 ha	200 ha	BAD	**0**
Ecological status ad score at the scale of ecotope			MODERATE	**55**

4.4 WITHIN ECOTOPE SCALE

The following steps were required for the assessment at the 'Within ecotope' scale:

- GIS-construction of the 13 ecotopes listed in Table 3 based on the underlying variables supplied with the ZES-ecotope map.
- Selection of the macrofauna data from the NIOO BIS database and geo-coupling with the GIS information.
- Estimate of the macrofauna indicators and evaluation of status and scores for each indicator
  - Number of species per ecotope and total surface of sampling (Table 10)
  - Species list per ecotope and total surface of sampling (Table 11)
  - Average and standard deviation for densities and biomass of total macrofauna per ecotope (Table 12.)
- Average of sub-indicator scores in one score and status representative for the 'Within ecotope' scale (Table 13, Table 14).

4.4.1 Construction of 13 ecotope GIS-map and coupling with the macrofauna data

The map representing the distribution of the 13 ecotopes in the Westerschelde has been constructed based on the ZES-ecotope map that was delivered by RIKZ for the year 2001. The resulting map is shown in the appendix section.

This map was used to realise the coupling between the macrofauna monitoring data (autumn 2000-2002) and the 13 ecotopes. In total, 526 hints were obtained that were unequally distributed over the ecotopes (Table 17). For the ecotope 6 (Brackish upper-littoral_Muddy) no coupling was obtained with the macrofauna dataset and a low number of samples (3) was found for ecotope 7 (Brackish upper-littoral_Sandy).

Table 17
List of the 13 ecotopes considered in the present study and number of monitoring observations (autumn 2000-2002) that have been coupled with these ecotopes.

ECOTOPE_ID	NEW ECOTOPE	Number of samples
1	Brackish midlow-littoral[hdyn]	42
2	Brackish midlow-littoral[ldyn]_Muddy	22
3	Brackish midlow-littoral[ldyn]_Sandy	9
4	Brackish sub-littoral deep	45
5	Brackish sub-littoral shallow	37
6	Brackish upper-littoral_Muddy	0
7	Brackish upper-littoral_Sandy	3
8	Marine midlow-littoral[hdyn]	67
9	Marine midlow-littoral[ldyn]_Muddy	24
10	Marine midlow-littoral[ldyn]_Sandy	52
11	Marine sub-littoral deep	108
12	Marine sub-littoral shallow	109
13	Marine upper-littoral	8

4.4.2 Diversity indicator

The diversity indicator is based on the two sub-indicator as the number of species and the occurrence of a standard species list within the ecotopes. Both indicators consider the total surface that is sampled as a weighing factor for the (number of) species found within each ecotope.

Number of species

The total sampling surface and number of species found per ecotope are given in Table 18 together with the corresponding evaluation of the ecological status and scores.

Table 18

Total sampling surface and total number of species per ecotopes in the assessment dataset. Number of species required for the MEP, GEP, Moderate, Poor and Bad, estimated from the functions in Table 10. Ecological status and scores estimated for the assessment data.

Eco.#	Surface m2	N_species in assessment	Estimations for the required number of species					Ecological status	Ecological score
			MEP	GEP	MOD.	POOR	BAD		
1	0.615	**39**	*26*	*19*	*13*	*8*	*<8*	MEP	**100**
2	0.33	**29**	*15*	*12*	*8*	*5*	*<5*	MEP	**100**
3	0.135	**23**	*13*	*10*	*7*	*4*	*<4*	MEP	**100**
4	0.525	**33**	*18*	*14*	*9*	*5*	*<5*	MEP	**100**
5	0.465	**17**	*17*	*12*	*8*	*5*	*<5*	MEP	**100**
7	0.045	**13**	*2*	*1*	*1*	*1*	*<1*	MEP	**100**
8	1.005	**55**	*43*	*32*	*21*	*13*	*<13*	MEP	**100**
9	0.36	**45**	*29*	*22*	*15*	*9*	*<9*	MEP	**100**
10	0.78	**65**	*45*	*34*	*22*	*13*	*<13*	MEP	**100**
11	1.305	**58**	*35*	*26*	*17*	*10*	*<10*	MEP	**100**
12	1.365	**55**	*45*	*34*	*23*	*14*	*<14*	MEP	**100**
13	0.12	**24**	*23*	*17*	*11*	*7*	*<7*	MEP	**100**
Ecological status and score for number of species at within ecotope scale=								MEP	**100**

The numbers of species found within the ecotopes all exceed the norm defined for the MEP as function of the sampled surface as defined with the functions listed in Table 10. At the scale of ecotope, this gives an ecological status equal to the MEP and the corresponding score of 100.

Species lists

As for the number of species, species lists and corresponding sampling surface were estimated per ecotope and compared with the standard lists shown in the appendix section. As described earlier, each standard list consists of three sub-lists of species that appear with a probability of respectively >90%, 90≤-<50 and ≤50%. From each of these sub-lists, it is tolerated to miss a fraction that depends upon the surface that has been sampled in the assessment dataset (Figure 11).

Table 19
Results from the study on the species list per ecotope. Surface is the surface sampled, list% the individual probability for the species in the list, N in samples, the number of species in the assessment sample; N_MEP,GEP, MOD, POOR, the number of species that are required for the different ecological status; Status and score, the ecological status and score respectively.

Eco#	Surface	list%	N in samples	N_MEP	N_GEP	N_MOD.	N_POOR	Status	Score
1	0.62	90	17	14	10	7	4	MEP	100
1	0.62	75	11	8	6	4	2	MEP	100
1	0.62	25	7	2	1	1	1	MEP	100
2	0.33	90	14	11	8	5	3	MEP	100
2	0.33	75	4	1	1	1	0	MEP	100
2	0.33	25	2	0	0	0	0	MEP	100
3	0.14	90	6	5	3	2	1	MEP	100
3	0.14	75	8	6	5	3	2	MEP	100
3	0.14	25	4	2	2	1	1	MEP	100
4	0.53	90	8	9	7	4	3	GEP	85
4	0.53	75	6	5	4	2	1	MEP	100
4	0.53	25	12	7	5	3	2	MEP	100
5	0.47	90	6	5	3	2	1	MEP	100
5	0.47	75	4	5	4	2	1	GEP	85
5	0.47	25	4	5	4	3	2	GEP	85
7	0.05	90	2	0	0	0	0	MEP	100
7	0.05	75	6	3	2	1	1	MEP	100
7	0.05	25	5	2	2	1	1	MEP	100
8	1.01	90	32	27	20	13	8	MEP	100
8	1.01	75	5	8	6	4	2	MODERATE	60
8	1.01	25	7	2	1	1	1	MEP	100
9	0.36	90	26	23	17	11	7	MEP	100
9	0.36	75	4	3	3	2	1	MEP	100
9	0.36	25	0	0	0	0	0	MEP	100
10	0.78	90	37	35	27	18	11	MEP	100
10	0.78	75	2	2	2	1	1	GEP	85
10	0.78	25	0	0	0	0	0	MEP	100
11	1.31	90	19	17	12	8	5	MEP	100
11	1.31	75	16	15	11	8	5	MEP	100
11	1.31	25	10	6	5	3	2	MEP	100
12	1.37	90	28	23	18	12	7	MEP	100
12	1.37	75	10	15	11	8	5	MODERATE	60
12	1.37	25	9	4	3	2	1	MEP	100
13	0.12	90	13	12	9	6	4	MEP	100
13	0.12	75	7	6	5	3	2	MEP	1400
13	0.12	25	2	3	2	1	1	GEP	85
Ecological status and score species lists at within ecotope scale=								GEP	96

The numbers of species in the three sub-lists (<90%, 50-90%, <50%) that are required for the different level of ecological status are calculated as in Table 11. The number of species from the standard list that is found in the assessment samples is compared with these values. When the number of species in the sample exceeds this required number, the ecotope get the corresponding ecological status and score. The indicator, 'Number of species' is within the range defined for the GEP (Table 19).

Evaluation of the diversity indicator

The ecological value and corresponding score for the diversity indicator is calculated as the average of the twee sub-indicators Number of species and Species lists. The average score for the 'Diversity indicator' is within the range defined for the GEP (Table 20).

Table 20
Ecological value and score for the twee sub-indicators Number of species and Species list. Scores or both sub-indicator are averaged to obtaine the score for the diversity indicator

	Ecological status	Ecological score
Number of species	MEP	**100**
Species lists	GEP	**96**
Diversity indicator	GEP	**98**

4.4.3 Total macrofauna biomass and density

The average biomass and density found per ecotope in the reference and in the assessment dataset are compared by means of a t test. When no significant difference is found ($t_{test}<t_{table}$), the assessed samples is not considered as different from the reference and the ecotope acquires the MEP status. When a significant difference is found between the assessed samples and the reference, the ecological status of the ecotope is identified as BAD. The Within-ecotope 'Density indicator' is within the range defined for the GEP (Table 21). The 'Diversity indicator' estimates the ecological status at the Within-ecotope scale as POOR (Table 22).

Table 21
Outcomes of the t-test comparing the macrofauna density in the assessment dataset and in the reference. The ecological status and corresponding score is defined depending on the outcome of the test. The ecological status and score at the scale of the ecotope is calculated as the average of the individual ecotope scores

Eco#	Density in MEP	Density in assessment	t_{test}	$t_{0.05}$	State	Score
1	5751	6500	1.90	1.97	MEP	**100**
2	11500	12809	1.54	2.00	MEP	**100**
3	25291	12471	0.74	1.99	MEP	**100**
4	1154	1881	0.07	1.97	MEP	**100**
5	741	319	1.15	1.97	MEP	**100**
7	17155	12156	0.37	2.05	MEP	**100**
8	6843	3996	0.19	1.97	MEP	**100**
9	36610	25787	2.29	2.00	BAD	**0**
10	15187	12593	1.86	1.98	MEP	**100**
11	662	511	2.01	1.97	BAD	**0**
12	1507	749	0.52	1.96	MEP	**100**
13	16022	15218	0.10	1.99	MEP	**100**
Ecological status and score density at within ecotope scale=					GEP	**83**

Table 22

Outcomes of the t-test comparing the macrofauna biomass in the assessment dataset and in the reference. The ecological status and corresponding score is defined depending on the outcome of the test. The ecological status and score at the scale of the ecotope is calculated as the average of the individual ecotope scores

Eco#	Biomass in MEP	Biomass in assessment	t_{test}	$t_{0.05}$	State	Score
1	2.05	2.08	1.44	1.97	MEP	**100**
2	9.78	6.96	2.32	2.00	BAD	**0**
3	13.03	7.24	0.48	1.99	MEP	**100**
4	3.14	1.81	1.44	1.97	MEP	**100**
5	3.89	0.19	4.71	1.97	BAD	**0**
7	5.93	6.33	0.43	2.05	MEP	**100**
8	11.47	2.83	2.95	1.97	BAD	**0**
9	75.33	19.79	5.65	2.00	BAD	**0**
10	34.64	9.89	3.53	1.98	BAD	**0**
11	3.97	3.51	0.66	1.97	MEP	**100**
12	6.32	1.08	2.70	1.96	BAD	**0**
13	16.39	4.71	2.62	1.99	BAD	**0**
Ecological status and score biomass at within ecotope scale=					POOR	**42**

Integration of the sub-indicators at within ecotope scale

The three sub-indicators from the within ecotope scale are averaged in an indicator that is representative for the scale. The ecological status of the Within-ecotope scale is estimated as MODERATE. (Table 23).

Table 23

Ecological status and score obtained for the four sub-indicators at the within ecotope scale and average score and qualification obtained for the whole within ecotope scale

	Ecological status	Ecological score
Diversity	GEP	**98**
Total macrofauna density	GEP	**83**
Total macrofauna biomass	POOR	**42**
Average at within ecotope scale	**MODERATE**	**74**

4.5 INTEGRATED INDICATOR FOR THE WATER BODY

For the overall assessment of the water body the ecological status and score obtained for each of the three scales used here are averaged into an indicator representative for the whole water body. The average (Table 24) of the three scale indicators equals 72 corresponding with the MODERATE Ecological potential for the Westerschelde.

Table 24

Ecological status and score obtained for the three sub-indicators at the three scales studied in this report and weighed average score and qualification obtained for the water body indicator.

	Weighing factor	Ecological status	Ecological score
Ecosystem scale	**1**	MEP	**100**
Ecotope scale	**2**	MODERATE	**55**
Within ecotope scale	**2**	MODERATE	**74**
Whole water body		MODERATE	**72**

5 Discussion

In this report we propose a quantitative indicator for the Maximal Ecological Potential (MEP) and derived Good Ecological Potential (GEP) for the benthic macrofauna of the Westerschelde. The indicator is based on a hierarchical classification system that was proposed by Ysebaert & Herman (2004). The approach followed differs from most other classification systems that are being developed in other member states. Especially the hierarchical approach with the explicit use of surface area of ecotopes (habitats) as a quantitative indicator is an approach not included by the other member states. Another difference is the explicit use of biomass as an indicator. In the following discussion we will evaluate our approach in more detail and point out strong and weak points and give suggestions for improvements.

5.1 DO THE CHOSEN REFERENCE CONDITIONS REPRESENT THE MAXIMAL ECOLOGICAL POTENTIAL?

The reference conditions used in our approach differ at each level of the hierarchy.

At the scale of the whole water body, we use a relation between primary production and system-averaged benthic biomass, based on observations made for several shallow estuarine systems worldwide (Herman et al., 1999). The estuarine systems used in the analysis are all relatively un-impacted to moderately impacted systems. The relation presented by Herman et al. (1999) can be considered as a robust estimator that can be used in a generic way for different shallow, well-mixed estuarine systems, e.g. the Westerschelde. The ratio represents a state of equilibrium where the sum of pelagic and benthic production is adequately matched by the biomass of grazers that are present in the system (i.e. macrobenthos and zooplankton). We were able to demonstrate deviations from this relation, indicating unbalanced ecosystem functioning, based on two examples from the literature. These two examples show two contrasting situations in which an estuarine ecosystem can evolve. Additional mesocosm experiment data and model data (which showed good correspondence) allowed us to delimit boundaries at both sides of the spectrum. From this a quantitative indicator was constructed.

Suggestion: Try to find more examples of systems that show unbalanced conditions and look for changes that caused these unbalanced situations.

At the scale of the ecotope, the surface area of the different ecotopes is used as a quantitative indicator to evaluate the completeness of the Westerschelde in terms of ecotope diversity. As a starting point the reference condition in 1900 was chosen. Comparing the situation in 1900 with the present situation shows a distinct loss in mudflats and shallow subtidal areas. In their contribution to the Scheldt Estuary Project Development Plan 2010, Van den Bergh et al. (2003) showed that there was no realistic way back to the state of the estuary as it was around 1900. We used their analyses of possible measures to get a best estimate of the surface area that could be reintegrated again in the estuarine ecosystem, as salt marshes, mudflats and shallow subtidal areas. This best estimate we used as such to quantify the MEP for the Westerschelde, and therefore not the situation in 1900 was used as a reference condition, but a more realistic figure based on this best estimate from Van den Bergh et al. (2003). For the moment no better estimates are available, but as also mentioned by Van den Bergh et al. (2003), other alternatives/measures might be possible. Also large uncertainties remain about the consequences of the implementation of different measures (deepening, depoldering, etc.) on the morphological developments of the Westerschelde (Jeuken et al., 2004).

Suggestion: Further investigations to the optimal (and feasible) proportion and surface area of the different habitat types present in the Westerschelde are needed. Therefore, a more general principal on what the 'best' ratio is between the different habitats/ecotopes is needed (see further). A better understanding of the morphological developments under different scenarios of human impacts is needed.

At the within-ecotope scale, we evaluated the benthic macrofauna community structure within single ecotopes. We used biological monitoring data from the Westerschelde for the period 1978-1999 to construct the maximal ecological potentials. One can argue that this only reflects the present state of the system (actual MEP), and not really represent a historical MEP. On the other hand, because of the very large data set available for the Westerschelde, we were able to construct reference conditions based on a large amount of samples for most ecotopes. As such the MEP can be considered as relatively robust, taking into account the large natural spatial and temporal variability that exists in estuarine systems such as the Westerschelde. There are also no clear signs that the benthic community has changed drastically in the last 40 years. Observations made by Wolff (1973) in the Westerschelde showed similar species to be present. Also no large invasion events of alien species were observed in the Westerschelde. For instance, invasions by the oyster *Crassostrea gigas* in the Oosterschelde or the polychaete *Marenzelleria* sp. in the Dollard are not observed in the Westerschelde (although some individuals of *Marenzelleria* are irregularly observed). For these systems one should take care in setting up reference conditions or maximal ecological potentials based on recent monitoring data. Unfortunately, no real historical data are present, although it is known for instance that natural mussel beds were present and that at some places dense adult *Mya areanaria* populations were present. Both are nowadays absent. For mussel beds a separate indicator was developed, based on estimates proposed within the framework of WSV. For the Westerschelde, 200 ha of mussel beds were proposed.

We were also not able to find enough reference material from other estuarine systems during the limited time of the project, as most studies do not give enough information to classify samples in a certain ecotope. To prevent inconsistencies based on the unbalanced use per ecotope of samples from other systems, we decided to limit the analyses to Westerschelde samples only to construct the MEP. However, the maximal ecological potential could be refined and more validated by comparing with other estuarine systems.

Suggestion: We strongly suggest to do a more thorough analysis based on several, comparable estuarine systems to refine the reference conditions for each ecotope. This could be part of an intercalibration exercise.

5.2 IS THE USE OF SURFACE AREA OF ECOTOPES AS AN INDICATOR OF HABITAT DIVERSITY A USEFUL AND FEASIBLE APPROACH?

At the second level of the hierarchical classification system proposed by Ysebaert & Herman (2004) the use of a spatial component is introduced, i.e. one addresses the diversity of habitat types, and compares the availability and spatial organisation of these types to the expected possibilities, ideally based on the physical boundary conditions in the system. In this report we used the ecotope classification system that was developed by Bouma et al. (2003) as a starting point.

This hierarchical classification system uses several environmental variables to describe ecotopes: salinity, depth in the subtidal zone or exposure time in the intertidal zone, hydrodynamics and sediment characteristics. Due to the hierarchical structure of the ecotope classification, many combinations are possible, resulting in tens of ecotopes present in the Westerschelde. It was not considered feasible to establish a maximal ecological potential for all of these ecotopes, as not enough reference data were available, nor that future monitoring would be able to cover all these ecotopes in a sensible way (see further). Based on knowledge about the relation between environmental variables and benthic macrofauna in the Westerschelde, we classified 13 different ecotopes, 6 in the polyhaline (marine) zone and 7 in the mesohaline (brackish) zone. A special status was given to the occurrence of natural mussel beds (see above). These ecotopes are considered also as units we expect from nature in a system such as the Westerschelde.

We followed a rather rough classification for the subtidal zone, considering only deep subtidal and shallow subtidal, with no further distinction based on hydrodynamics or mud content. For the deep subtidal conditions are mostly high-dynamic with sandy sediments, and no further division is arguable. For the shallow subtidal zone, a further division into low-dynamic shallow subtidal and high-dynamic shallow subtidal might be desirable, as the creation of low-dynamic shallow subtidal areas is one of the measures proposed by Van den Bergh et al. (2003) that contribute to a better ecological functioning of the Westerschelde. Indeed, different communities might occur in these two ecotopes, the low-dynamic being a suitable habitat for certain suspension feeders like cockles. Due to the low amount of samples situated in the low-dynamic, shallow subtidal, however, we were not able to further divide this zone.

In the intertidal zone we followed a more refined classification, considering exposure time, hydrodynamics and mud content to characterize the different ecotopes. This resulted in four ecotopes in the polyhaline zone, and five ecotopes in the mesohaline zone. This higher resolution in the intertidal zone was chosen because changes in environmental constraints are larger here, resulting in stronger gradients and/or a more patchy environment. Most of the benthic productivity is also observed in this zone.

At the second level, i.e. the evaluation of the surface area of the different ecotopes, we were not able to establish a maximal ecological potential for the 13 ecotopes. Such a detailed information is not available for the moment for the period around 1900. Only five geomorphological habitat types could be distinguished in the Westerschelde based on available data: salt marshes, mud flats, sand flats, shallow subtidal areas, and deep subtidal areas. Further research into the ecotope distributions around 1900 is needed.

In the present indicator only surface area is used as an indicator, but nothing is said about the spatial organization of these ecotopes in the water body. Further research is needed to evaluate the role of connectivity, size of individual areas, etc.

Suggestion: Quantify the surface areas of the different ecotopes for the reference period 1900. Analyse data from a landscape ecology perspective, similar to analyses performed in terrestrial and freshwater ecology.

5.3 COMPARISON WITH THE APPROACH PROPOSED BY RIKZ FOR THE WESTERSCHELDE

A first development of a classification system for natural waters was developed by Fred Twisk in a report from the National Institute for Coastal and Marine Management/RIKZ (Duijts et al. 2003), with reference conditions for the macrobenthos based mainly on the "Natuurdoeltypes" (Bal et al. 2001). In a second exercise Fred Twisk used the hierarchical classification approach from Ysebaert & Herman (2004) to develop a new classification system for the Westerschelde, Ems Dollard, Oosterschelde and Wadden Sea (van der Molen 2004). For each of the three levels of the hierarchical classification approach, i.e. at the scale of the whole water body, ecotope and within-ecotope, different indicators were developed, as was also the case for this study.

At the scale of the whole water body, Twisk proposed to use the relation between primary production and system-averaged benthic biomass, as is also the case in this study. This indicator was not worked out in detail by Twisk.

Besides this relation between primary production and system-averaged benthic biomass, Twisk also used a standard list of species established at the scale of the whole ecosystem to judge of the diversity in the system to be tested. The diversity of organisms is however directly related to the diversity in an ecotope. Since it has been chosen here to integrate the spatial diversity in the present assessment tool, it is preferable, against redundancies, to consider the species diversity within each ecotope. There is consequently no consideration made on the presence/absence of species at the ecosystem level.

At the scale of the ecotope

The mussel banks were exclusively considered at the ecotope scale in the assessment in van der Molen (2004) whereas the other habitats as defined in the present report were not used for the assessment.

At the within-ecotope scale, i.e. the benthic community structure within an ecotope, Twisk used the AMBI index developed by Borja et al. (2000, 2003). Twisk calculated for six ecotopes the Biotic Coefficient, based on species composition and abundance data from literature (Westerschelde and other systems such as Oosterschelde, Dollard). As such an ecotope-specific reference condition was obtained and deviations from this reference condition were evaluated in the overall assessment.

In our approach we did not use AMBI, but used number of species, species composition, abundance and biomass as indicators to assess the maximal ecological potential for an ecotope. Under certain circumstances, Prior et al. (2004) caution about the use of the AMBI index. That is the case when the number of individuals and the number of taxa within the samples are low. Following the authors, this is especially true in the low salinity upstreams or estuarine intertidal sites where macrofauna may have a natural low diversity. If the taxa present belong to an ecological group with a high value, e.g. Oligochaeta, this would give an overall high biotic coefficient, indicating an impacted environment where this might not actually be the case. AMBI classification generally assigns congeners (members of the same genus) to the same pollution category. For instance all species of *Ampelisca* are assigned to group I even though there is evidence that *A. sarsi* might be more resistant to oil spills than other congener species.

A last but not least point of concern about the AMBI index is about the locations that are identified by the lowest Biotic Index or highest Ecological status as in Borja et al. (2000). These are locations that are mostly characterised by low silt content, abundance, species richness and biomass. These characteristics that are found in the high dynamic (high current speeds), sandy environments (*e.g.* gullies) do not correspond to our representation of the MEP for the Westerschelde or the High ecological status for any other shallow well mixed estuaries. As a consequence, the application of the AMBI method to an estuarine system such as the Westerschelde do not seem to be a suitable tool for the assessment of the disturbance level. These were for us the main arguments not to use the AMBI biotic index for the assessment of the Westerschelde.
Important starting point was that all observations, especially regarding diversity (e.g. number of species), is strongly affected by the surface area sampled or by the number of samples taken. This not only influences the quantification of the maximal ecological potential, but also strongly affects the future monitoring and evaluation of the ecological status of the Westerschelde. In all our calculations, therefore, a correction for sampled surface area (in the case of number of species and species composition) or number of samples taken (in the case of abundance and biomass) is considered.

5.4 ARE THE PROPOSED ECOLOGICAL INDICATORS ABLE TO DETECT ANTHROPOGENIC IMPACTS AND TO WHAT EXTENT ARE THEY STRESSOR SPECIFIC?

At the whole water body, the P_{prim}:B_{macro} indicator measures the state of equilibrium where the sum of pelagic and benthic production is adequately ideally matched by the biomass of grazers that are present in the system (i.e. macrobenthos and zooplankton). Deviations from this relation could point at unbalanced ecosystem functioning. Such unbalance is illustrated with two examples in the literature from the upper estuary of the San Francisco Bay after the invasion by the Asiatic clam (*Potamocorbula amurensis*) after 1987 and the Seine estuary. These examples witness the sensitivity of the chosen indicator for man-made disturbances such as the canalisation of an estuary as the Seine or the introduction of an invasive species as in the San Francisco Bay. However, as said earlier, this indicator integrates the whole spectrum of interactive processes that tend to buffer the various disturbances affecting the system. As a consequence, the P_{prim}:B_{macrof} is rather robust as disturbances will have to exceed the buffer capacity of the system (its resilience) before to induce a significant shift in this indicator. On the other hand, this indicator has a strong signal function; when a significant deviation is observed one knows the system is / will be in unbalance.
The indicators that have been chosen at the lower level in our hierarchic approach should more sensible to man-made disturbances. When the indicator at the ecosystem scale integrate the whole spectra of disturbances affecting the system, the indicators at and within ecotope scale allow to discriminate between effects from disturbances either affecting the morpho-/dynamic or water quality conditions in the system.
At the scale of the ecotope, the changes in the habitat distribution (size and proportion) are responses to changes in the morpho-/hydrodynamic conditions as witnessed by tremendous changes observed over the last decades to centuries of available observations. As a consequence, man-made interventions such as sediment dredging and dumping affecting the extent and relative proportions of the different habitats should be adequately tracked by the chosen indicators.
At the within ecotope scale, community shifts occurring within an ecotope are a response to a change in a parameter that is not used for the definition of the ecotope; that could be for example sediment and or water chemistry, temperature. For example, decreases in the number of species have been for a long time used as

an indicator for man-made disturbances (Pearson & Rosenberg 1978) such as eutrophication, sediment dumping etc. The widely accepted concept behind this relation is that sensitive species disappear from disturbed environment whereas tolerant species survive. As a result the intensity of the anthropogenic stress can adequately been described with a decrease in the number of species and/or changes in species composition as included in our diversity indicator between the reference and the affected areas. A worthy addition to the proposed set of indicators would consist in an indicator scaling the dominance levels of pre-defined taxonomic and/or functional groups at the Within-ecotope scale. Such extension should promote the sensitivity of our assessment tool to slight changes that would otherwise remain unnoticed under the present configuration.

5.5 IS THE CURRENT MONITORING EFFORT AND STRATEGY IN THE WESTERSCHELDE SUFFICIENT TO EVALUATE ITS ECOLOGICAL STATUS BASED ON THE PROPOSED METHODOLOGY?

The approach that we propose in this report is fundamentally hierarchical. The monitoring programme to be used in coordination with the present assessment tool should share the same hierarchical structure. This is not the case and we give here below some recommendations aiming at a better homogeneity between both the monitoring programme and the assessment tool.

At the within-ecotope scale, the monitoring should be stratified following the same ecotope system as that used for the assessment tool. An optimum should then be sought that allow matching the minimal sampling effort with the maximal sensitivity to changes. This could be obtained by ensuring that a sufficient number of samples is taken within each ecotope. Indeed during the present assessment one ecotope (#6) was not found back in the assessment (monitoring) dataset and a second one contained only three samples. These are about 30 samples per ecotope that should be collected over a period of three years to allow a relevant use of our assessment tool. A better approximation for the optimal monitoring effort could make use of the indicators defined in the present report that integrate the field variability.

At the ecotope scale, the present system of habitats that is available for the definition of the MEP (based on historical records) is too rough to allow the coupling with the underlying within ecotope scale. In the absence of useable historical data, hydro morphological modelling could be employed to refine our MEP definition regarding the habitat distribution within the Westerschelde. Efforts should be done to allow both systems (MEP and present monitoring) to converge towards a unique set of ecotopes.

5.6 CONCLUSION

The hierarchical concept and the indicators developed in this report to assess the Maximal Ecological Potential (MEP) and derived Good Ecological Potential (GEP) for the benthic macrofauna of the Westerschelde allows a quantitative, ecologically sound judgement of the ecological status of this heavily modified water body. At the same time the approach is reproducible and each step of the integration remains visible and editable for the purpose of management priorities.

The approach must be considered as a next step in the development of indicators that allow the classification of the ecological status of water bodies in a scientifcally-sound way. Further developments and refinements, together with a sound validation is needed in the future.

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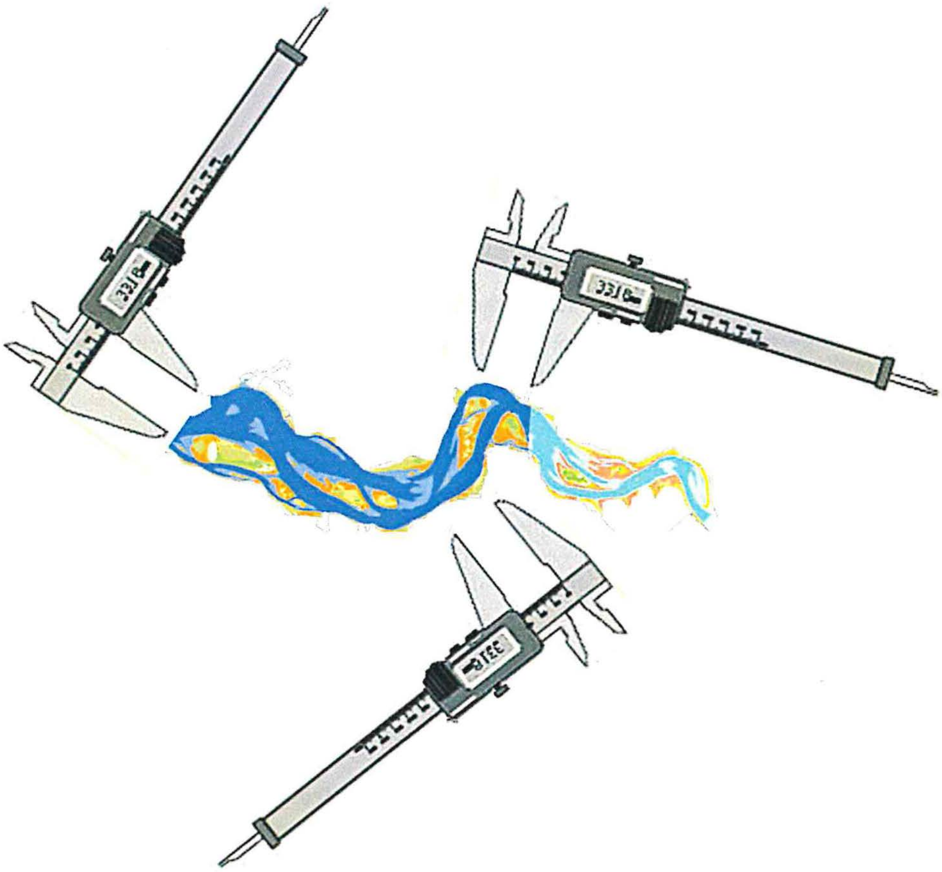
MEP/GEP WESTERSCHELDE



appendix

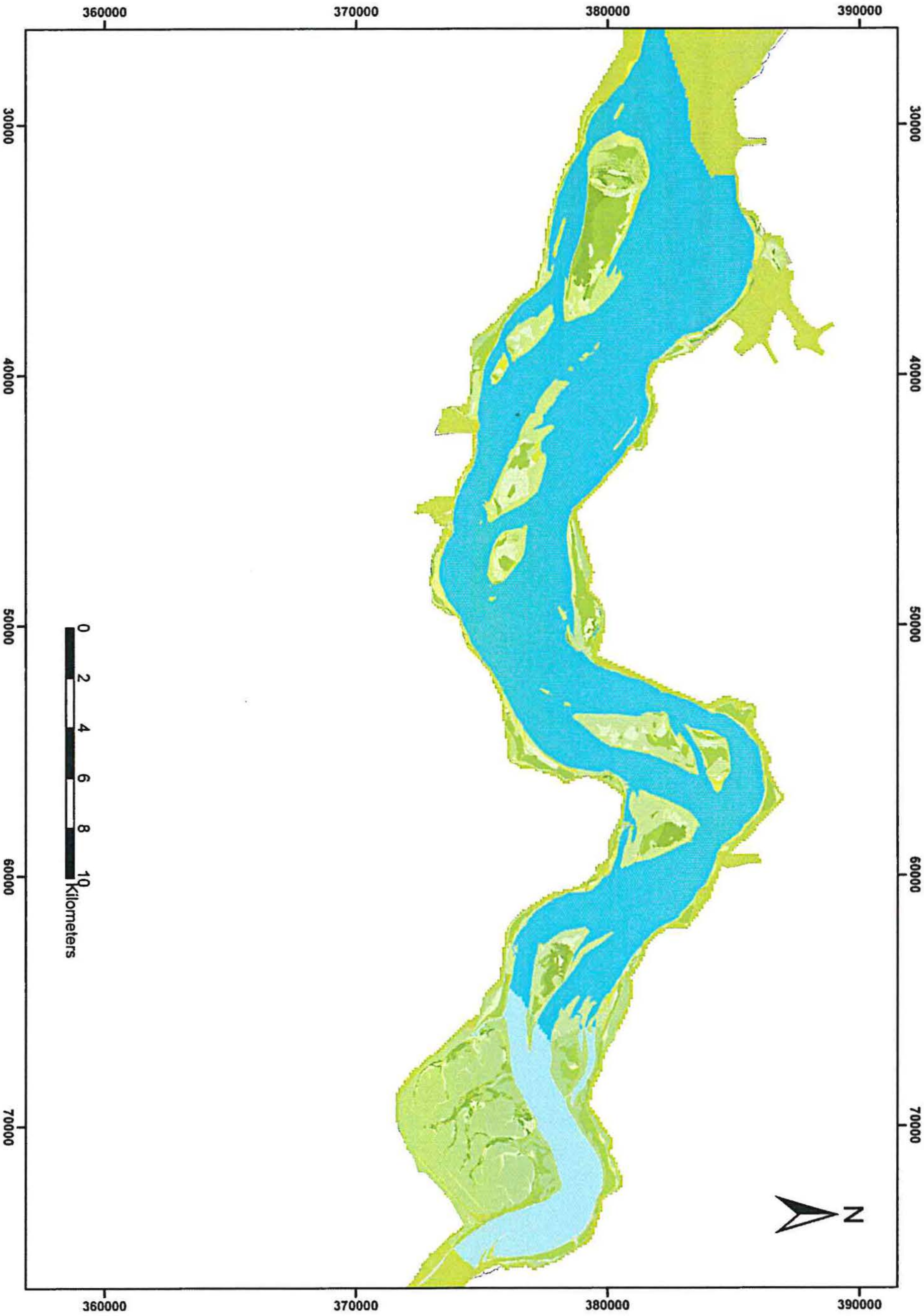
Content

Ecotope base map established by RIKZ for the ZES-ecotope typology in the Westerschelde (2001) (D. de Jong & F. Twisk)

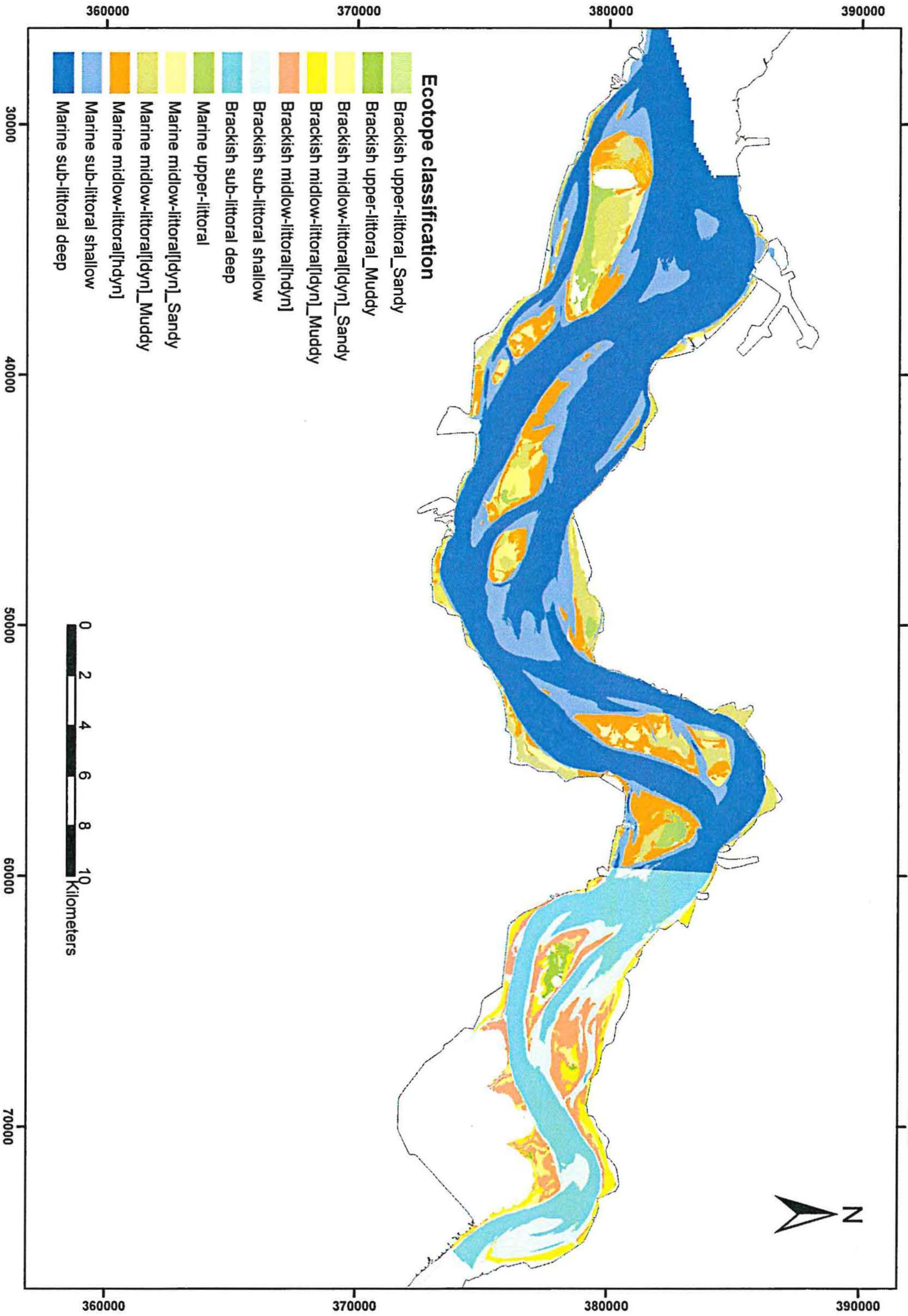
ECO2001 (ft22)

STAND_NAAM, GEOSLIB

- ,
- , overig
- , schelpenru
- , slibarm
- , slibrijk
- , zand
- , zandrug
- Brak hoogdyn litoraal, zand
- Brak hoogdyn. sublitoraal,
- Brak hoogdyn. sublitoraal, slibarm
- Brak hoogdyn. sublitoraal, slibrijk
- Brak hoogdyn. sublitoraal, zand
- Brak laagdyn. hooglitoraal, slibarm
- Brak laagdyn. hooglitoraal, slibrijk
- Brak laagdyn. hooglitoraal, zand
- Brak laagdyn. laaglitoraal, slibarm
- Brak laagdyn. laaglitoraal, slibrijk
- Brak laagdyn. middenlit., slibarm
- Brak laagdyn. middenlit., slibrijk
- Brak laagdyn. middenlit., zand
- Brak laagdyn. ondiep,
- Brak laagdyn. ondiep, slibarm
- Brak laagdyn. ondiep, slibrijk
- Brak laagdyn. ondiep, zand
- Schor en overig geomorf.,
- Schor en overig geomorf., overig
- Schor en overig geomorf., schor
- Schor en overig geomorf., slibarm
- Zout hoogdyn. litoraal, schelpenru
- Zout hoogdyn. litoraal, zand
- Zout hoogdyn. litoraal, zandrug
- Zout hoogdyn. sublitoraal,
- Zout hoogdyn. sublitoraal, schelpenru
- Zout hoogdyn. sublitoraal, slibarm
- Zout hoogdyn. sublitoraal, slibrijk
- Zout hoogdyn. sublitoraal, zand
- Zout laagdyn. hooglitoraal, slibarm
- Zout laagdyn. hooglitoraal, slibrijk
- Zout laagdyn. laaglitoraal, slibarm
- Zout laagdyn. laaglitoraal, slibrijk
- Zout laagdyn. middenlit., slibarm
- Zout laagdyn. middenlit., slibrijk
- Zout laagdyn. ondiep,
- Zout laagdyn. ondiep, schelpenru
- Zout laagdyn. ondiep, slibarm
- Zout laagdyn. ondiep, slibrijk
- Zout laagdyn. ondiep, zand

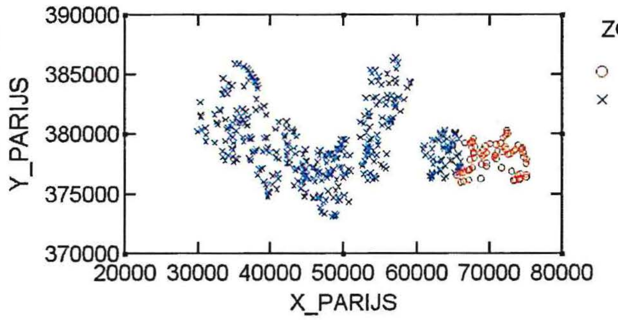


Map for the distribution for the 13 ecotopes in the Westerschelde (2001) adapted from the RIKZ ZES_ecotope map (A. Wielemaker, CEMERE dept)

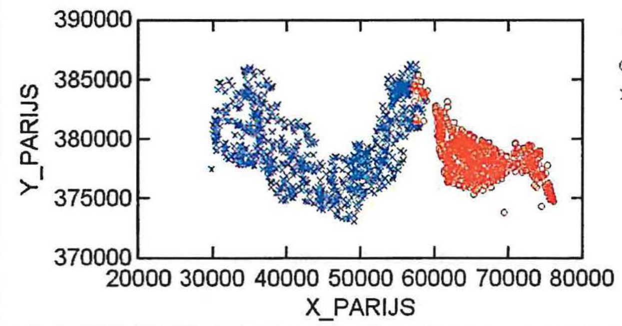


Problems encountered for the definition of the marine vs brackish areas

A

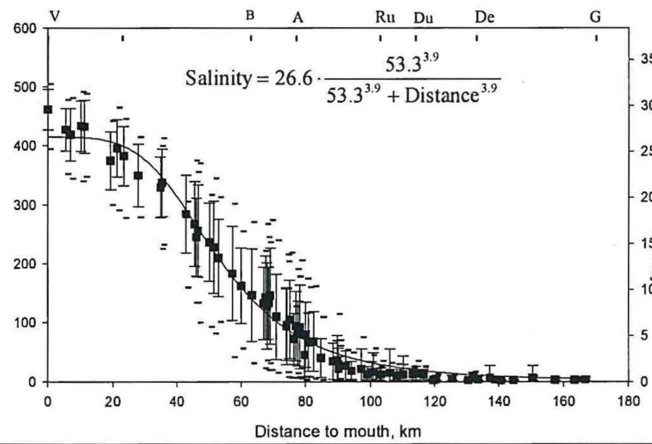


B

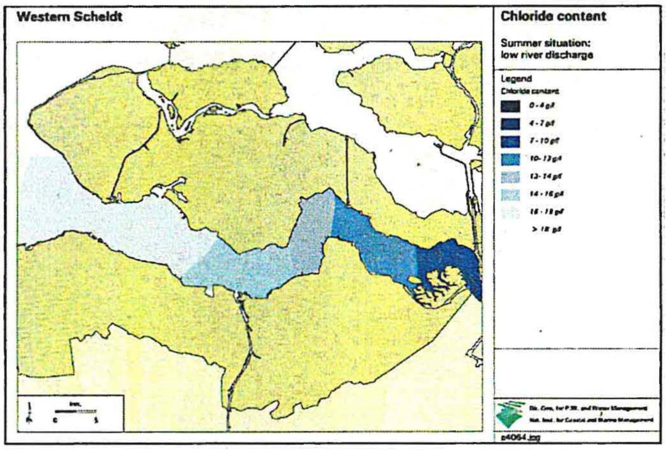


The salinity distribution appeared to significantly differ between the map of the ZES_ecotopes and the reference data from T. Ysebaert. The 18 ppt line is situated by Baalhoek-Krabbendijk in the ZES_map whereas it is situated by Perkpolder-Kruiningen in our reference data (Compare **A** and **B**).

C

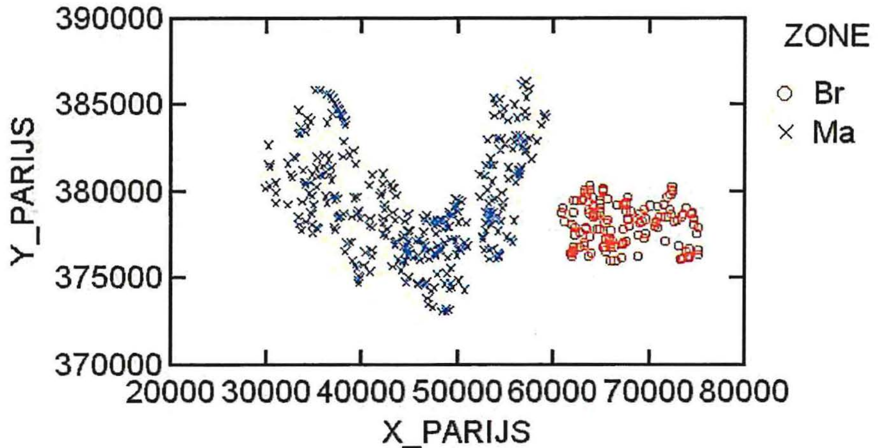


D



The salinity distribution presented by Soetaert et al (2004) in **C** is in accordance with that in our reference data with the 18 ppt isohaline at ca 20 km from the belgian border. As an illustration for the HABIMAP tool, de Ruiter and de Jong (1997) presented a map of the salinity summer distribution in the Westerschelde by low water discharge (**D**). On this map, the 18 ppt line (transition between light and dark blue) is situated as for the ZES map near the line Baalhoek-Krabbendijk.
The difference between the two datasets results from the fact that the map for the ZES_ecotope seems to be based on summer salinities conditions whereas the salinity in our reference data are year averages.

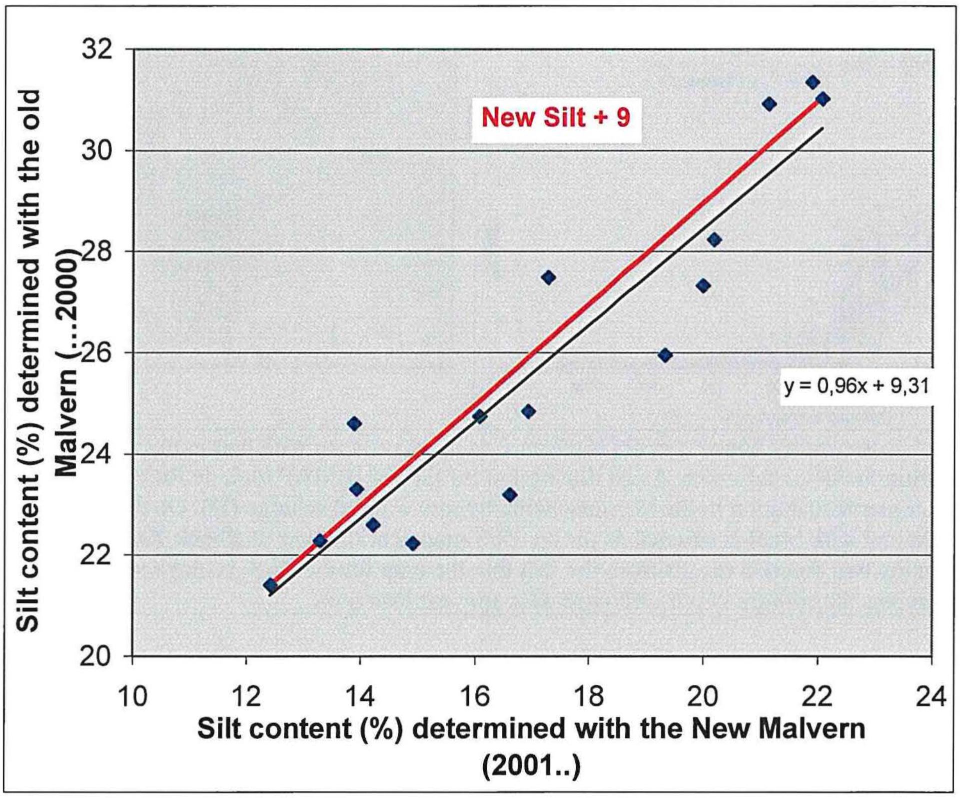
E



For the purpose of the present study it seems more sensible to use year averages instead of summer salinities. Therefore the 18 ppt isohaline was shifted in our 13 ecotope map to the same position as indicated by Soetaert et al (2004) and used in our reference data (See **E** and GIS map on previous page).

Problems encountered with heterogeneity in silt content data

Since 2001, a new laser particle multisizer (MALVERN™) is in use at the CEME. Short after the start of the new measurements, it appeared that the silt content measured with the new Malvern were lower than those found with the 'old' one (drop in monitoring series).
With respect to the integrity of the monitoring series, in our case the consistency between the reference and assessment series, it is advisable to correct the new measurements into values comparable with those found in the rest of the database.
Archived samples measured with the old Malvern (provided by R. Forstner) were measured again with the new Malvern and a multi parameter conversion function (defined for all size fractions and their inteaction) was estimated by Escaravage et al (NIOO-CEME Rapport 2003-08). This conversion formula allows to convert new measurements of the sediment characteristics (all size fractions together) into wat it should have been when measured with the old Malvern.
In the present case we are only interested with a conversion of new measures for the silt content especially in the region where the switch between <25% to >25% occurs. For this purpose a selection of the intercalibration series was made around this region (old measurements between 22 and 32 %). The observations showed there a sterk linear relation that could adequately be described with a line constructed when adding 9% to the silt content measured with the new malverm (See Figure below)

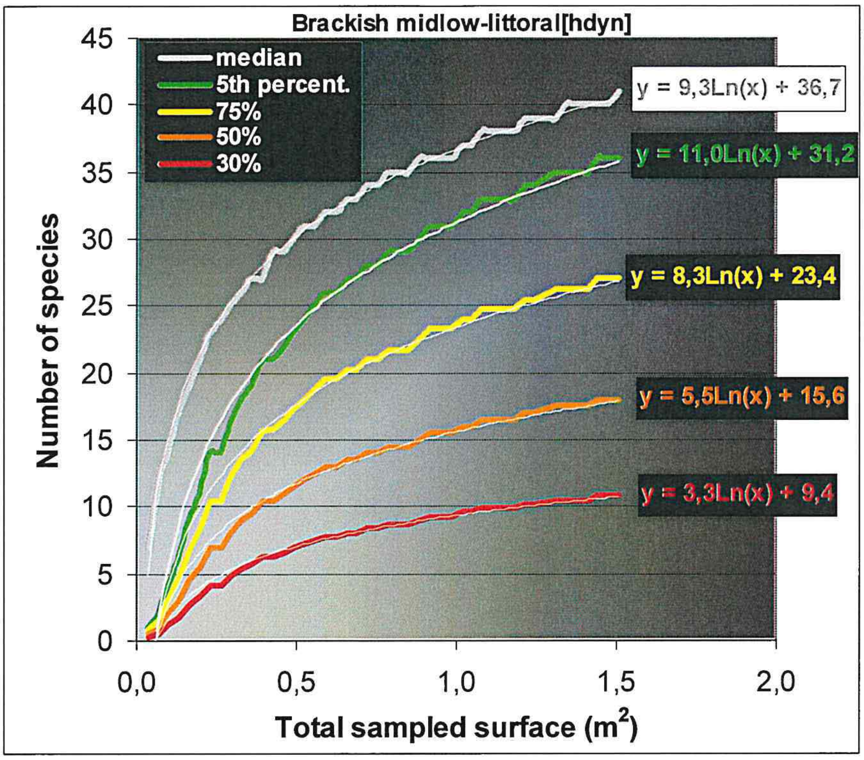


As a consequence, all silt content measurements made since the year 2001 were increased with 9%. In the present case, 36 records from our assessment series (total 526 records) shifted from sandy to muddy.

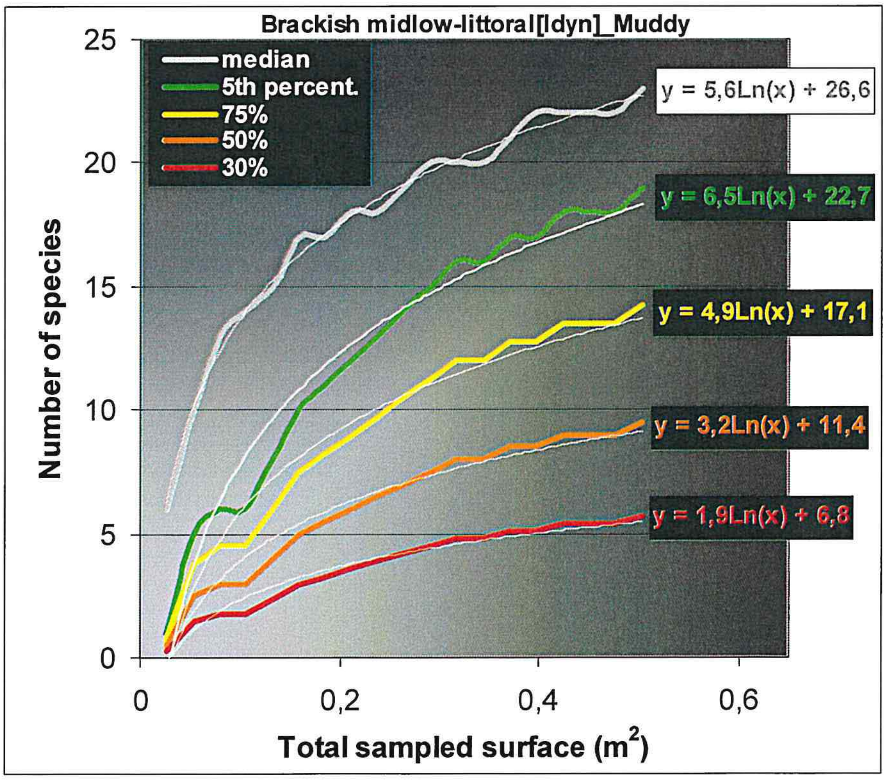
Number of species in the 13 ecotopes from our MEP dataset as a function of the sampling surface

The following pictures show the number of species to be expected by sampling various surfaces within each ecotope. The median of the distribution from 1000 permutations on the reference samples is plotted together with the 5thpercentile and corresponding 75%, 50%, 30% that represent the lower boundaries of the classes for MEP, GEP, Moderate and Poor ecological status. Each of these functions is fitted with a logarithmic relation that describes the expected number of species for any given sampling surface (m^2).

1.-Brackish midlow-littoral[hdyn]



2.-Brackish midlow-littoral[ldyn]_Muddy



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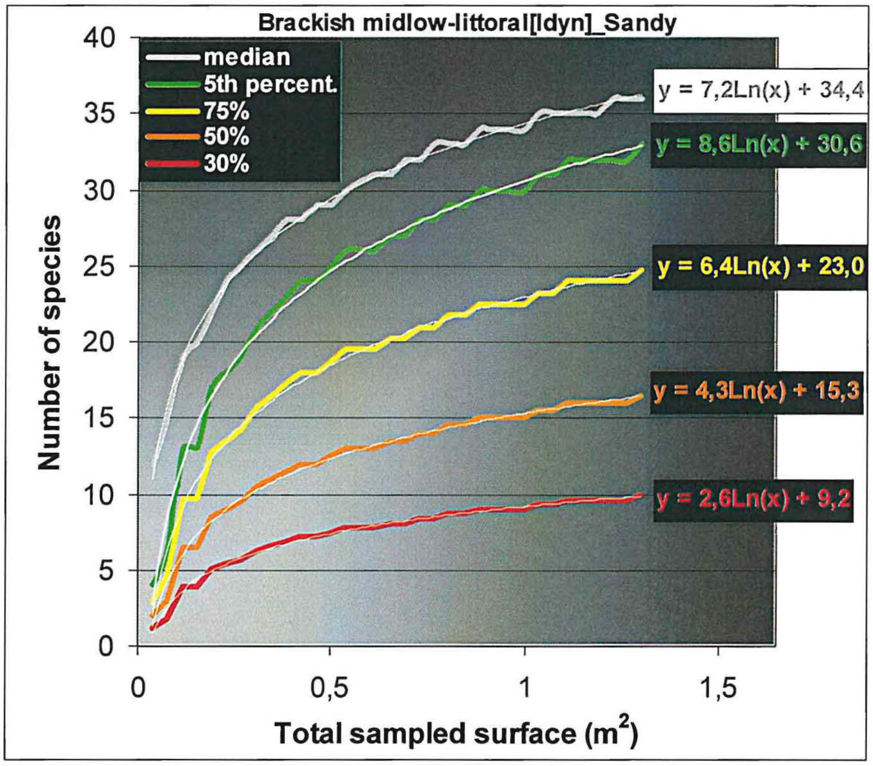
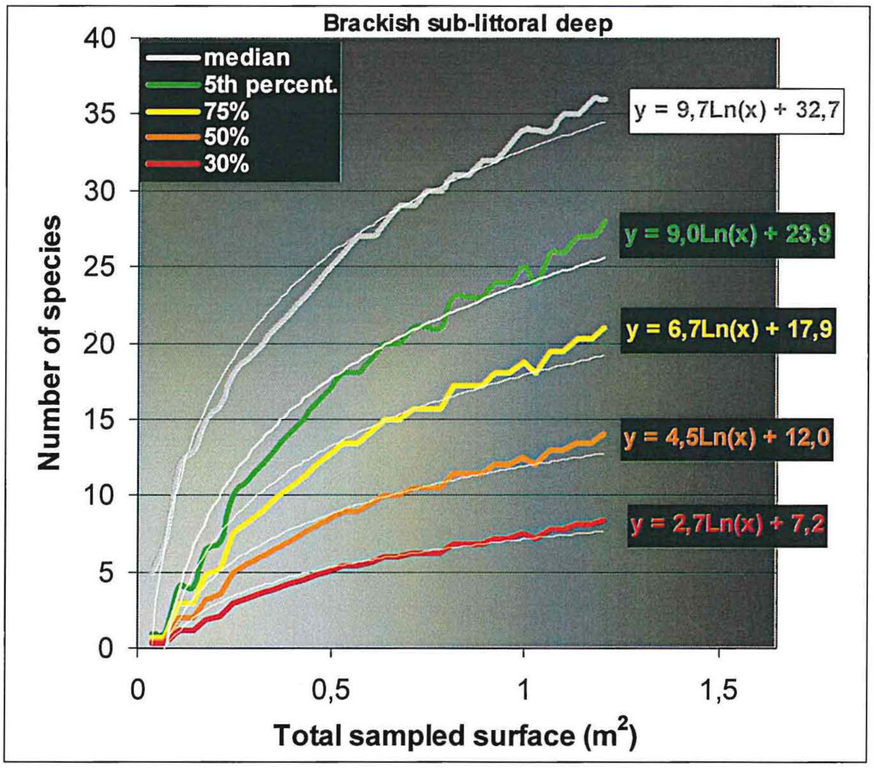
3.-Brackish midlow-littoral[Idyn]_Sandy



4.-Brackish sub-littoral deep



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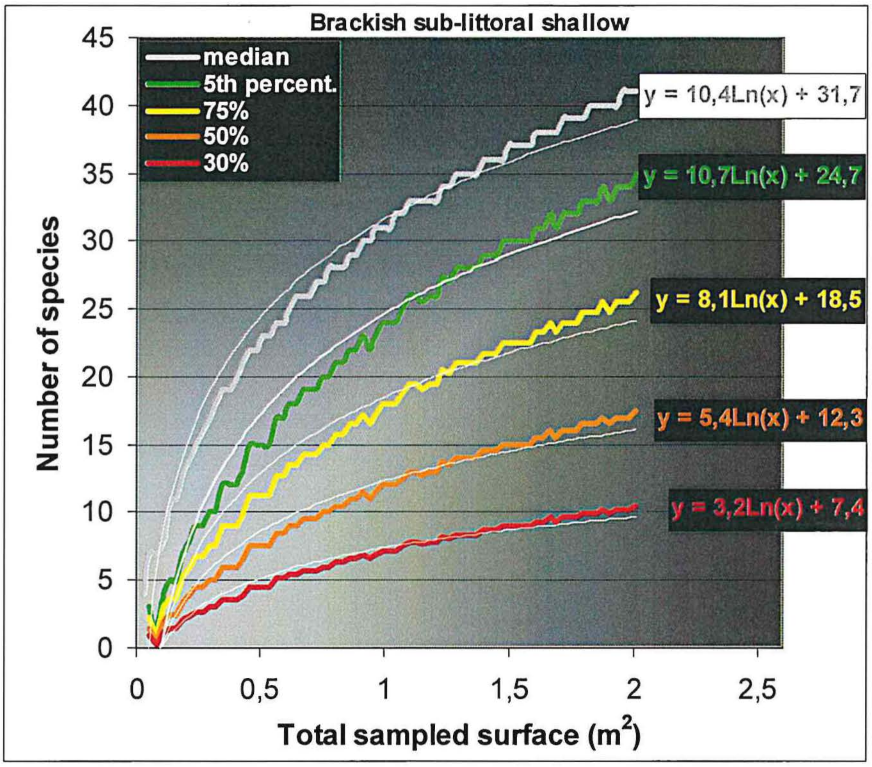
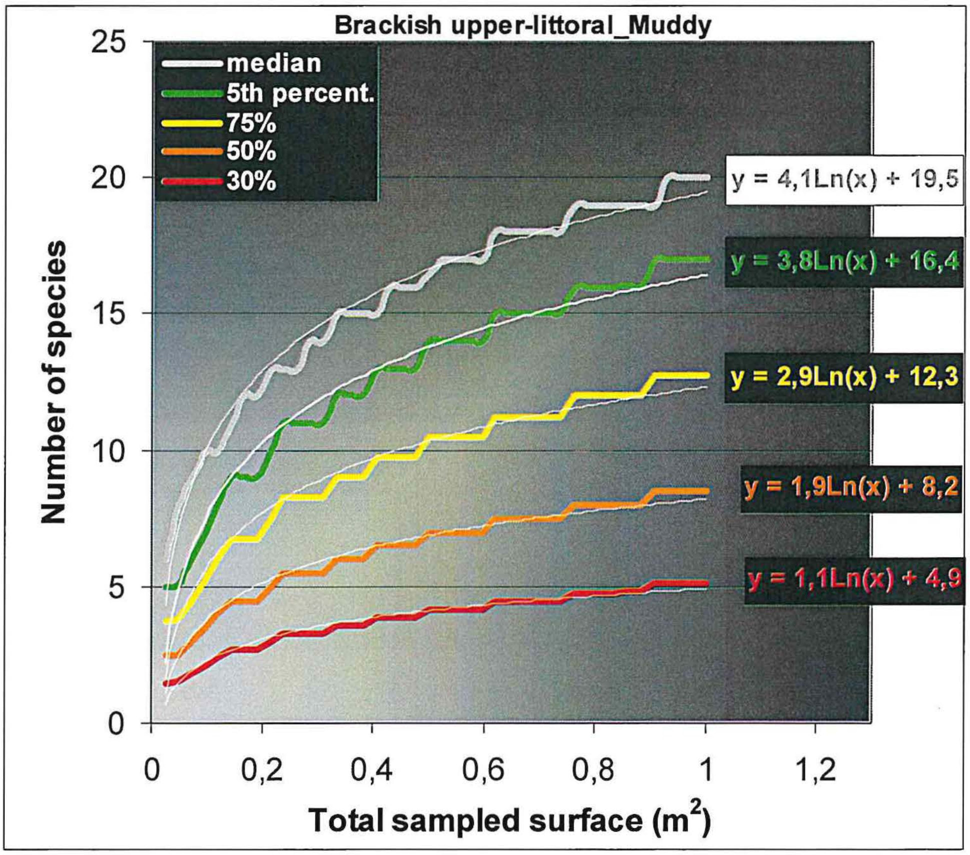
5.-Brackish sub-littoral shallow



6.-Brackish upper-littoral_Muddy



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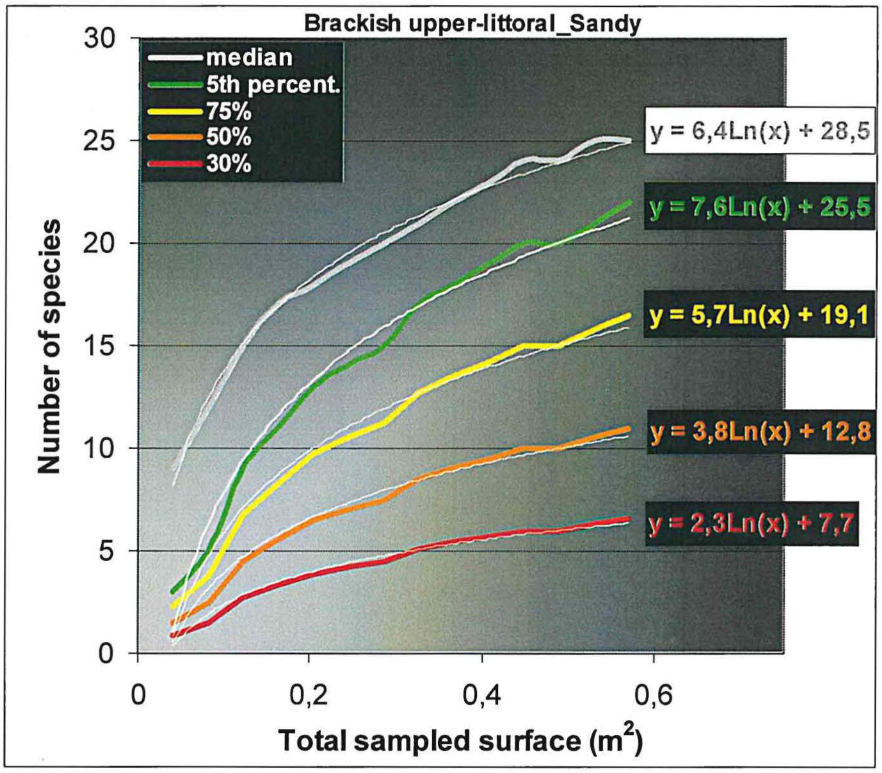
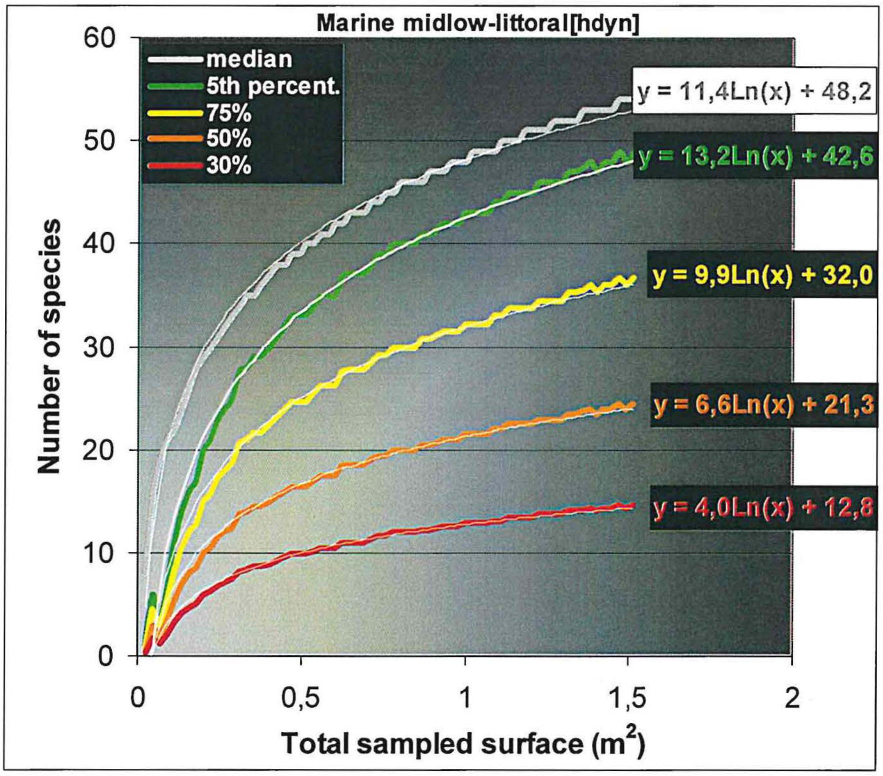
7.-Brackish upper-littoral_Sandy



8.-Marine midlow-littoral[hdyn]



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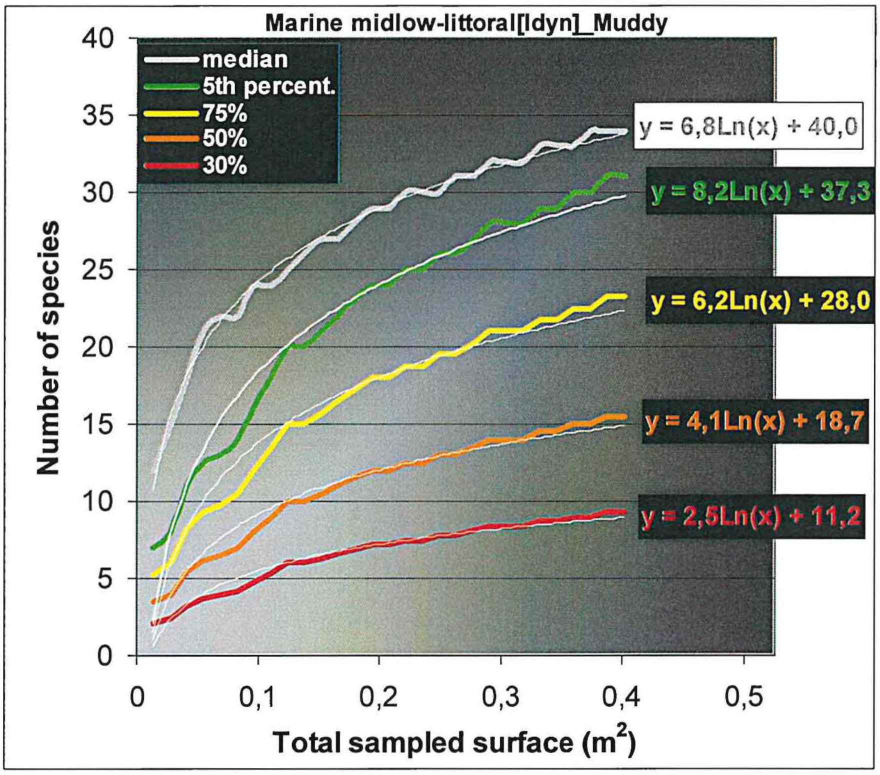
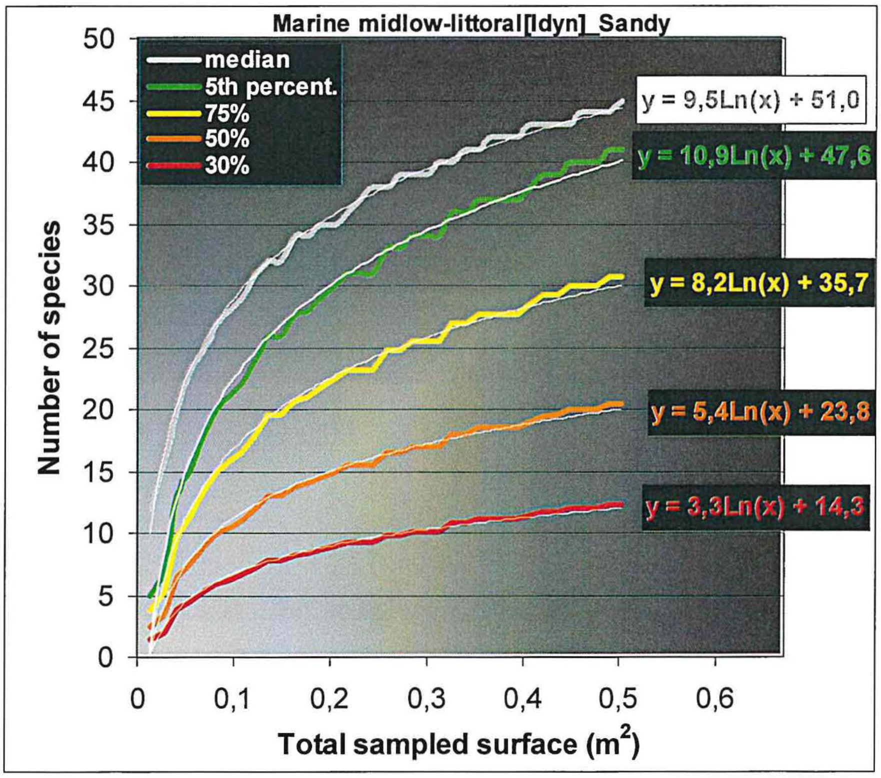
9.-Marine midlow-littoral[Idyn]_Muddy



10.-Marine midlow-littoral[Idyn]_Sandy



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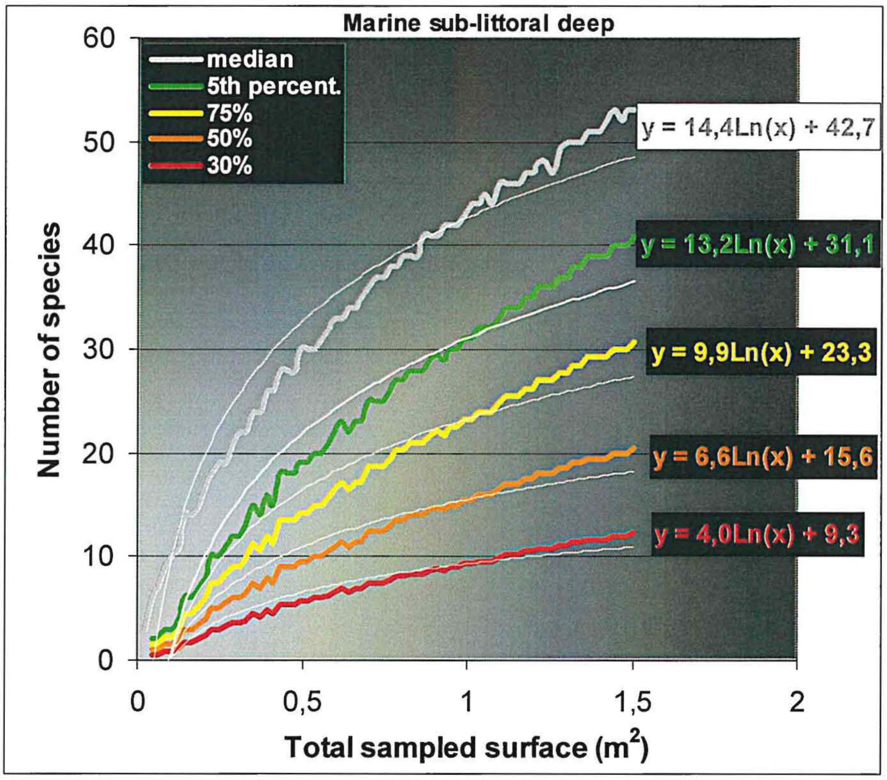
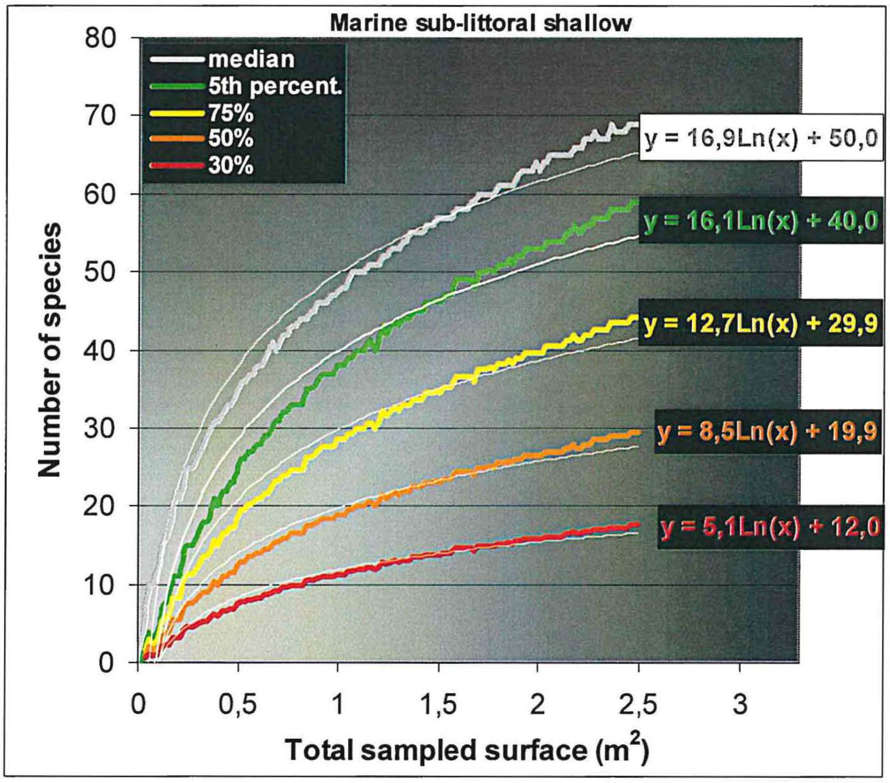
11.-Marine sub-littoral deep



12.-Marine sub-littoral shallow



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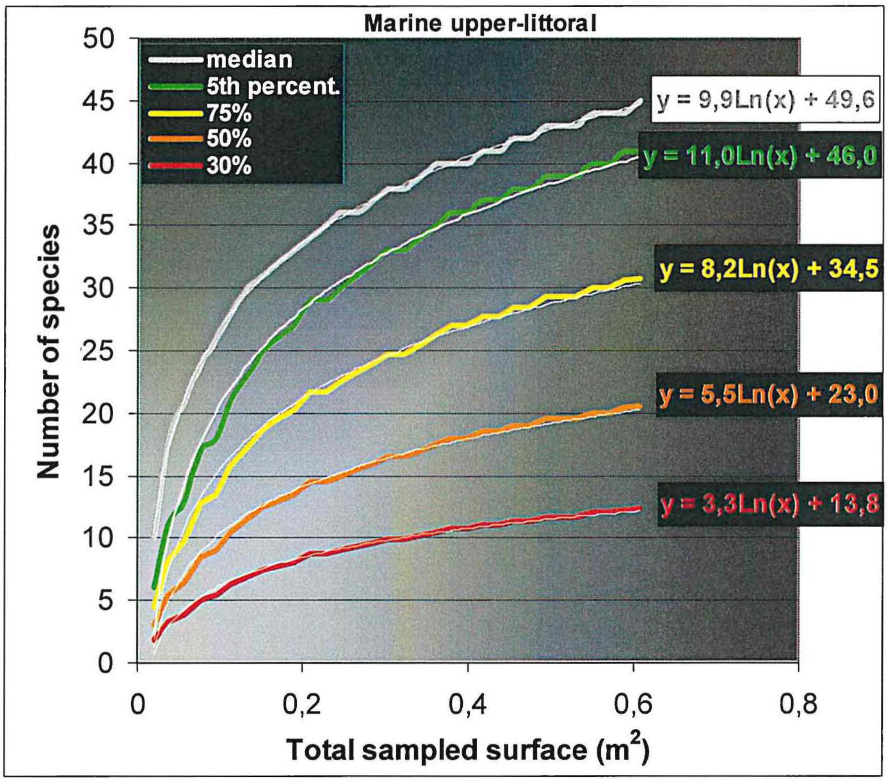
13.-Marine upper-littoral



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Individual probability for species to occur within each of the 13 ecotopes from our MEP dataset as function of the sampling surface

The following tables show the individual probability of species to occur in samples of increasing surface. The probability are colored according to there value:

PROBABILITY OF PRESENCE		
->0.9	0.5>- >0.9	0>->0.5

The three colors identify the list of species with respectively more than 90%, 90% to 50% and less than 50% chance to be found in a sample according to its surface.
The individual probabilities are obtained by permutations (all possible combinations of 1,2,..,n samples) of the samples used for the reference for each ecotope.

1.-Brackish midlow-littoral[hdyn]

Brackish midlow-littoral[hdyn]

PROBABILITY OF PRESENCE
->0.9 0.5>- >0.9 0>->0.5

Name	0.15	0.3	0.45	0.6	0,75	0.9	1.05	1.2	1.35	1.5	1.9	2.25	2.6	3
Bathyporeia sp.	0,95	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Heteromastus filiformis	0,95	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Pygospio elegans	0,93	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Macoma balthica	0,87	0,98	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Eurydice pulchra	0,86	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Haustorius arenarius	0,75	0,96	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Nereis succinea	0,72	0,93	0,98	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Hydrobia ulvae	0,70	0,92	0,98	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Corophium volutator	0,70	0,93	0,97	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Bathyporeia pilosa	0,70	0,91	0,97	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Nereis diversicolor	0,66	0,89	0,97	0,99	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Eteone sp.	0,65	0,90	0,96	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Crangon crangon	0,60	0,87	0,96	0,98	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
OLIGOCHAETA	0,62	0,86	0,94	0,98	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Cerastoderma edule	0,60	0,85	0,94	0,98	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Polydora sp.	0,58	0,83	0,94	0,97	0,98	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Corophium arenarium	0,52	0,77	0,89	0,95	0,98	0,99	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00
NEMERTEA	0,43	0,71	0,85	0,91	0,95	0,98	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Capitella capitata	0,39	0,62	0,74	0,86	0,90	0,94	0,97	0,98	0,99	1,00	1,00	1,00	1,00	1,00
Petricola pholadiformis	0,35	0,61	0,73	0,84	0,91	0,94	0,97	0,98	0,99	0,99	1,00	1,00	1,00	1,00
Corophium sp.	0,32	0,56	0,70	0,82	0,88	0,94	0,96	0,98	0,99	0,99	1,00	1,00	1,00	1,00
Cyathura carinata	0,30	0,54	0,69	0,80	0,87	0,90	0,93	0,96	0,98	0,98	1,00	1,00	1,00	1,00
Mya arenaria	0,31	0,51	0,69	0,76	0,83	0,90	0,93	0,96	0,97	0,98	0,99	1,00	1,00	1,00
Aphelochaeta marioni	0,26	0,48	0,60	0,70	0,76	0,84	0,90	0,92	0,96	0,97	0,99	1,00	1,00	1,00
Carcinus maenas	0,25	0,48	0,60	0,70	0,76	0,85	0,90	0,92	0,94	0,96	0,98	0,99	1,00	1,00
Spio sp.	0,24	0,41	0,56	0,67	0,73	0,80	0,88	0,91	0,93	0,95	0,98	0,99	1,00	1,00
MYSIDACEA	0,19	0,39	0,55	0,66	0,78	0,81	0,85	0,91	0,94	0,96	0,98	1,00	1,00	1,00
Arenicola marina	0,22	0,37	0,48	0,61	0,67	0,75	0,80	0,87	0,88	0,91	0,96	0,99	1,00	1,00
Scrobicularia plana	0,19	0,37	0,48	0,59	0,66	0,74	0,82	0,87	0,89	0,92	0,97	0,99	1,00	1,00
Manayunkia aestuarina	0,21	0,35	0,48	0,59	0,67	0,75	0,79	0,86	0,89	0,93	0,96	0,99	0,99	1,00
Ensis sp.	0,16	0,32	0,41	0,54	0,59	0,71	0,76	0,82	0,85	0,87	0,94	0,97	0,99	1,00
Mesopodopsis slabberi	0,15	0,32	0,45	0,53	0,60	0,68	0,75	0,84	0,85	0,88	0,95	0,97	0,99	1,00
Nereis sp.	0,18	0,30	0,44	0,53	0,61	0,69	0,71	0,83	0,83	0,87	0,94	0,97	0,98	1,00
Gastrosaccus spinifer	0,13	0,26	0,36	0,45	0,56	0,60	0,68	0,72	0,77	0,82	0,89	0,94	0,98	0,99
Bathyporeia pelagica	0,12	0,21	0,29	0,37	0,43	0,50	0,54	0,63	0,66	0,72	0,81	0,88	0,93	0,96
Gammarus sp.	0,11	0,22	0,28	0,37	0,42	0,50	0,57	0,63	0,66	0,72	0,82	0,89	0,92	0,96
Scolelepis squamata	0,10	0,20	0,28	0,34	0,45	0,51	0,56	0,63	0,66	0,69	0,81	0,89	0,94	0,97
Mytilus edulis	0,06	0,12	0,19	0,26	0,30	0,36	0,41	0,47	0,52	0,59	0,68	0,76	0,84	0,91
Barnea candida	0,07	0,14	0,20	0,25	0,28	0,37	0,41	0,46	0,52	0,59	0,67	0,75	0,81	0,89
Bathyporeia sarsi	0,04	0,09	0,11	0,14	0,19	0,21	0,26	0,29	0,29	0,35	0,42	0,52	0,60	0,67
Spisula sp.	0,04	0,07	0,12	0,16	0,17	0,21	0,25	0,28	0,30	0,34	0,42	0,52	0,58	0,69
Streblospio shrubsolii	0,03	0,08	0,11	0,14	0,17	0,20	0,24	0,28	0,33	0,34	0,45	0,50	0,60	0,66
Neomysis integer	0,03	0,08	0,11	0,15	0,17	0,21	0,25	0,28	0,31	0,34	0,46	0,49	0,59	0,64
Corophium insidiosum	0,04	0,09	0,12	0,14	0,17	0,22	0,26	0,28	0,29	0,35	0,42	0,51	0,57	0,67
Mysella bidentata	0,03	0,09	0,12	0,14	0,17	0,20	0,23	0,27	0,31	0,33	0,43	0,54	0,56	0,67
ASCIDIACEA	0,04	0,07	0,11	0,15	0,19	0,21	0,23	0,28	0,31	0,32	0,44	0,51	0,58	0,66
Corophium lacustre	0,03	0,08	0,11	0,14	0,19	0,20	0,25	0,26	0,32	0,34	0,42	0,51	0,56	0,67
Urothoe poseidonis	0,04	0,07	0,11	0,15	0,19	0,20	0,25	0,25	0,30	0,33	0,42	0,52	0,59	0,68
Spiophanes bombyx	0,04	0,06	0,11	0,14	0,15	0,21	0,25	0,30	0,30	0,34	0,42	0,51	0,59	0,66
Eumida sp.	0,04	0,06	0,11	0,14	0,16	0,21	0,25	0,30	0,30	0,34	0,42	0,51	0,59	0,66
Nephtys cirrosa	0,03	0,07	0,09	0,14	0,15	0,19	0,23	0,26	0,30	0,35	0,43	0,50	0,60	0,70
Crassostrea angulata	0,04	0,07	0,10	0,14	0,16	0,19	0,24	0,27	0,32	0,33	0,42	0,49	0,58	0,64

2.-Brackish midlow-littoral[Idyn]_Muddy

Brackish midlow-littoral[Idyn]_Muddy

	PROBABILITY OF PRESENCE					
	->0.9	0.5>- >0.9	0>->0.5			
Name	0.15	0.3	0.45	0.6	0,75	0.9
Heteromastus filiformis	1,00	1,00	1,00	1,00	1,00	1,00
Macoma balthica	1,00	1,00	1,00	1,00	1,00	1,00
Corophium volutator	1,00	1,00	1,00	1,00	1,00	1,00
Nereis diversicolor	1,00	1,00	1,00	1,00	1,00	1,00
OLIGOCHAETA	1,00	1,00	1,00	1,00	1,00	1,00
Pygospio elegans	0,99	1,00	1,00	1,00	1,00	1,00
Hydrobia ulvae	0,95	1,00	1,00	1,00	1,00	1,00
Polydora sp.	0,90	0,99	1,00	1,00	1,00	1,00
Cerastoderma edule	0,84	0,98	1,00	1,00	1,00	1,00
Eteone sp.	0,83	0,99	1,00	1,00	1,00	1,00
Scrobicularia plana	0,79	0,96	0,99	1,00	1,00	1,00
Cyathura carinata	0,75	0,94	0,99	1,00	1,00	1,00
Crangon crangon	0,68	0,93	0,98	1,00	1,00	1,00
Mya arenaria	0,58	0,88	0,98	1,00	1,00	1,00
NEMERTEA	0,54	0,79	0,94	0,99	1,00	1,00
Bathyporeia sp.	0,52	0,77	0,94	0,99	1,00	1,00
Nereis succinea	0,37	0,69	0,85	0,96	1,00	1,00
Ensis sp.	0,30	0,54	0,74	0,89	0,95	1,00
Arenicola marina	0,30	0,53	0,74	0,89	0,95	1,00
Capitella capitata	0,16	0,33	0,47	0,65	0,79	0,95
Corophium arenarium	0,17	0,32	0,50	0,65	0,78	0,94
Gammarus salinus	0,16	0,32	0,48	0,65	0,79	0,93
Manayunkia aestuarina	0,17	0,32	0,46	0,67	0,78	0,93
Sphaeroma sp.	0,16	0,30	0,49	0,67	0,77	0,93
Aphelochaeta marioni	0,10	0,30	0,45	0,57	0,83	1,00
Nephtys caeca	0,10	0,30	0,45	0,57	0,83	1,00
Mesopodopsis slabberi	0,10	0,30	0,45	0,57	0,83	1,00
Carcinus maenas	0,10	0,30	0,45	0,57	0,83	1,00

3.-Brackish midlow-littoral[Idyn]_Sandy

Brackish midlow-littoral[Idyn]_Sandy

PROBABILITY OF PRESENCE		
->0.9	0.5>- >0.9	0>->0.5

Name	0.15	0.3	0.45	0.6	0,75	0.9	1.05	1.2	1.35	1.5	1.9	2.25	2.6
Heteromastus filiformis	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Macoma balthica	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Nereis diversicolor	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Pygospio elegans	0,98	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Hydrobia ulvae	0,93	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Eteone sp.	0,93	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Cerastoderma edule	0,93	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Mya arenaria	0,85	0,98	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Bathyporeia sp.	0,84	0,98	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Corophium volutator	0,82	0,97	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Crangon crangon	0,82	0,97	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Polydora sp.	0,81	0,98	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Nereis succinea	0,80	0,97	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
OLIGOCHAETA	0,76	0,96	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Corophium arenarium	0,72	0,91	0,99	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Scrobicularia plana	0,65	0,87	0,96	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
NEMERTEA	0,60	0,84	0,95	0,99	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Eurydice pulchra	0,53	0,79	0,91	0,96	0,99	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Carcinus maenas	0,52	0,78	0,90	0,95	0,99	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Arenicola marina	0,49	0,72	0,86	0,92	0,97	0,99	0,99	1,00	1,00	1,00	1,00	1,00	1,00
Cyathura carinata	0,47	0,73	0,87	0,92	0,97	0,98	0,99	1,00	1,00	1,00	1,00	1,00	1,00
Ensis sp.	0,39	0,66	0,83	0,91	0,96	0,98	0,99	1,00	1,00	1,00	1,00	1,00	1,00
Bathyporeia pilosa	0,39	0,60	0,75	0,84	0,91	0,95	0,97	0,99	0,99	1,00	1,00	1,00	1,00
Haustorius arenarius	0,31	0,55	0,72	0,84	0,90	0,93	0,97	0,98	1,00	1,00	1,00	1,00	1,00
Capitella capitata	0,31	0,55	0,69	0,80	0,88	0,92	0,96	0,98	0,99	0,99	1,00	1,00	1,00
Manayunkia aestuarina	0,30	0,58	0,67	0,79	0,87	0,91	0,96	0,97	0,99	0,99	1,00	1,00	1,00
Mesopodopsis slabberi	0,21	0,40	0,56	0,67	0,76	0,84	0,89	0,93	0,96	0,98	1,00	1,00	1,00
Aphelochaeta marioni	0,24	0,42	0,54	0,66	0,76	0,82	0,88	0,93	0,96	0,97	1,00	1,00	1,00
Corophium sp.	0,25	0,37	0,56	0,65	0,74	0,84	0,87	0,93	0,96	0,97	1,00	1,00	1,00
Spio sp.	0,17	0,32	0,45	0,55	0,62	0,74	0,81	0,86	0,91	0,93	0,99	1,00	1,00
MYSIDACEA	0,16	0,33	0,45	0,55	0,64	0,74	0,79	0,85	0,91	0,93	0,98	1,00	1,00
Nephtys hombergii	0,18	0,31	0,47	0,53	0,64	0,72	0,80	0,86	0,89	0,92	0,97	1,00	1,00
Gastrosaccus spinifer	0,11	0,20	0,33	0,41	0,51	0,57	0,66	0,71	0,78	0,82	0,95	0,99	1,00
Nephtys cirrosa	0,10	0,21	0,32	0,39	0,49	0,60	0,66	0,74	0,78	0,83	0,92	0,99	1,00
Nephtys sp.	0,07	0,11	0,17	0,24	0,29	0,34	0,40	0,46	0,52	0,57	0,75	0,87	1,00
Petricola pholadiformis	0,07	0,11	0,17	0,24	0,29	0,34	0,40	0,46	0,52	0,57	0,75	0,87	1,00
Neomysis integer	0,05	0,13	0,17	0,24	0,26	0,36	0,39	0,47	0,52	0,59	0,71	0,88	1,00
Nephtys caeca	0,05	0,13	0,17	0,24	0,26	0,36	0,39	0,47	0,52	0,59	0,71	0,88	1,00
Sphaeroma sp.	0,04	0,11	0,16	0,22	0,27	0,35	0,41	0,48	0,53	0,57	0,72	0,89	1,00
Gammarus sp.	0,07	0,12	0,19	0,21	0,29	0,34	0,39	0,44	0,53	0,57	0,73	0,87	1,00

4.-Brackish sub-littoral deep

Brackish sub-littoral deep

PROBABILITY OF PRESENCE
->0.9   0.5>- >0.9   0>->0.5

Name	0.15	0.3	0.45	0.6	0,75	0.9	1.05	1.2	1.35	1.5	1.9	2.25	2.6
Heteromastus filiformis	0,90	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Spio sp.	0,83	0,97	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Haustorius arenarius	0,75	0,94	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Gastrosaccus spinifer	0,73	0,93	0,98	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Capitella capitata	0,71	0,90	0,98	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Bathyporeia pilosa	0,71	0,89	0,96	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Mesopodopsis slabberi	0,70	0,88	0,97	0,98	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Bathyporeia sp.	0,59	0,83	0,91	0,98	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Ensis sp.	0,54	0,79	0,90	0,96	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Macoma balthica	0,54	0,76	0,87	0,94	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Eteone sp.	0,52	0,75	0,88	0,94	0,98	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Eurydice pulchra	0,52	0,74	0,86	0,93	0,98	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Nephtys cirrosa	0,46	0,70	0,84	0,93	0,98	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Nephtys caeca	0,42	0,68	0,81	0,92	0,97	0,99	0,99	0,99	1,00	1,00	1,00	1,00	1,00
NEMERTEA	0,42	0,67	0,80	0,88	0,97	0,98	0,98	1,00	1,00	1,00	1,00	1,00	1,00
Crangon crangon	0,31	0,56	0,69	0,80	0,91	0,96	0,97	0,98	0,99	1,00	1,00	1,00	1,00
Mytilus edulis	0,32	0,51	0,63	0,76	0,87	0,92	0,94	0,96	0,98	0,99	1,00	1,00	1,00
Nereis succinea	0,30	0,46	0,59	0,73	0,85	0,88	0,92	0,95	0,96	0,98	0,99	1,00	1,00
Cerastoderma edule	0,21	0,38	0,51	0,64	0,82	0,85	0,89	0,91	0,93	0,97	0,99	0,99	1,00
Pygospio elegans	0,22	0,38	0,48	0,62	0,74	0,78	0,83	0,85	0,90	0,95	0,97	0,99	1,00
Polydora sp.	0,23	0,35	0,44	0,55	0,70	0,76	0,81	0,84	0,88	0,93	0,96	0,99	0,99
Gammarus sp.	0,19	0,32	0,43	0,54	0,66	0,74	0,78	0,83	0,86	0,92	0,95	0,97	0,99
Petricola pholadiformis	0,18	0,31	0,42	0,53	0,66	0,74	0,78	0,81	0,84	0,91	0,96	0,97	0,99
Neomysis integer	0,19	0,29	0,41	0,51	0,67	0,73	0,77	0,82	0,85	0,90	0,96	0,97	0,98
Hydrobia ulvae	0,15	0,29	0,39	0,48	0,63	0,69	0,75	0,79	0,83	0,89	0,93	0,96	0,98
OLIGOCHAETA	0,14	0,24	0,30	0,39	0,56	0,60	0,69	0,69	0,72	0,83	0,88	0,92	0,96
Parapleustes assimilis	0,16	0,22	0,30	0,39	0,53	0,60	0,66	0,68	0,72	0,82	0,88	0,93	0,96
Carcinus maenas	0,11	0,21	0,30	0,40	0,52	0,60	0,65	0,67	0,76	0,84	0,88	0,92	0,96
MYSIDACEA	0,11	0,20	0,28	0,38	0,48	0,53	0,63	0,64	0,68	0,77	0,83	0,89	0,92
Gammarus salinus	0,13	0,19	0,26	0,36	0,48	0,54	0,60	0,61	0,67	0,77	0,84	0,89	0,93
Bathyporeia pelagica	0,13	0,19	0,29	0,37	0,47	0,52	0,60	0,63	0,67	0,77	0,84	0,87	0,92
Aphelochaeta marioni	0,10	0,17	0,25	0,32	0,42	0,47	0,55	0,60	0,61	0,71	0,78	0,82	0,86
Nephtys hombergii	0,09	0,17	0,24	0,30	0,43	0,46	0,52	0,57	0,63	0,71	0,77	0,83	0,89
Corophium insidiosum	0,10	0,15	0,19	0,26	0,34	0,43	0,46	0,48	0,54	0,62	0,71	0,76	0,81
Mya arenaria	0,08	0,15	0,21	0,27	0,36	0,41	0,46	0,50	0,53	0,60	0,71	0,74	0,82
Atylus swammerdami	0,07	0,12	0,18	0,26	0,35	0,39	0,45	0,48	0,55	0,61	0,68	0,76	0,83
Melita sp.	0,07	0,12	0,17	0,21	0,27	0,33	0,38	0,41	0,44	0,49	0,60	0,64	0,73
Corophium volutator	0,06	0,09	0,16	0,19	0,27	0,30	0,38	0,39	0,43	0,54	0,59	0,67	0,74
Nereis diversicolor	0,06	0,11	0,14	0,21	0,27	0,33	0,36	0,39	0,41	0,52	0,60	0,64	0,75
Corophium arenarium	0,04	0,09	0,14	0,19	0,27	0,34	0,36	0,37	0,42	0,52	0,61	0,66	0,70
Portumnus latipes	0,05	0,10	0,15	0,17	0,27	0,33	0,36	0,40	0,44	0,51	0,59	0,64	0,73
Streblospio shrubsolii	0,04	0,07	0,11	0,14	0,20	0,21	0,27	0,31	0,32	0,41	0,44	0,52	0,56
Arenicola marina	0,04	0,07	0,12	0,14	0,20	0,24	0,27	0,29	0,34	0,38	0,46	0,50	0,55
Bathyporeia elegans	0,04	0,08	0,11	0,15	0,20	0,23	0,25	0,32	0,31	0,38	0,44	0,50	0,58
Cyathura carinata	0,03	0,07	0,10	0,14	0,18	0,22	0,26	0,28	0,33	0,39	0,44	0,52	0,57
Pleusymtes glaber	0,03	0,07	0,10	0,15	0,21	0,24	0,24	0,26	0,30	0,39	0,45	0,50	0,59
Scolelepis squamata	0,04	0,07	0,09	0,12	0,19	0,21	0,25	0,27	0,31	0,39	0,45	0,50	0,57
Pectinaria koreni	0,02	0,04	0,06	0,08	0,11	0,13	0,15	0,16	0,19	0,22	0,27	0,30	0,34
Corophium bonnellii	0,02	0,04	0,06	0,09	0,10	0,14	0,15	0,17	0,18	0,20	0,27	0,30	0,33
Autolytus langerhansi	0,02	0,04	0,06	0,09	0,10	0,14	0,15	0,17	0,18	0,20	0,27	0,30	0,33
Harmothoe sp.	0,02	0,04	0,06	0,09	0,10	0,14	0,15	0,17	0,18	0,20	0,27	0,30	0,33
Gammarus zaddachi	0,03	0,03	0,05	0,08	0,10	0,11	0,14	0,17	0,19	0,25	0,25	0,30	0,32
Parajassa pelagica	0,03	0,04	0,06	0,07	0,10	0,11	0,14	0,17	0,18	0,21	0,27	0,29	0,35
Corophium lacustre	0,03	0,04	0,05	0,08	0,10	0,12	0,14	0,16	0,18	0,21	0,27	0,30	0,35
Nephtys sp.	0,03	0,04	0,05	0,07	0,10	0,12	0,13	0,15	0,17	0,22	0,27	0,32	0,32
Scoloplos armiger	0,01	0,04	0,05	0,07	0,10	0,13	0,14	0,18	0,17	0,22	0,26	0,30	0,35
Scrobicularia plana	0,02	0,04	0,04	0,07	0,11	0,11	0,14	0,15	0,17	0,21	0,26	0,31	0,37
Praunus sp.	0,02	0,04	0,06	0,09	0,10	0,13	0,14	0,16	0,17	0,21	0,25	0,30	0,34
Microphthalmus sp.	0,02	0,04	0,05	0,06	0,10	0,11	0,15	0,18	0,17	0,20	0,25	0,31	0,36
Microphthalmus similis	0,02	0,04	0,06	0,06	0,10	0,12	0,13	0,15	0,16	0,21	0,27	0,31	0,34
Spiophanes bombyx	0,02	0,05	0,06	0,07	0,10	0,12	0,13	0,17	0,18	0,22	0,25	0,29	0,35
Polycirrus sp.	0,02	0,04	0,05	0,08	0,11	0,12	0,13	0,16	0,16	0,21	0,25	0,31	0,36
Corophium sp.	0,03	0,04	0,05	0,06	0,11	0,13	0,13	0,16	0,16	0,21	0,25	0,30	0,33
Nereis sp.	0,02	0,03	0,05	0,07	0,09	0,12	0,13	0,15	0,18	0,23	0,27	0,29	0,33
Nephtys longosetosa	0,01	0,04	0,05	0,07	0,10	0,13	0,14	0,17	0,17	0,21	0,26	0,30	0,32
Magelona papillicornis	0,02	0,03	0,05	0,07	0,10	0,12	0,12	0,16	0,16	0,20	0,25	0,30	0,35
Pontocrates altamarinus	0,02	0,04	0,05	0,07	0,10	0,10	0,12	0,14	0,17	0,21	0,25	0,28	0,34

5.-Brackish sub-littoral shallow

Brackish sub-littoral shallow

PROBABILITY OF PRESENCE		
->0.9	0.5>- >0.9	0>->0.5

Name	0.15	0.3	0.45	0.6	0,75	0.9	1.05	1.2	1.35	1.5	1.9	2.25	2.6	3
Heteromastus filiformis	0,96	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Haustorius arenarius	0,86	0,98	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Bathyporeia sp.	0,77	0,94	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Bathyporeia pilosa	0,73	0,94	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Eurydice pulchra	0,74	0,93	0,99	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Spio sp.	0,72	0,91	0,97	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Macoma balthica	0,62	0,85	0,94	0,98	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Capitella capitata	0,47	0,69	0,84	0,91	0,95	0,97	0,98	0,99	1,00	1,00	1,00	1,00	1,00	1,00
Pygospio elegans	0,43	0,67	0,80	0,88	0,93	0,96	0,98	0,99	0,99	1,00	1,00	1,00	1,00	1,00
Mesopodopsis slabberi	0,40	0,64	0,77	0,87	0,94	0,97	0,98	0,99	1,00	1,00	1,00	1,00	1,00	1,00
Crangon crangon	0,39	0,63	0,74	0,86	0,92	0,96	0,98	0,99	0,99	1,00	1,00	1,00	1,00	1,00
NEMERTEA	0,33	0,57	0,72	0,83	0,90	0,94	0,97	0,98	0,98	0,99	1,00	1,00	1,00	1,00
Hydrobia ulvae	0,29	0,47	0,65	0,72	0,81	0,86	0,91	0,94	0,97	0,95	0,99	1,00	1,00	1,00
Gastrosaccus spinifer	0,28	0,47	0,64	0,72	0,81	0,86	0,90	0,95	0,96	0,97	0,99	1,00	1,00	1,00
Nereis succinea	0,28	0,47	0,62	0,72	0,78	0,87	0,91	0,92	0,96	0,97	1,00	0,99	1,00	1,00
Eteone sp.	0,28	0,46	0,60	0,67	0,76	0,82	0,88	0,91	0,92	0,96	0,98	0,99	1,00	1,00
Polydora sp.	0,24	0,38	0,52	0,63	0,72	0,80	0,85	0,85	0,91	0,95	0,98	0,99	1,00	1,00
Ensis sp.	0,19	0,32	0,45	0,57	0,66	0,74	0,81	0,87	0,88	0,92	0,97	0,98	0,99	1,00
Neomysis integer	0,17	0,33	0,43	0,57	0,68	0,75	0,82	0,86	0,89	0,92	0,96	0,98	0,99	1,00
Arenicola marina	0,18	0,37	0,47	0,58	0,66	0,74	0,78	0,84	0,86	0,91	0,96	0,98	0,99	1,00
MYSIDACEA	0,17	0,28	0,41	0,52	0,60	0,67	0,75	0,80	0,82	0,86	0,93	0,97	0,99	1,00
Aphelochaeta marioni	0,21	0,31	0,42	0,50	0,61	0,67	0,73	0,76	0,82	0,85	0,92	0,96	0,98	1,00
Corophium volutator	0,18	0,29	0,41	0,50	0,57	0,69	0,74	0,77	0,83	0,87	0,93	0,95	0,99	1,00
Cerastoderma edule	0,14	0,26	0,38	0,50	0,59	0,69	0,75	0,79	0,83	0,86	0,94	0,96	0,99	1,00
Nephtys cirrosa	0,12	0,25	0,36	0,45	0,51	0,57	0,65	0,71	0,77	0,81	0,87	0,93	0,96	0,99
Corophium arenarium	0,15	0,24	0,33	0,45	0,50	0,60	0,63	0,72	0,75	0,81	0,89	0,93	0,97	0,99
Petricola pholadiformis	0,15	0,24	0,37	0,41	0,54	0,59	0,66	0,69	0,75	0,80	0,88	0,92	0,96	0,99
Nereis diversicolor	0,14	0,24	0,34	0,43	0,50	0,58	0,64	0,71	0,75	0,79	0,88	0,93	0,96	0,98
Nephtys caeca	0,14	0,23	0,33	0,40	0,49	0,57	0,65	0,73	0,76	0,78	0,90	0,94	0,97	1,00
OLIGOCHAETA	0,13	0,21	0,26	0,34	0,41	0,48	0,55	0,59	0,66	0,70	0,82	0,86	0,92	0,95
Parapleustes assimilis	0,11	0,20	0,29	0,34	0,41	0,49	0,56	0,56	0,64	0,71	0,80	0,84	0,92	0,97
Bathyporeia pelagica	0,10	0,17	0,28	0,34	0,44	0,49	0,54	0,58	0,66	0,69	0,79	0,84	0,92	0,96
Mytilus edulis	0,07	0,11	0,18	0,25	0,30	0,38	0,41	0,44	0,50	0,57	0,65	0,72	0,80	0,87
Nephtys hombergii	0,08	0,14	0,18	0,24	0,28	0,34	0,42	0,45	0,48	0,54	0,65	0,74	0,82	0,89
Lanice conchilega	0,09	0,12	0,17	0,22	0,29	0,33	0,42	0,43	0,50	0,54	0,62	0,74	0,81	0,89
Spiophanes bombyx	0,04	0,08	0,11	0,15	0,17	0,20	0,25	0,26	0,29	0,36	0,38	0,48	0,56	0,63
Glycera alba	0,04	0,07	0,10	0,14	0,17	0,21	0,23	0,25	0,30	0,34	0,41	0,46	0,60	0,68
Gammarus salinus	0,04	0,06	0,11	0,13	0,16	0,21	0,25	0,25	0,30	0,35	0,45	0,48	0,55	0,66
Magelona papillicornis	0,04	0,07	0,10	0,13	0,15	0,21	0,24	0,28	0,32	0,35	0,40	0,49	0,54	0,66
Actiniaria	0,04	0,07	0,12	0,14	0,18	0,19	0,23	0,26	0,30	0,31	0,39	0,51	0,55	0,68
Nereis sp.	0,03	0,07	0,10	0,14	0,17	0,21	0,23	0,27	0,29	0,31	0,41	0,50	0,55	0,63
Cyathura carinata	0,03	0,07	0,10	0,14	0,15	0,20	0,23	0,22	0,28	0,35	0,40	0,49	0,57	0,68
Corophium lacustre	0,03	0,07	0,10	0,14	0,15	0,20	0,23	0,22	0,28	0,35	0,40	0,49	0,57	0,68
Antinoella sarsi	0,04	0,07	0,11	0,13	0,18	0,20	0,22	0,28	0,30	0,32	0,41	0,46	0,55	0,65
Microdeutopus gryllotalpa	0,04	0,06	0,11	0,14	0,14	0,20	0,23	0,28	0,29	0,32	0,42	0,49	0,53	0,64
Urothoe sp.	0,04	0,08	0,09	0,12	0,17	0,20	0,21	0,23	0,29	0,33	0,43	0,49	0,57	0,65
Parajassa pelagica	0,04	0,08	0,09	0,12	0,17	0,20	0,21	0,23	0,29	0,33	0,43	0,49	0,57	0,65
Mysella bidentata	0,04	0,07	0,11	0,13	0,18	0,20	0,24	0,27	0,30	0,33	0,40	0,45	0,54	0,63
Carcinus maenas	0,04	0,08	0,12	0,12	0,17	0,20	0,24	0,25	0,30	0,31	0,41	0,45	0,55	0,65
Barnea candida	0,03	0,07	0,11	0,13	0,17	0,19	0,24	0,25	0,28	0,32	0,42	0,47	0,55	0,63
Pleusymtes glaber	0,04	0,06	0,08	0,12	0,14	0,18	0,23	0,23	0,29	0,32	0,40	0,49	0,57	0,70
Scrobicularia plana	0,04	0,06	0,08	0,12	0,14	0,18	0,23	0,23	0,29	0,32	0,40	0,49	0,57	0,70
Mya arenaria	0,04	0,06	0,08	0,12	0,14	0,18	0,23	0,23	0,29	0,32	0,40	0,49	0,57	0,70
Marenzelleria viridis	0,03	0,06	0,11	0,13	0,17	0,21	0,24	0,23	0,28	0,32	0,40	0,48	0,52	0,62

6.-Brackish upper-littoral_Muddy

Brackish upper-littoral_Muddy

PROBABILITY OF PRESENCE
->0.9 0.5>- >0.9 0>->0.5

Name	0.15	0.3	0.45	0.6	0,75	0.9	1.05	1.2	1.35
Macoma balthica	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Corophium volutator	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Heteromastus filiformis	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Nereis diversicolor	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
OLIGOCHAETA	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Hydrobia ulvae	0,98	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Manayunkia aestuarina	0,75	0,94	0,99	1,00	1,00	1,00	1,00	1,00	1,00
Pygospio elegans	0,74	0,94	0,99	1,00	1,00	1,00	1,00	1,00	1,00
NEMERTEA	0,75	0,93	0,99	1,00	1,00	1,00	1,00	1,00	1,00
Nereis succinea	0,62	0,85	0,97	0,99	1,00	1,00	1,00	1,00	1,00
Crangon crangon	0,56	0,82	0,94	0,98	1,00	1,00	1,00	1,00	1,00
Polydora sp.	0,39	0,62	0,80	0,89	0,95	0,99	1,00	1,00	1,00
Corophium arenarium	0,30	0,51	0,67	0,82	0,90	0,96	0,99	1,00	1,00
Mya arenaria	0,28	0,50	0,69	0,79	0,91	0,95	0,99	1,00	1,00
Bathyporeia sp.	0,21	0,40	0,53	0,64	0,78	0,86	0,93	0,98	1,00
Sphaeroma sp.	0,20	0,38	0,52	0,66	0,77	0,87	0,92	0,98	1,00
Gammarus salinus	0,11	0,22	0,35	0,42	0,51	0,62	0,75	0,85	0,94
Cyathura carinata	0,10	0,22	0,32	0,40	0,53	0,63	0,74	0,85	0,94
Capitella capitata	0,11	0,20	0,32	0,43	0,52	0,65	0,72	0,84	0,94
Scrobicularia plana	0,10	0,22	0,33	0,41	0,52	0,62	0,74	0,83	0,94
Eurydice pulchra	0,10	0,22	0,33	0,41	0,52	0,62	0,74	0,83	0,94
Eteone sp.	0,10	0,22	0,30	0,41	0,53	0,62	0,73	0,84	0,93

7.-Brackish upper-littoral_Sandy

Brackish upper-littoral_Sandy

PROBABILITY OF PRESENCE
->0.9 0.5>- >0.9 0>->0.5

Name	0.15	0.3	0.45	0.6	0,75	0.9	1.05
Macoma balthica	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Nereis diversicolor	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Pygospio elegans	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Heteromastus filiformis	0,99	1,00	1,00	1,00	1,00	1,00	1,00
OLIGOCHAETA	0,98	1,00	1,00	1,00	1,00	1,00	1,00
Corophium volutator	0,96	1,00	1,00	1,00	1,00	1,00	1,00
Hydrobia ulvae	0,95	1,00	1,00	1,00	1,00	1,00	1,00
Eteone sp.	0,94	1,00	1,00	1,00	1,00	1,00	1,00
Cerastoderma edule	0,82	0,97	1,00	1,00	1,00	1,00	1,00
NEMERTEA	0,75	0,95	0,99	1,00	1,00	1,00	1,00
Nereis succinea	0,70	0,90	0,99	1,00	1,00	1,00	1,00
Bathyporeia sp.	0,63	0,88	0,96	1,00	1,00	1,00	1,00
Polydora sp.	0,63	0,84	0,97	0,99	1,00	1,00	1,00
Corophium arenarium	0,57	0,81	0,94	0,98	1,00	1,00	1,00
Crangon crangon	0,53	0,77	0,90	0,96	1,00	1,00	1,00
Eurydice pulchra	0,46	0,75	0,90	0,97	1,00	1,00	1,00
Mya arenaria	0,50	0,72	0,88	0,95	0,98	1,00	1,00
Manayunkia aestuarina	0,51	0,72	0,85	0,94	0,98	1,00	1,00
Arenicola marina	0,38	0,64	0,76	0,91	0,97	1,00	1,00
Scrobicularia plana	0,36	0,63	0,79	0,91	0,97	1,00	1,00
Corophium sp.	0,42	0,48	0,73	0,84	0,91	0,98	1,00
Bathyporeia pilosa	0,30	0,48	0,64	0,78	0,88	0,94	0,99
Haustorius arenarius	0,27	0,47	0,62	0,79	0,89	0,96	1,00
Ensis sp.	0,22	0,45	0,58	0,81	0,89	0,97	1,00
MYSIDACEA	0,23	0,28	0,45	0,56	0,70	0,80	0,92
Capitella capitata	0,17	0,27	0,41	0,52	0,65	0,79	0,93
Cyathura carinata	0,09	0,25	0,40	0,52	0,66	0,81	0,93
Carcinus maenas	0,09	0,25	0,40	0,52	0,66	0,81	0,93
Petricola pholadiformis	0,10	0,24	0,36	0,54	0,62	0,81	0,95

8.-Marine midlow-littoral[hdyn]

Marine midlow-littoral[hdyn]

PROBABILITY OF PRESENCE
->0.9 0.5>- >0.9 0>->0.5

Name	0.15	0.3	0.45	0.6	0,75	0.9	1.05	1.2	1.35	1.5	1.9	2.25	2.6	3
Macoma balthica	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Heteromastus filiformis	0,98	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Pygospio elegans	0,97	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Aphelochaeta marioni	0,93	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Cerastoderma edule	0,92	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
OLIGOCHAETA	0,90	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Capitella capitata	0,90	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Hydrobia ulvae	0,91	0,98	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Eteone sp.	0,89	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Nephtys hombergii	0,88	0,98	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Scoloplos armiger	0,86	0,98	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Spio sp.	0,85	0,98	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Nereis diversicolor	0,82	0,96	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Crangon crangon	0,78	0,94	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Bathyporeia pilosa	0,73	0,91	0,98	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Nereis succinea	0,68	0,87	0,96	0,98	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Arenicola marina	0,69	0,86	0,95	0,98	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Polydora sp.	0,65	0,87	0,96	0,98	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Bathyporeia sp.	0,62	0,87	0,96	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
NEMERTEA	0,63	0,84	0,93	0,97	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Nephtys cirrosa	0,54	0,79	0,93	0,98	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Eurydice pulchra	0,57	0,79	0,91	0,97	0,98	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Corophium arenarium	0,56	0,78	0,88	0,96	0,98	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Corophium volutator	0,52	0,77	0,89	0,95	0,98	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Bathyporeia sarsi	0,51	0,76	0,88	0,94	0,98	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Carcinus maenas	0,52	0,76	0,86	0,93	0,98	0,98	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Phyllodoce mucosa	0,50	0,75	0,85	0,94	0,97	0,99	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Mya arenaria	0,43	0,67	0,81	0,89	0,94	0,97	0,98	0,99	1,00	1,00	1,00	1,00	1,00	1,00
Scrobicularia plana	0,44	0,67	0,80	0,88	0,93	0,97	0,99	0,99	1,00	1,00	1,00	1,00	1,00	1,00
Haustorius arenarius	0,37	0,58	0,73	0,81	0,89	0,94	0,97	0,98	0,99	0,99	1,00	1,00	1,00	1,00
Scolelepis squamata	0,31	0,49	0,65	0,74	0,82	0,88	0,94	0,95	0,96	0,98	1,00	1,00	1,00	1,00
Lanice conchilega	0,29	0,49	0,62	0,74	0,84	0,88	0,95	0,95	0,97	0,99	1,00	1,00	1,00	1,00
Nereis sp.	0,31	0,49	0,62	0,72	0,82	0,86	0,92	0,95	0,96	0,97	1,00	1,00	1,00	1,00
Retusa obtusa	0,25	0,44	0,57	0,67	0,77	0,82	0,88	0,92	0,95	0,98	1,00	1,00	1,00	1,00
Ophelia rathkei	0,20	0,36	0,48	0,61	0,67	0,76	0,81	0,86	0,91	0,93	0,97	0,99	1,00	1,00
Magelona papillicornis	0,20	0,34	0,47	0,60	0,67	0,75	0,83	0,88	0,90	0,93	0,98	1,00	1,00	1,00
Spiophanes bombyx	0,23	0,34	0,46	0,58	0,68	0,75	0,83	0,86	0,91	0,94	0,98	1,00	1,00	1,00
Nephtys sp.	0,21	0,37	0,47	0,61	0,65	0,74	0,80	0,88	0,90	0,93	0,98	0,99	1,00	1,00
Corophium sp.	0,16	0,28	0,43	0,48	0,58	0,65	0,72	0,79	0,83	0,86	0,93	0,98	1,00	1,00
Ensis sp.	0,14	0,27	0,38	0,49	0,58	0,67	0,71	0,79	0,82	0,88	0,96	0,98	1,00	1,00
Gastrosaccus spinifer	0,15	0,28	0,38	0,47	0,59	0,65	0,72	0,77	0,84	0,86	0,95	0,98	1,00	1,00
Bathyporeia pelagica	0,11	0,20	0,28	0,35	0,45	0,51	0,58	0,65	0,69	0,73	0,85	0,93	0,98	1,00
Petricola pholadiformis	0,12	0,19	0,29	0,37	0,43	0,52	0,58	0,63	0,68	0,74	0,86	0,93	0,97	1,00
Gammarus sp.	0,12	0,21	0,27	0,38	0,45	0,50	0,56	0,63	0,66	0,77	0,86	0,93	0,98	1,00
Ophelia limacina	0,12	0,19	0,28	0,34	0,46	0,49	0,59	0,63	0,71	0,74	0,85	0,92	0,98	1,00
Spisula sp.	0,10	0,17	0,27	0,37	0,43	0,50	0,55	0,63	0,71	0,76	0,87	0,93	0,98	1,00
Tellina tenuis	0,10	0,18	0,26	0,34	0,43	0,50	0,55	0,63	0,68	0,73	0,86	0,93	0,97	1,00
Spisula subtruncata	0,05	0,10	0,15	0,19	0,26	0,30	0,36	0,40	0,44	0,52	0,64	0,73	0,87	0,97
Mysella bidentata	0,06	0,11	0,16	0,19	0,23	0,30	0,34	0,40	0,46	0,50	0,64	0,74	0,85	0,97
Nereis longissima	0,06	0,11	0,16	0,21	0,24	0,31	0,36	0,39	0,43	0,48	0,62	0,74	0,84	0,97
Harmothoe sp.	0,06	0,10	0,15	0,21	0,26	0,29	0,37	0,40	0,48	0,49	0,60	0,74	0,85	0,98
Eumida sp.	0,06	0,10	0,15	0,18	0,26	0,31	0,37	0,39	0,44	0,50	0,62	0,73	0,85	0,98
Autolytus prolifera	0,06	0,10	0,15	0,18	0,26	0,31	0,37	0,39	0,44	0,50	0,62	0,73	0,85	0,98
Microphthalmus similis	0,06	0,10	0,15	0,21	0,25	0,30	0,34	0,40	0,44	0,53	0,63	0,74	0,85	0,98
Ensis arcuatus	0,06	0,12	0,15	0,22	0,25	0,29	0,35	0,36	0,47	0,49	0,62	0,74	0,82	0,98
Littorina littorea	0,06	0,10	0,15	0,19	0,25	0,29	0,34	0,39	0,46	0,51	0,62	0,74	0,85	0,99
Mysta picta	0,05	0,09	0,16	0,20	0,25	0,30	0,36	0,40	0,45	0,50	0,64	0,72	0,84	0,97
Parajassa pelagica	0,06	0,10	0,14	0,19	0,25	0,29	0,36	0,40	0,46	0,48	0,63	0,73	0,84	0,97
Microphthalmus sp.	0,03	0,10	0,15	0,19	0,23	0,29	0,33	0,38	0,44	0,49	0,65	0,75	0,86	1,00
Mytilus edulis	0,03	0,10	0,15	0,19	0,23	0,29	0,33	0,38	0,44	0,49	0,65	0,75	0,86	1,00
Idotea linearis	0,05	0,10	0,16	0,19	0,26	0,30	0,33	0,40	0,43	0,51	0,60	0,72	0,83	0,97
Urothoe poseidonis	0,05	0,10	0,16	0,19	0,26	0,30	0,33	0,40	0,43	0,51	0,60	0,72	0,83	0,97
Paraonis fulgens	0,04	0,10	0,16	0,19	0,24	0,29	0,34	0,40	0,46	0,51	0,60	0,72	0,82	0,98
Nephtys caeca	0,05	0,09	0,12	0,21	0,23	0,29	0,34	0,41	0,44	0,49	0,63	0,73	0,87	1,00
Malacoceros fuliginosus	0,05	0,10	0,14	0,19	0,26	0,29	0,34	0,37	0,41	0,48	0,60	0,73	0,84	0,98
Abra alba	0,04	0,09	0,13	0,19	0,24	0,29	0,33	0,36	0,43	0,47	0,64	0,73	0,86	1,00

9.-Marine midlow-littoral[ldyn]_Muddy

Marine midlow-littoral[ldyn]_Muddy

PROBABILITY OF PRESENCE
->0.9 0.5>- >0.9 -<0.5

Name	0.15	0.3	0.45
Macoma balthica	1,00	1,00	1,00
Aphelochaeta marioni	1,00	1,00	1,00
Cerastoderma edule	1,00	1,00	1,00
Eteone sp.	1,00	1,00	1,00
Heteromastus filiformis	1,00	1,00	1,00
Hydrobia ulvae	1,00	1,00	1,00
Mya arenaria	1,00	1,00	1,00
Nereis diversicolor	1,00	1,00	1,00
Nereis succinea	1,00	1,00	1,00
Scrobicularia plana	1,00	1,00	1,00
Polydora sp.	1,00	1,00	1,00
Pygospio elegans	1,00	1,00	1,00
Arenicola marina	1,00	1,00	1,00
Crangon crangon	0,99	1,00	1,00
Nephtys hombergii	0,99	1,00	1,00
OLIGOCHAETA	0,97	1,00	1,00
Carcinus maenas	0,96	1,00	1,00
Capitella capitata	0,85	1,00	1,00
Retusa obtusa	0,85	0,99	1,00
Corophium volutator	0,76	0,98	1,00
Mysella bidentata	0,76	0,98	1,00
Abra tenuis	0,76	0,98	1,00
Scoloplos armiger	0,69	0,95	1,00
Spisula sp.	0,66	0,94	1,00
Spio sp.	0,64	0,95	1,00
Nereis sp.	0,51	0,83	0,98
Phyllodoce mucosa	0,50	0,84	0,99
Ensis sp.	0,49	0,84	0,99
Nephtys caeca	0,29	0,57	0,90
Manayunkia aestuarina	0,27	0,61	0,88
Corophium sp.	0,27	0,61	0,88
Petricola pholadiformis	0,31	0,57	0,87
Glycera sp.	0,30	0,60	0,84
Cyathura carinata	0,27	0,59	0,88
Gastrosaccus spinifer	0,27	0,59	0,88
Corophium arenarium	0,29	0,57	0,87

10.-Marine midlow-littoral[Idyn]_Sandy

Marine midlow-littoral[Idyn]_Sandy

PROBABILITY OF PRESENCE
->0.9 0.5>- >0.9 -<0.5

Name	0.15	0.3	0.45	0,6	0,75
Nereis diversicolor	1,00	1,00	1,00	1,00	1,00
Aphelochaeta marioni	1,00	1,00	1,00	1,00	1,00
Heteromastus filiformis	1,00	1,00	1,00	1,00	1,00
Hydrobia ulvae	1,00	1,00	1,00	1,00	1,00
Macoma balthica	1,00	1,00	1,00	1,00	1,00
Cerastoderma edule	1,00	1,00	1,00	1,00	1,00
Eteone sp.	1,00	1,00	1,00	1,00	1,00
Pygospio elegans	1,00	1,00	1,00	1,00	1,00
Nereis succinea	1,00	1,00	1,00	1,00	1,00
Arenicola marina	1,00	1,00	1,00	1,00	1,00
OLIGOCHAETA	1,00	1,00	1,00	1,00	1,00
Capitella capitata	1,00	1,00	1,00	1,00	1,00
Mya arenaria	1,00	1,00	1,00	1,00	1,00
Scoloplos armiger	0,99	1,00	1,00	1,00	1,00
Nephtys hombergii	0,98	1,00	1,00	1,00	1,00
Corophium volutator	0,98	1,00	1,00	1,00	1,00
Crangon crangon	0,98	1,00	1,00	1,00	1,00
Polydora sp.	0,98	1,00	1,00	1,00	1,00
NEMERTEA	0,94	1,00	1,00	1,00	1,00
Bathyporeia pilosa	0,89	0,98	1,00	1,00	1,00
Bathyporeia sp.	0,85	0,99	1,00	1,00	1,00
Scrobicularia plana	0,84	0,98	1,00	1,00	1,00
Phyllodoce mucosa	0,81	0,98	1,00	1,00	1,00
Spio sp.	0,78	0,97	1,00	1,00	1,00
Carcinus maenas	0,69	0,93	0,99	1,00	1,00
Corophium arenarium	0,68	0,92	0,99	1,00	1,00
Spiophanes bombyx	0,64	0,90	0,97	1,00	1,00
Scolelepis squamata	0,57	0,83	0,94	1,00	1,00
Corophium sp.	0,53	0,82	0,96	1,00	1,00
Mysella bidentata	0,53	0,84	0,95	0,99	1,00
Retusa obtusa	0,51	0,82	0,96	1,00	1,00
Mytilus edulis	0,45	0,73	0,90	0,97	1,00
Magelona papillicornis	0,44	0,75	0,89	0,97	1,00
Nereis sp.	0,44	0,74	0,90	0,97	1,00
Nephtys cirrosa	0,43	0,72	0,87	0,97	1,00
Glycera sp.	0,43	0,72	0,87	0,96	1,00
Ophelia rathkei	0,33	0,58	0,76	0,91	0,98
Haustorius arenarius	0,30	0,57	0,78	0,91	0,99
Lanice conchilega	0,29	0,55	0,80	0,91	0,98
Ensis sp.	0,31	0,57	0,76	0,90	0,98
Spisula sp.	0,29	0,56	0,77	0,91	0,99
Eurydice pulchra	0,30	0,55	0,77	0,90	0,98
Nereis pelagica	0,16	0,35	0,54	0,68	0,85
Nereis virens	0,17	0,34	0,50	0,70	0,86
Tellina tenuis	0,18	0,33	0,52	0,68	0,86
Manayunkia aestuarina	0,18	0,35	0,51	0,66	0,85
Atylus swammerdami	0,17	0,33	0,53	0,67	0,84
Antinoella sarsi	0,17	0,32	0,51	0,66	0,83
Gastrosaccus spinifer	0,18	0,33	0,47	0,66	0,84

11.-Marine sub-littoral deep

Marine sub-littoral deep

PROBABILITY OF PRESENCE		
->0.9	0.5>- >0.9	0>->0.5

Name	0.15	0.3	0.45	0.6	0,75	0.9	1.05	1.2	1.35	1.5	1.9	2.25	2.6	3
Nephtys cirrosa	0,93	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Heteromastus filiformis	0,91	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Spio sp.	0,81	0,96	0,99	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Gastrosaccus spinifer	0,78	0,92	0,97	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Nephtys hombergii	0,71	0,91	0,96	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
OLIGOCHAETA	0,59	0,87	0,95	0,98	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Macoma balthica	0,56	0,84	0,93	0,97	0,98	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Aphelochaeta marioni	0,51	0,77	0,89	0,93	0,97	0,99	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Capitella capitata	0,47	0,75	0,87	0,94	0,97	0,98	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Scoloplos armiger	0,46	0,74	0,82	0,91	0,96	0,98	0,99	0,99	1,00	1,00	1,00	1,00	1,00	1,00
NEMERTEA	0,38	0,58	0,75	0,84	0,89	0,93	0,94	0,98	0,99	0,99	1,00	1,00	1,00	1,00
Ensis sp.	0,33	0,50	0,72	0,79	0,86	0,91	0,93	0,96	0,98	0,98	1,00	1,00	1,00	1,00
Mytilus edulis	0,31	0,54	0,66	0,76	0,83	0,89	0,90	0,95	0,97	0,98	0,99	1,00	1,00	1,00
Polydora sp.	0,30	0,49	0,64	0,73	0,79	0,86	0,89	0,93	0,96	0,97	0,99	1,00	1,00	1,00
Actiniaria	0,28	0,51	0,63	0,72	0,80	0,86	0,90	0,93	0,95	0,97	0,99	1,00	1,00	1,00
Hydrobia ulvae	0,28	0,47	0,58	0,68	0,75	0,83	0,89	0,91	0,93	0,96	0,98	1,00	1,00	1,00
Crangon crangon	0,24	0,43	0,57	0,69	0,77	0,83	0,89	0,91	0,93	0,96	0,99	0,99	1,00	1,00
Eurydice pulchra	0,23	0,42	0,55	0,67	0,74	0,80	0,84	0,89	0,91	0,94	0,98	0,99	1,00	1,00
Haustorius arenarius	0,25	0,41	0,54	0,67	0,72	0,81	0,83	0,88	0,91	0,94	0,98	0,99	0,99	1,00
Spiophanes bombyx	0,24	0,44	0,52	0,63	0,74	0,80	0,85	0,89	0,91	0,92	0,97	0,99	1,00	1,00
Magelona papillicornis	0,23	0,38	0,53	0,64	0,71	0,80	0,84	0,89	0,92	0,95	0,97	0,99	1,00	1,00
Pygospio elegans	0,19	0,35	0,46	0,59	0,67	0,77	0,82	0,87	0,88	0,91	0,97	0,98	0,99	1,00
Phyllodoce mucosa	0,22	0,41	0,48	0,57	0,66	0,74	0,80	0,83	0,88	0,90	0,96	0,98	0,99	1,00
Abra alba	0,17	0,31	0,45	0,51	0,63	0,71	0,76	0,81	0,84	0,87	0,94	0,96	0,99	0,99
Lanice conchilega	0,18	0,36	0,43	0,53	0,62	0,69	0,74	0,78	0,83	0,87	0,93	0,96	0,98	0,99
Nephtys sp.	0,18	0,32	0,43	0,53	0,62	0,67	0,75	0,81	0,83	0,87	0,94	0,96	0,98	0,99
Nephtys caeca	0,17	0,31	0,41	0,52	0,61	0,69	0,76	0,81	0,84	0,87	0,94	0,97	0,99	0,99
MYSIDACEA	0,14	0,28	0,41	0,50	0,62	0,72	0,77	0,79	0,85	0,89	0,95	0,97	0,99	1,00
Bathyporeia sp.	0,13	0,30	0,39	0,53	0,62	0,70	0,73	0,81	0,84	0,88	0,93	0,97	0,99	1,00
Arenicola marina	0,15	0,29	0,37	0,48	0,56	0,62	0,71	0,75	0,79	0,82	0,89	0,94	0,96	0,99
Microphthalmus sp.	0,13	0,24	0,33	0,42	0,45	0,57	0,60	0,66	0,70	0,75	0,86	0,89	0,94	0,97
Ophelia limacina	0,14	0,24	0,32	0,41	0,46	0,54	0,59	0,65	0,70	0,76	0,85	0,90	0,94	0,97
Petricola pholadiformis	0,12	0,24	0,33	0,40	0,47	0,54	0,58	0,68	0,70	0,78	0,83	0,89	0,92	0,97
Eteone sp.	0,11	0,25	0,31	0,40	0,49	0,52	0,61	0,65	0,70	0,74	0,83	0,89	0,94	0,98
Nephtys longosetosa	0,08	0,19	0,29	0,39	0,47	0,51	0,62	0,65	0,71	0,76	0,84	0,92	0,94	0,97
CAPRELLIDAE	0,09	0,19	0,25	0,32	0,40	0,46	0,50	0,56	0,61	0,67	0,75	0,81	0,87	0,92
Corophium acherusicum	0,09	0,19	0,25	0,32	0,40	0,46	0,50	0,56	0,61	0,67	0,75	0,81	0,87	0,92
Abludomelita obtusata	0,09	0,19	0,25	0,32	0,40	0,46	0,50	0,56	0,61	0,67	0,75	0,81	0,87	0,92
Harmothoe impar	0,09	0,19	0,26	0,31	0,38	0,47	0,49	0,55	0,61	0,69	0,75	0,81	0,87	0,93
Spisula subtruncata	0,10	0,19	0,26	0,30	0,40	0,44	0,51	0,56	0,59	0,64	0,75	0,82	0,87	0,92
Eumida sp.	0,09	0,20	0,25	0,31	0,41	0,44	0,50	0,52	0,60	0,63	0,76	0,81	0,87	0,93
Nereis succinea	0,10	0,20	0,25	0,31	0,38	0,44	0,49	0,56	0,60	0,67	0,74	0,82	0,87	0,91
Microphthalmus fragilis	0,10	0,16	0,26	0,32	0,35	0,42	0,50	0,54	0,62	0,67	0,76	0,82	0,88	0,94
Pontocrates altamarinus	0,10	0,15	0,23	0,33	0,35	0,42	0,51	0,56	0,61	0,65	0,77	0,80	0,89	0,94
Microphthalmus similis	0,09	0,17	0,27	0,32	0,37	0,45	0,49	0,54	0,60	0,64	0,76	0,82	0,86	0,94
Gattyana cirrosa	0,10	0,20	0,25	0,32	0,38	0,42	0,50	0,53	0,60	0,63	0,75	0,80	0,88	0,93
Parajassa pelagica	0,07	0,14	0,18	0,25	0,27	0,34	0,36	0,40	0,46	0,51	0,62	0,66	0,76	0,83
Sthenelais boa	0,06	0,12	0,18	0,22	0,29	0,34	0,37	0,41	0,47	0,52	0,61	0,67	0,73	0,82
Neoamphitrite figulus	0,06	0,12	0,18	0,22	0,29	0,34	0,37	0,41	0,47	0,52	0,61	0,67	0,73	0,82
Asterias rubens	0,06	0,12	0,18	0,22	0,29	0,34	0,37	0,41	0,47	0,52	0,61	0,67	0,73	0,82
Autolytus langerhansi	0,06	0,12	0,18	0,22	0,29	0,34	0,37	0,41	0,47	0,52	0,61	0,67	0,73	0,82
Nymphon rubrum	0,06	0,13	0,17	0,24	0,30	0,33	0,37	0,42	0,46	0,52	0,59	0,67	0,75	0,81
Parapleustes assimilis	0,06	0,12	0,19	0,24	0,29	0,32	0,35	0,43	0,45	0,50	0,60	0,69	0,74	0,84
Gammarus sp.	0,06	0,11	0,17	0,23	0,27	0,33	0,35	0,41	0,48	0,53	0,60	0,68	0,73	0,83
Stenothoe marina	0,05	0,12	0,16	0,20	0,28	0,33	0,37	0,39	0,48	0,53	0,62	0,69	0,75	0,83
Scolelepis squamata	0,05	0,14	0,18	0,22	0,27	0,33	0,38	0,44	0,47	0,50	0,59	0,68	0,75	0,83
Mysella bidentata	0,05	0,13	0,17	0,24	0,27	0,31	0,38	0,40	0,47	0,49	0,60	0,68	0,75	0,84
Neomysis integer	0,07	0,12	0,15	0,23	0,27	0,33	0,37	0,41	0,44	0,51	0,58	0,69	0,76	0,83
Nereis longissima	0,07	0,14	0,16	0,22	0,27	0,31	0,37	0,39	0,46	0,48	0,60	0,69	0,78	0,83
Cerastoderma edule	0,05	0,13	0,17	0,21	0,27	0,32	0,37	0,40	0,44	0,50	0,59	0,70	0,77	0,83
Aricidea minuta	0,04	0,07	0,09	0,11	0,15	0,17	0,24	0,24	0,27	0,30	0,36	0,43	0,49	0,61
Harmothoe imbricata	0,04	0,07	0,09	0,13	0,15	0,17	0,22	0,24	0,25	0,31	0,38	0,45	0,47	0,60
Schistomysis kervillei	0,04	0,07	0,09	0,13	0,15	0,17	0,22	0,24	0,25	0,31	0,38	0,45	0,47	0,60
Nereis diversicolor	0,03	0,06	0,11	0,13	0,15	0,18	0,19	0,26	0,25	0,27	0,37	0,46	0,51	0,61
Autolytus sp.	0,03	0,06	0,11	0,13	0,15	0,18	0,19	0,26	0,25	0,27	0,37	0,46	0,51	0,61
Crepidula fornicata	0,03	0,08	0,09	0,12	0,14	0,19	0,20	0,24	0,27	0,32	0,36	0,43	0,49	0,58
Pycnogonum littorale	0,03	0,06	0,09	0,13	0,17	0,18	0,20	0,23	0,26	0,31	0,37	0,42	0,49	0,59
Pholoe inornata	0,03	0,06	0,09	0,13	0,17	0,18	0,20	0,23	0,26	0,31	0,37	0,42	0,49	0,59
Anoplodactylus petiolatus	0,03	0,06	0,09	0,13	0,17	0,18	0,20	0,23	0,26	0,31	0,37	0,42	0,49	0,59
Carcinus maenas	0,03	0,06	0,09	0,13	0,17	0,18	0,20	0,23	0,26	0,31	0,37	0,42	0,49	0,59
Achelia echinata	0,03	0,06	0,09	0,13	0,17	0,18	0,20	0,23	0,26	0,31	0,37	0,42	0,49	0,59
ASCIDIACEA	0,03	0,06	0,09	0,13	0,17	0,18	0,20	0,23	0,26	0,31	0,37	0,42	0,49	0,59
Venerupis senegalensis	0,03	0,06	0,09	0,13	0,17	0,18	0,20	0,23	0,26	0,31	0,37	0,42	0,49	0,59
Notomastus latericeus	0,03	0,06	0,09	0,13	0,17	0,18	0,20	0,23	0,26	0,31	0,37	0,42	0,49	0,59
Ophiothrix fragilis	0,03	0,06	0,09	0,13	0,17	0,18	0,20	0,23	0,26	0,31	0,37	0,42	0,49	0,59
Paraonis fulgens	0,04	0,06	0,08	0,12	0,14	0,19	0,20	0,22	0,28	0,27	0,35	0,44	0,52	0,58
Ensis arcuatus	0,03	0,08	0,09	0,12	0,15	0,17	0,22	0,21	0,26	0,28	0,36	0,45	0,51	0,58
Tellina tenuis	0,03	0,06	0,10	0,11	0,16	0,19	0,21	0,26	0,25	0,28	0,37	0,44	0,50	0,56
Streblospio shrubsolii	0,03	0,06	0,09	0,12	0,13	0,16	0,20	0,24	0,27	0,31	0,36	0,46	0,50	0,59
Harmothoe sp.	0,04	0,05	0,09	0,12	0,14	0,17	0,21	0,25	0,26	0,29	0,39	0,40	0,50	0,60
Schistomysis spiritus	0,04	0,06	0,09	0,12	0,15	0,16	0,21	0,24	0,27	0,31	0,35	0,43	0,52	0,52
Ophelia borealis	0,04	0,06	0,08	0,10	0,13	0,19	0,21	0,22	0,24	0,31	0,38	0,46	0,51	0,59
Scolelepis foliosa	0,02	0,06	0,08	0,12	0,14	0,14	0,21	0,22	0,26	0,30	0,35	0,46	0,53	0,60
Portumnus latipes	0,04	0,04	0,09	0,12	0,14	0,17	0,21	0,22	0,26	0,28	0,36	0,42	0,53	0,57
Barnea candida	0,03	0,07	0,11	0,14	0,15	0,16	0,20	0,22	0,24	0,31	0,35	0,43	0,48	0,58
Mya arenaria	0,03	0,07	0,09	0,10	0,15	0,17	0,20	0,21	0,25	0,27	0,38	0,41	0,50	0,61
Urothoe brevicornis	0,03	0,08	0,09	0,12	0,13	0,17	0,20	0,25	0,26	0,29	0,34	0,44	0,49	0,57
Corophium volutator	0,02	0,05	0,07	0,10	0,14	0,18	0,20	0,23	0,26	0,28	0,37	0,43	0,46	0,54

12.-Marine sub-littoral shallow

Marine sub-littoral shallow

PROBABILITY OF PRESENCE
->0.9 | 0.5>- >0.9 | 0>->0.5

Name	0.15	0.3	0.45	0.6	0,75	0.9	1.05	1.2	1.35	1.5	1.9	2.25	2.6	3
Spio sp.	0,97	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Heteromastus filiformis	0,94	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Nephtys cirrosa	0,92	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Aphelochaeta marioni	0,80	0,96	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Nephtys hombergii	0,76	0,95	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
OLIGOCHAETA	0,71	0,93	0,98	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Macoma balthica	0,73	0,90	0,98	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Capitella capitata	0,70	0,91	0,98	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Scoloplos armiger	0,64	0,87	0,95	0,98	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Gastrosaccus spinifer	0,54	0,82	0,93	0,97	0,99	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Pygospio elegans	0,51	0,76	0,89	0,94	0,98	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Spiophanes bombyx	0,49	0,75	0,85	0,93	0,96	0,98	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Crangon crangon	0,49	0,71	0,85	0,92	0,96	0,99	0,99	0,99	1,00	1,00	1,00	1,00	1,00	1,00
Magelona papillicornis	0,46	0,71	0,87	0,91	0,95	0,98	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Ensis sp.	0,44	0,69	0,84	0,91	0,95	0,98	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Eurydice pulchra	0,38	0,64	0,83	0,88	0,95	0,97	0,98	0,99	1,00	1,00	1,00	1,00	1,00	1,00
Eteone sp.	0,37	0,60	0,76	0,85	0,92	0,95	0,96	0,99	0,99	0,99	1,00	1,00	1,00	1,00
Spisula subtruncata	0,36	0,59	0,72	0,82	0,90	0,93	0,96	0,98	0,99	0,99	1,00	1,00	1,00	1,00
Nephtys sp.	0,29	0,54	0,68	0,80	0,85	0,90	0,93	0,96	0,98	0,99	1,00	1,00	1,00	1,00
Cerastoderma edule	0,32	0,53	0,68	0,75	0,86	0,90	0,92	0,96	0,99	0,98	1,00	1,00	1,00	1,00
NEMERTEA	0,30	0,54	0,69	0,75	0,85	0,91	0,92	0,96	0,99	0,99	1,00	1,00	1,00	1,00
Polydora sp.	0,30	0,54	0,67	0,76	0,86	0,90	0,94	0,97	0,97	0,98	1,00	1,00	1,00	1,00
Hydrobia ulvae	0,30	0,50	0,69	0,74	0,83	0,88	0,90	0,95	0,97	0,98	1,00	1,00	1,00	1,00
Arenicola marina	0,28	0,47	0,63	0,76	0,84	0,88	0,93	0,95	0,97	0,98	1,00	1,00	1,00	1,00
Phyllodoce mucosa	0,26	0,46	0,62	0,71	0,80	0,85	0,90	0,94	0,96	0,97	0,99	1,00	1,00	1,00
Nereis diversicolor	0,25	0,42	0,60	0,68	0,76	0,82	0,83	0,91	0,94	0,95	0,98	1,00	1,00	1,00
Ensis arcuatus	0,25	0,41	0,57	0,67	0,76	0,81	0,86	0,91	0,92	0,96	0,98	0,99	1,00	1,00
Haustorius arenarius	0,22	0,39	0,52	0,61	0,72	0,78	0,84	0,85	0,91	0,94	0,98	0,99	1,00	1,00
Lanice conchilega	0,20	0,41	0,52	0,62	0,71	0,79	0,82	0,87	0,89	0,93	0,97	0,99	1,00	1,00
Paraonis fulgens	0,20	0,36	0,44	0,55	0,65	0,72	0,79	0,83	0,87	0,87	0,95	0,98	0,99	1,00
Scrobicularia plana	0,17	0,35	0,46	0,56	0,65	0,74	0,75	0,82	0,87	0,90	0,95	0,97	0,99	1,00
Bathyporeia pilosa	0,20	0,32	0,45	0,57	0,65	0,71	0,78	0,81	0,87	0,89	0,95	0,98	0,99	1,00
Bathyporeia sp.	0,14	0,27	0,40	0,53	0,59	0,65	0,72	0,76	0,83	0,86	0,92	0,96	0,98	0,99
Mesopodopsis slabberi	0,16	0,29	0,40	0,48	0,57	0,64	0,72	0,76	0,81	0,84	0,93	0,96	0,98	0,99
Tellina tenuis	0,12	0,24	0,35	0,41	0,51	0,60	0,63	0,70	0,74	0,79	0,87	0,94	0,96	0,98
Scolelepis squamata	0,12	0,23	0,35	0,45	0,50	0,58	0,65	0,68	0,74	0,76	0,88	0,93	0,96	0,98
Eumida sp.	0,12	0,26	0,34	0,43	0,51	0,59	0,60	0,71	0,73	0,78	0,87	0,93	0,94	0,98
Actiniaria	0,12	0,26	0,34	0,42	0,50	0,58	0,61	0,71	0,73	0,76	0,86	0,92	0,96	0,99
Mysella bidentata	0,14	0,24	0,38	0,43	0,49	0,57	0,62	0,68	0,74	0,75	0,87	0,92	0,97	0,99
Nereis succinea	0,12	0,23	0,34	0,42	0,51	0,57	0,62	0,71	0,74	0,76	0,89	0,93	0,95	0,98
Corophium arenarium	0,13	0,22	0,36	0,43	0,49	0,56	0,64	0,70	0,74	0,76	0,89	0,94	0,97	0,98
Mya arenaria	0,09	0,19	0,28	0,34	0,40	0,46	0,53	0,59	0,66	0,69	0,78	0,85	0,92	0,94
Tellina sp.	0,09	0,19	0,26	0,35	0,41	0,46	0,54	0,57	0,63	0,71	0,79	0,86	0,91	0,96
Mytilus edulis	0,11	0,18	0,25	0,34	0,41	0,48	0,52	0,61	0,62	0,69	0,80	0,84	0,91	0,95
Gammarus sp.	0,09	0,18	0,25	0,35	0,39	0,47	0,54	0,59	0,62	0,69	0,81	0,84	0,91	0,94
Glycera sp.	0,08	0,18	0,26	0,33	0,42	0,47	0,52	0,60	0,64	0,66	0,75	0,86	0,90	0,95
Asterias rubens	0,08	0,17	0,25	0,32	0,42	0,46	0,52	0,58	0,62	0,69	0,77	0,85	0,92	0,95
Carcinus maenas	0,09	0,19	0,24	0,32	0,41	0,45	0,53	0,59	0,63	0,69	0,77	0,86	0,90	0,95
Nereis sp.	0,09	0,15	0,27	0,34	0,40	0,44	0,51	0,56	0,62	0,67	0,80	0,86	0,92	0,95
Parajassa pelagica	0,06	0,14	0,18	0,25	0,28	0,36	0,38	0,45	0,50	0,52	0,65	0,72	0,81	0,86
Ophelia limacina	0,06	0,15	0,18	0,25	0,29	0,35	0,41	0,46	0,49	0,50	0,64	0,74	0,81	0,88
Streblospio shrubsolii	0,06	0,14	0,18	0,23	0,28	0,36	0,40	0,45	0,49	0,54	0,63	0,72	0,79	0,88
MYSIDACEA	0,06	0,12	0,20	0,25	0,31	0,33	0,38	0,44	0,49	0,55	0,66	0,72	0,79	0,87
Corophium acherusicum	0,06	0,13	0,17	0,23	0,31	0,35	0,36	0,48	0,48	0,52	0,66	0,73	0,78	0,88
Bathyporeia sarsi	0,06	0,14	0,20	0,26	0,30	0,34	0,36	0,42	0,50	0,52	0,66	0,72	0,81	0,86
Parapleustes assimilis	0,06	0,13	0,18	0,23	0,31	0,35	0,38	0,44	0,48	0,53	0,64	0,73	0,79	0,85
Crepidula fornicata	0,07	0,14	0,18	0,23	0,30	0,34	0,39	0,46	0,47	0,53	0,62	0,73	0,79	0,86
Nephtys longosetosa	0,06	0,10	0,18	0,26	0,27	0,33	0,39	0,45	0,50	0,55	0,64	0,73	0,80	0,86
Microphthalmus similis	0,06	0,11	0,16	0,23	0,30	0,32	0,40	0,44	0,48	0,53	0,63	0,72	0,79	0,87
Lepidonotus squamatus	0,06	0,11	0,15	0,21	0,30	0,32	0,39	0,44	0,47	0,53	0,64	0,73	0,79	0,87
Microphthalmus fragilis	0,03	0,08	0,10	0,13	0,16	0,19	0,21	0,28	0,29	0,29	0,41	0,48	0,57	0,64
Harmothoe lunulata	0,03	0,08	0,09	0,12	0,16	0,21	0,23	0,27	0,28	0,34	0,38	0,47	0,55	0,63
Nereis longissima	0,03	0,07	0,09	0,14	0,17	0,19	0,20	0,27	0,29	0,30	0,42	0,47	0,55	0,66
Corophium sp.	0,03	0,07	0,09	0,14	0,17	0,19	0,20	0,27	0,29	0,30	0,42	0,47	0,55	0,66
Corophium bonnellii	0,03	0,07	0,09	0,14	0,17	0,19	0,20	0,27	0,29	0,30	0,42	0,47	0,55	0,66
Magelona mirabilis	0,03	0,08	0,09	0,12	0,17	0,20	0,24	0,25	0,28	0,30	0,38	0,47	0,56	0,62
Urothoe poseidonis	0,04	0,07	0,11	0,14	0,16	0,19	0,19	0,24	0,27	0,31	0,43	0,48	0,57	0,63
Petricola pholadiformis	0,03	0,07	0,11	0,12	0,15	0,20	0,22	0,26	0,28	0,32	0,37	0,49	0,56	0,64
Bodotria pulchella	0,03	0,07	0,09	0,14	0,16	0,18	0,22	0,26	0,29	0,33	0,40	0,47	0,57	0,63
Corophium volutator	0,03	0,07	0,10	0,13	0,17	0,20	0,23	0,28	0,28	0,29	0,43	0,46	0,55	0,62
Ophiura sp.	0,03	0,06	0,11	0,12	0,17	0,19	0,22	0,26	0,30	0,32	0,39	0,47	0,54	0,64
Harmothoe impar	0,04	0,07	0,09	0,11	0,17	0,19	0,21	0,27	0,26	0,32	0,40	0,49	0,53	0,63
Autolytus langerhansi	0,04	0,07	0,09	0,11	0,17	0,19	0,21	0,27	0,26	0,32	0,40	0,49	0,53	0,63
Eulalia viridis	0,04	0,07	0,09	0,11	0,17	0,19	0,21	0,27	0,26	0,32	0,40	0,49	0,53	0,63
Neoamphitrite figulus	0,04	0,07	0,09	0,11	0,17	0,19	0,21	0,27	0,26	0,32	0,40	0,49	0,53	0,63
Sthenelais boa	0,04	0,07	0,09	0,11	0,17	0,19	0,21	0,27	0,26	0,32	0,40	0,49	0,53	0,63
Pseudopolydora pulchra	0,04	0,07	0,09	0,11	0,17	0,19	0,21	0,27	0,26	0,32	0,40	0,49	0,53	0,63
Crassostrea angulata	0,04	0,07	0,09	0,11	0,17	0,19	0,21	0,27	0,26	0,32	0,40	0,49	0,53	0,63
Bathyporeia pelagica	0,04	0,06	0,09	0,12	0,16	0,19	0,24	0,24	0,28	0,32	0,41	0,48	0,54	0,63
Glycera tridactyla	0,04	0,05	0,13	0,13	0,15	0,18	0,21	0,24	0,27	0,27	0,42	0,49	0,57	0,62
Autolytus prolifera	0,02	0,07	0,09	0,14	0,16	0,18	0,22	0,24	0,28	0,31	0,41	0,48	0,54	0,63
Urothoe sp.	0,03	0,05	0,09	0,13	0,15	0,18	0,23	0,25	0,25	0,33	0,41	0,47	0,53	0,65
Schistomysis spiritus	0,04	0,05	0,10	0,12	0,15	0,21	0,20	0,25	0,28	0,31	0,38	0,46	0,56	0,62
Nephtys caeca	0,03	0,06	0,10	0,12	0,15	0,19	0,20	0,26	0,26	0,29	0,40	0,48	0,53	0,66

13.-Marine upper-littoral

Marine upper-littoral

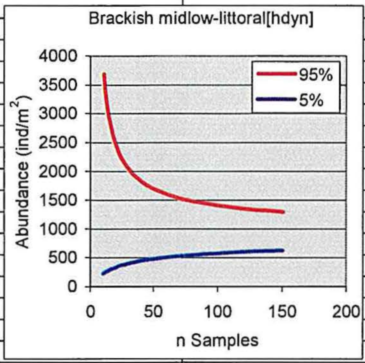
PROBABILITY OF PRESENCE
->0.9 0.5>- >0.9 0>->0.5

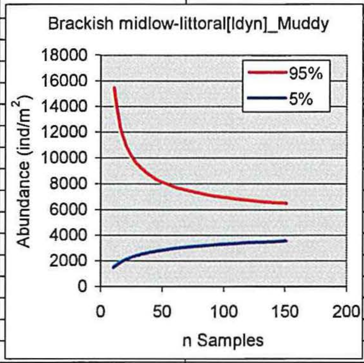
Name	0.15	0.3	0.45	0.6	0,75	0.9	1.05	1.2
Hydrobia ulvae	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Macoma balthica	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
OLIGOCHAETA	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Cerastoderma edule	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Nereis diversicolor	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Eteone sp.	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Corophium arenarium	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Heteromastus filiformis	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Pygospio elegans	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Bathyporeia pilosa	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Scrobicularia plana	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Arenicola marina	0,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Nephtys hombergii	0,98	1,00	1,00	1,00	1,00	1,00	1,00	1,00
NEMERTEA	0,97	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Crangon crangon	0,96	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Aphelochaeta marioni	0,93	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Capitella capitata	0,92	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Polydora sp.	0,84	0,98	1,00	1,00	1,00	1,00	1,00	1,00
Corophium volutator	0,83	0,99	1,00	1,00	1,00	1,00	1,00	1,00
Carcinus maenas	0,84	0,98	1,00	1,00	1,00	1,00	1,00	1,00
Scoloplos armiger	0,78	0,96	0,99	1,00	1,00	1,00	1,00	1,00
Mya arenaria	0,76	0,96	1,00	1,00	1,00	1,00	1,00	1,00
Bathyporeia sp.	0,78	0,94	0,98	1,00	1,00	1,00	1,00	1,00
Nereis sp.	0,74	0,94	0,99	1,00	1,00	1,00	1,00	1,00
Eurydice pulchra	0,69	0,92	0,99	1,00	1,00	1,00	1,00	1,00
Corophium sp.	0,64	0,88	0,98	1,00	1,00	1,00	1,00	1,00
Nereis succinea	0,63	0,88	0,98	1,00	1,00	1,00	1,00	1,00
Bathyporeia sarsi	0,59	0,85	0,96	1,00	1,00	1,00	1,00	1,00
Scolelepis squamata	0,53	0,78	0,91	0,97	1,00	1,00	1,00	1,00
Spio sp.	0,46	0,68	0,87	0,94	0,99	1,00	1,00	1,00
Tellina sp.	0,42	0,69	0,87	0,94	0,99	1,00	1,00	1,00
Malacoceros fuliginosus	0,40	0,69	0,87	0,95	0,99	1,00	1,00	1,00
Malacoceros sp.	0,40	0,67	0,87	0,95	0,98	1,00	1,00	1,00
Mysella bidentata	0,38	0,69	0,86	0,96	0,99	1,00	1,00	1,00
Abra alba	0,36	0,61	0,77	0,88	0,96	0,99	1,00	1,00
Phyllodoce mucosa	0,38	0,60	0,75	0,89	0,96	0,99	1,00	1,00
Abra tenuis	0,32	0,55	0,77	0,88	0,96	0,99	1,00	1,00
Nephtys cirrosa	0,26	0,44	0,65	0,78	0,87	0,95	0,98	1,00
Nephtys sp.	0,23	0,46	0,65	0,77	0,87	0,94	0,99	1,00
Ensis sp.	0,24	0,45	0,61	0,76	0,86	0,95	0,99	1,00
Petricola pholadiformis	0,25	0,44	0,59	0,78	0,86	0,95	0,99	1,00
Spiophanes bombyx	0,14	0,26	0,38	0,50	0,64	0,80	0,88	1,00
Glycera tridactyla	0,13	0,25	0,40	0,51	0,63	0,77	0,87	1,00
Haustorius arenarius	0,15	0,26	0,37	0,52	0,61	0,79	0,88	1,00
Manayunkia aestuarina	0,10	0,29	0,38	0,51	0,64	0,76	0,87	1,00
Streblospio shrubsolii	0,12	0,23	0,37	0,51	0,64	0,78	0,88	1,00
Spisula subtruncata	0,15	0,24	0,38	0,49	0,64	0,76	0,88	1,00
Glycera sp.	0,14	0,25	0,39	0,50	0,63	0,74	0,88	1,00
Retusa obtusa	0,11	0,25	0,37	0,50	0,63	0,79	0,88	1,00
Lepidochitona sp.	0,13	0,28	0,37	0,51	0,61	0,76	0,88	1,00
Cyathura carinata	0,13	0,24	0,38	0,49	0,62	0,75	0,88	1,00

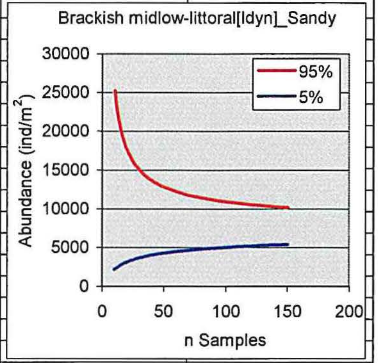
Overview of the total macrofauna densities measured in the 13 ecotopes from our MEP dataset

On the following spreadsheets the 5% confidence interval (where 95% of the observations are found) are plotted for increasing number of samples from 10 tot 150. This interval is calculated by adding the value ($\pm$ 1.96 $\sigma/\sqrt{n}$) to the average where σ is the samples standard deviation and n the number of samples. The average, standard deviation and number of samples are given below the graphs. The series used in the graphics are also presented in the lower part of these spreadsheets.

1-3.-Brackish midlow-littoral

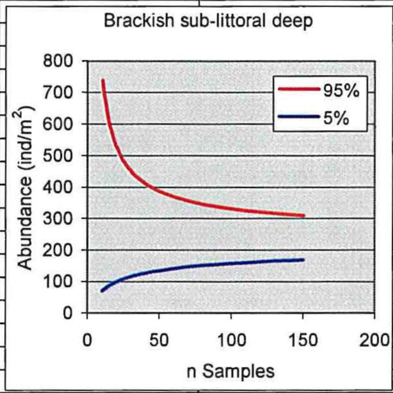


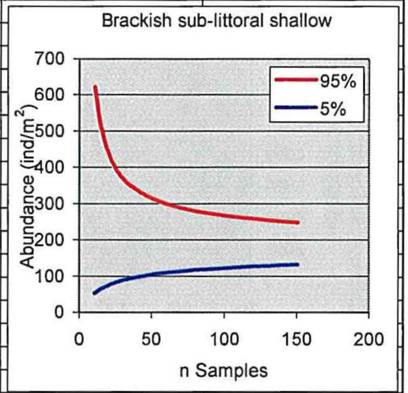




	1			2			3	
	Brackish midlow-littoral[hdyn]			Brackish midlow-littoral[ldyn]_Muddy			Brackish midlow-littoral[ldyn]_Sandy	
avg	6,803229661		avg	8,471937436		avg	8,909020605	
std	2,270423041		std	1,89112372		std	1,976655158	
n	157		n	36		n	69	
	1			**2**			**3**	
	5%	95%		5%	95%		5%	95%
	ECO01-	ECO01+		ECO02-	ECO02+		ECO03-	ECO03+
10	221	3679	10	1480	15430	10	2173	25189
11	235	3446	11	1563	14611	11	2301	23793
12	249	3255	12	1639	13932	12	2418	22639
13	262	3095	13	1709	13359	13	2526	21667
14	274	2959	14	1775	12869	14	2627	20836
15	285	2842	15	1835	12444	15	2721	20118
16	296	2740	16	1892	12071	16	2809	19489
17	306	2651	17	1945	11742	17	2891	18933
18	316	2571	18	1995	11448	18	2969	18438
19	325	2500	19	2042	11185	19	3042	17995
20	333	2436	20	2086	10946	20	3111	17594
21	341	2379	21	2128	10730	21	3177	17231
22	349	2326	22	2168	10532	22	3239	16899
23	356	2278	23	2206	10351	23	3298	16595
24	363	2234	24	2242	10184	24	3355	16315
25	370	2193	25	2277	10029	25	3409	16057
26	376	2156	26	2310	9886	26	3461	15817
27	383	2121	27	2342	9752	27	3510	15594
28	388	2089	28	2372	9628	28	3558	15386
29	394	2058	29	2401	9511	29	3603	15191
30	400	2030	30	2429	9402	30	3647	15008
31	405	2003	31	2456	9299	31	3689	14837
32	410	1978	32	2482	9202	32	3730	14675
33	415	1954	33	2507	9110	33	3769	14522
34	420	1932	34	2531	9024	34	3807	14378
35	425	1911	35	2554	8942	35	3844	14241
36	429	1891	36	2576	8864	36	3879	14111
37	433	1872	37	2598	8789	37	3913	13988
38	438	1854	38	2619	8719	38	3946	13870
39	442	1837	39	2640	8651	39	3978	13758
40	446	1820	40	2659	8587	40	4010	13651
41	450	1805	41	2679	8525	41	4040	13549
42	453	1790	42	2697	8467	42	4069	13451
43	457	1776	43	2715	8410	43	4098	13358
44	461	1762	44	2733	8356	44	4126	13268
45	464	1749	45	2750	8304	45	4153	13181
46	467	1736	46	2767	8254	46	4179	13098
47	471	1724	47	2783	8206	47	4204	13019
48	474	1712	48	2799	8160	48	4229	12942
49	477	1701	49	2814	8115	49	4254	12868
50	480	1690	50	2829	8072	50	4277	12796
60	507	1600	60	2961	7711	60	4487	12200
70	529	1533	70	3068	7442	70	4656	11756
80	548	1481	80	3157	7233	80	4798	11409
90	563	1440	90	3233	7063	90	4918	11130
100	577	1406	100	3299	6923	100	5022	10899
110	589	1377	110	3356	6805	110	5113	10704
120	600	1352	120	3407	6703	120	5194	10537
130	610	1331	130	3452	6615	130	5267	10392
140	618	1312	140	3494	6537	140	5333	10265
150	626	1295	150	3531	6468	150	5392	10151

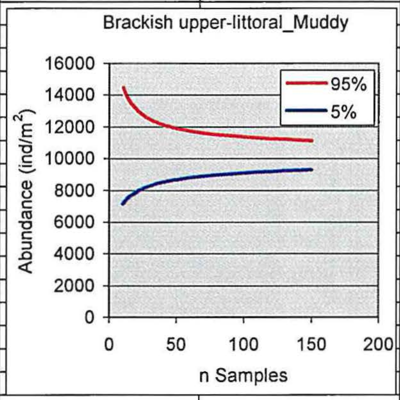
4-5.- Brackish sub-littoral

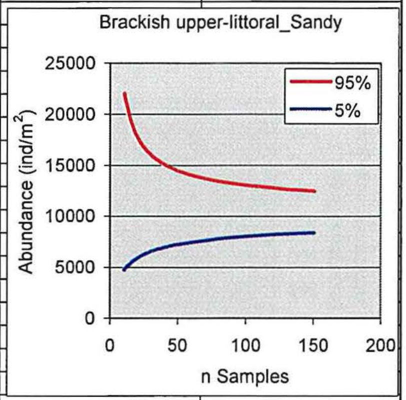




	4			5	
	Brackish sub-littoral deep			Brackish sub-littoral shallow	
avg	5,427996148		avg	5,195177949	
std	1,894874494		std	1,994165247	
n	265		n	182	
	4			**5**	
	5%	95%		5%	95%
	ECO04-	ECO04+		ECO05-	ECO05+
10	70	737	10	52	621
11	74	698	11	56	586
12	78	665	12	58	558
13	81	638	13	61	533
14	84	614	14	63	513
15	87	594	15	66	495
16	90	576	16	68	479
17	93	560	17	70	466
18	95	546	18	72	453
19	97	534	19	74	442
20	99	522	20	75	432
21	101	512	21	77	423
22	103	503	22	78	415
23	105	494	23	80	408
24	107	486	24	81	401
25	108	479	25	83	394
26	110	472	26	84	388
27	111	465	27	85	383
28	113	459	28	86	378
29	114	454	29	87	373
30	116	449	30	88	368
31	117	444	31	89	364
32	118	439	32	90	360
33	119	435	33	91	356
34	120	430	34	92	353
35	122	427	35	93	349
36	123	423	36	94	346
37	124	419	37	95	343
38	125	416	38	96	340
39	126	413	39	96	337
40	127	410	40	97	335
41	127	407	41	98	332
42	128	404	42	99	330
43	129	401	43	99	327
44	130	399	44	100	325
45	131	396	45	101	323
46	132	394	46	101	321
47	132	391	47	102	319
48	133	389	48	103	317
49	134	387	49	103	315
50	135	385	50	104	314
60	141	368	60	109	299
70	146	355	70	113	288
80	150	345	80	117	279
90	154	337	90	119	272
100	157	330	100	122	267
110	160	324	110	124	262
120	162	320	120	126	258
130	164	315	130	128	254
140	166	312	140	130	251
150	168	308	150	131	248

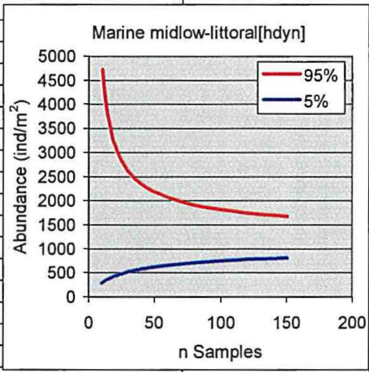
6-7.-Brackish upper-littoral

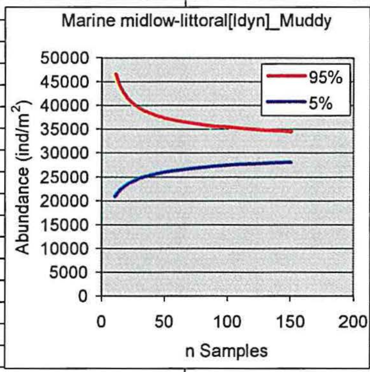


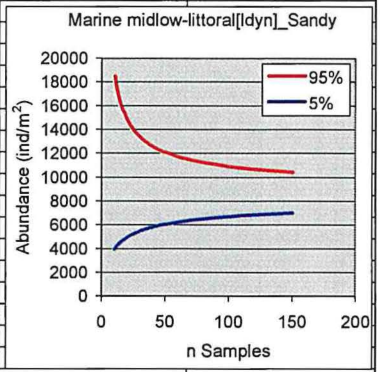


	6			7	
	Brackish upper-littoral_Muddy			Brackish upper-littoral_Sandy	
avg	9,225456158		avg	9,23217265	
std	0,569684739		std	1,24108521	
n	60		n	28	
	6			**7**	
	5%	95%		5%	95%
	ECO06-	ECO06+		ECO07-	ECO07+
10	7132	14451	10	4736	22057
11	7250	14216	11	4909	21282
12	7355	14014	12	5064	20628
13	7449	13838	13	5206	20067
14	7533	13683	14	5335	19581
15	7610	13545	15	5454	19154
16	7680	13421	16	5564	18775
17	7744	13310	17	5666	18438
18	7803	13209	18	5761	18134
19	7858	13116	19	5850	17858
20	7909	13032	20	5933	17608
21	7957	12953	21	6011	17379
22	8002	12881	22	6085	17168
23	8044	12814	23	6155	16973
24	8083	12751	24	6221	16793
25	8120	12693	25	6283	16625
26	8156	12638	26	6343	16469
27	8189	12586	27	6400	16323
28	8221	12537	28	6454	16186
29	8251	12491	29	6506	16057
30	8280	12448	30	6555	15935
31	8307	12407	31	6603	15821
32	8334	12368	32	6649	15712
33	8359	12330	33	6692	15609
34	8383	12295	34	6734	15512
35	8406	12261	35	6775	15419
36	8428	12229	36	6814	15330
37	8450	12198	37	6852	15246
38	8470	12168	38	6888	15166
39	8490	12140	39	6923	15089
40	8509	12113	40	6957	15015
41	8528	12086	41	6990	14944
42	8546	12061	42	7022	14876
43	8563	12037	43	7053	14811
44	8579	12014	44	7083	14748
45	8596	11991	45	7112	14688
46	8611	11969	46	7140	14630
47	8626	11948	47	7168	14574
48	8641	11928	48	7194	14520
49	8655	11908	49	7220	14468
50	8669	11889	50	7246	14417
60	8789	11726	60	7466	13992
70	8884	11602	70	7642	13669
80	8961	11502	80	7787	13415
90	9025	11420	90	7909	13208
100	9080	11352	100	8014	13035
110	9127	11293	110	8105	12889
120	9168	11242	120	8185	12762
130	9205	11197	130	8257	12651
140	9238	11157	140	8321	12554
150	9268	11121	150	8380	12466

8-10.-Marine midlow-littoral

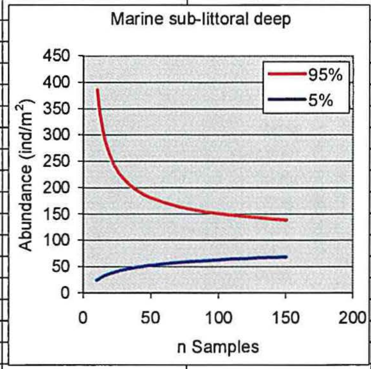


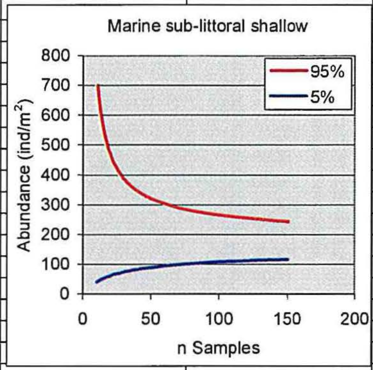


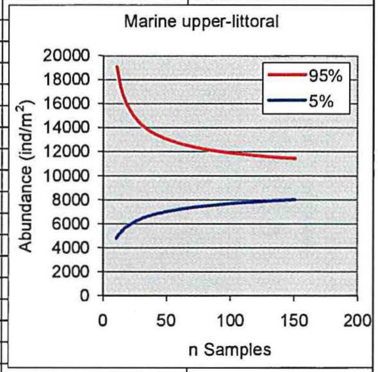


	8			9			10	
	Marine midlow-littoral[hdyn]			Marine midlow-littoral[ldyn]_Muddy			Marine midlow-littoral[ldyn]_Sandy	
avg	7,058182744		avg	10,34530888		avg	9,049815396	
std	2,258272309		std	0,649676849		std	1,246900033	
n	156		n	38		n	65	
	8			**9**			**10**	
	5%	95%		5%	95%		5%	95%
	ECO08-	ECO08+		ECO09-	ECO09+		ECO10-	ECO10+
10	287	4712	10	20798	46536	10	3932	18447
11	306	4415	11	21192	45672	11	4076	17795
12	324	4171	12	21541	44932	12	4206	17246
13	341	3967	13	21854	44288	13	4324	16775
14	356	3794	14	22137	43723	14	4432	16366
15	371	3645	15	22394	43221	15	4531	16008
16	384	3515	16	22629	42772	16	4623	15690
17	397	3401	17	22845	42368	17	4708	15407
18	409	3299	18	23044	42001	18	4788	15151
19	421	3209	19	23230	41666	19	4862	14920
20	432	3127	20	23402	41359	20	4931	14710
21	442	3054	21	23563	41076	21	4997	14518
22	452	2986	22	23714	40814	22	5058	14341
23	462	2925	23	23856	40572	23	5116	14177
24	471	2869	24	23990	40345	24	5172	14026
25	480	2817	25	24116	40134	25	5224	13885
26	488	2769	26	24236	39936	26	5274	13754
27	496	2724	27	24349	39750	27	5321	13632
28	504	2683	28	24457	39575	28	5367	13517
29	511	2644	29	24559	39410	29	5410	13408
30	518	2608	30	24657	39253	30	5451	13307
31	525	2574	31	24751	39105	31	5491	13210
32	532	2542	32	24840	38965	32	5529	13119
33	538	2512	33	24925	38831	33	5566	13033
34	544	2483	34	25007	38704	34	5601	12951
35	550	2456	35	25086	38582	35	5635	12873
36	556	2431	36	25162	38466	36	5667	12799
37	561	2406	37	25235	38355	37	5699	12728
38	567	2383	38	25305	38249	38	5729	12661
39	572	2361	39	25372	38147	39	5759	12596
40	577	2340	40	25437	38050	40	5787	12534
41	582	2320	41	25500	37956	41	5815	12475
42	587	2301	42	25561	37865	42	5841	12418
43	592	2283	43	25620	37779	43	5867	12364
44	596	2265	44	25677	37695	44	5892	12311
45	601	2248	45	25732	37614	45	5916	12260
46	605	2232	46	25785	37536	46	5940	12212
47	609	2217	47	25837	37461	47	5963	12165
48	614	2202	48	25887	37388	48	5985	12119
49	618	2187	49	25936	37318	49	6007	12076
50	622	2174	50	25984	37249	50	6028	12033
60	656	2058	60	26395	36669	60	6212	11676
70	685	1973	70	26719	36225	70	6360	11406
80	709	1907	80	26982	35871	80	6481	11193
90	729	1853	90	27203	35580	90	6583	11020
100	747	1809	100	27391	35336	100	6670	10875
110	762	1773	110	27554	35127	110	6747	10752
120	776	1741	120	27697	34946	120	6814	10646
130	788	1714	130	27823	34787	130	6874	10553
140	800	1690	140	27937	34646	140	6928	10471
150	810	1668	150	28039	34519	150	6976	10398

11-13.-Marine sub-littoral and upper-littoral





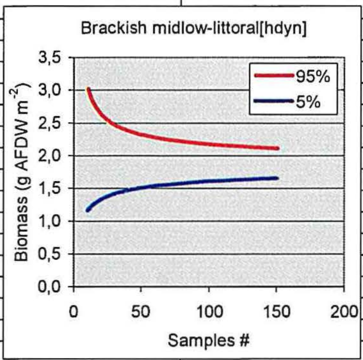


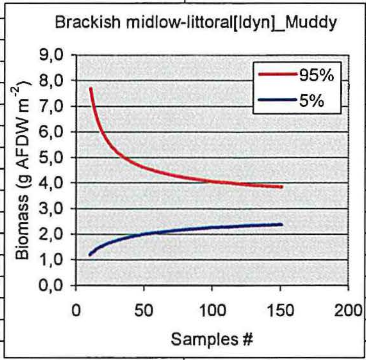
	11			12			13	
	Marine sub-littoral deep			Marine sub-littoral shallow			Marine upper-littoral	
avg	4,577724737		avg	5,128853027		avg	9,164453823	
std	2,219559362		std	2,292757123		std	1,113371792	
n	334		n	396		n	64	
	11			**12**			**13**	
	5%	95%		5%	95%		5%	95%
	ECO11-	ECO11+		ECO12-	ECO12+		ECO13-	ECO13+
10	25	385	10	41	699	10	4790	19044
11	26	361	11	44	654	11	4947	18443
12	28	342	12	46	618	12	5087	17933
13	29	325	13	49	587	13	5215	17495
14	30	311	14	51	561	14	5331	17114
15	32	299	15	53	539	15	5437	16779
16	33	289	16	55	519	16	5535	16482
17	34	279	17	57	502	17	5626	16215
18	35	271	18	59	487	18	5711	15975
19	36	264	19	60	473	19	5790	15758
20	37	257	20	62	461	20	5863	15559
21	38	251	21	63	450	21	5933	15377
22	38	246	22	65	440	22	5998	15210
23	39	241	23	66	431	23	6060	15055
24	40	236	24	67	422	24	6118	14912
25	41	232	25	69	415	25	6173	14778
26	41	228	26	70	408	26	6226	14653
27	42	225	27	71	401	27	6276	14537
28	43	221	28	72	395	28	6324	14427
29	43	218	29	73	389	29	6369	14324
30	44	215	30	74	383	30	6413	14227
31	45	213	31	75	378	31	6454	14135
32	45	210	32	76	374	32	6494	14048
33	46	207	33	77	369	33	6533	13965
34	46	205	34	78	365	34	6570	13887
35	47	203	35	79	361	35	6605	13812
36	47	201	36	80	357	36	6639	13741
37	48	199	37	81	353	37	6672	13673
38	48	197	38	81	350	38	6704	13609
39	48	195	39	82	347	39	6735	13547
40	49	194	40	83	344	40	6764	13487
41	49	192	41	84	341	41	6793	13430
42	50	190	42	84	338	42	6821	13375
43	50	189	43	85	335	43	6848	13323
44	50	187	44	86	332	44	6874	13272
45	51	186	45	86	330	45	6899	13224
46	51	185	46	87	327	46	6924	13177
47	52	184	47	88	325	47	6948	13131
48	52	182	48	88	323	48	6971	13088
49	52	181	49	89	321	49	6993	13045
50	53	180	50	89	319	50	7015	13005
60	55	171	60	95	302	60	7206	12660
70	58	164	70	99	289	70	7359	12398
80	60	158	80	102	279	80	7484	12191
90	62	154	90	105	271	90	7589	12022
100	63	150	100	108	265	100	7679	11881
110	64	147	110	110	259	110	7757	11761
120	65	145	120	112	254	120	7826	11657
130	66	142	130	114	250	130	7888	11566
140	67	141	140	115	247	140	7943	11486
150	68	139	150	117	244	150	7993	11414

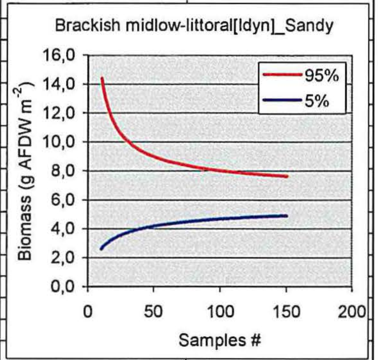
Overview of the total macrofauna biomass measured in the 13 ecotopes from our MEP dataset

On the following spreadsheets the 5% confidence interval (where 95% of the observations are found) are plotted for increasing number of samples from 10 tot 150. This interval is calculated by adding the value ($\pm$ 1.96 $\sigma/\sqrt{n}$) to the average where σ is the samples standard deviation and n the number of samples. The average, standard deviation and number of samples are given below the graphs. The series used in the graphics are also presented in the lower part of these spreadsheets.

1-3.-Brackish midlow-littoral

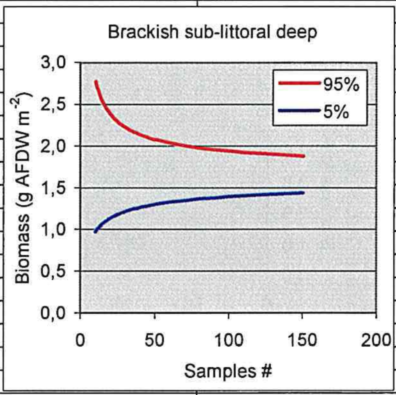


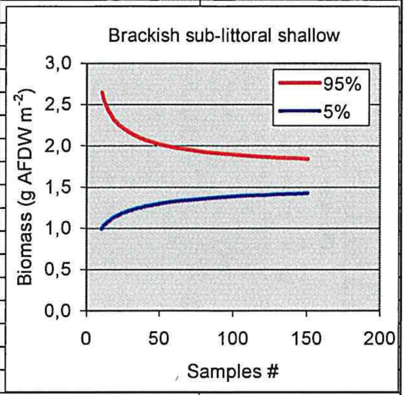




	1			2			3	
	Brackish midlow-littoral[hdyn]			Brackish midlow-littoral[ldyn]_Muddy			Brackish midlow-littoral[ldyn]_Sandy	
avg	0,624739656	cv	avg	1,107355826	cv	avg	1,809931493	cv
std	0,770605937	123	std	1,500821627	136	std	1,381182485	76
n	157		n	36		n	69	
	1			2			3	
	5%	95%		5%	95%		5%	95%
	ECO01-	ECO01+		ECO02-	ECO02+		ECO03-	ECO03+
10	1,16	3,01	10	1,19	7,67	10	2,60	14,38
11	1,18	2,95	11	1,25	7,35	11	2,70	13,82
12	1,21	2,89	12	1,29	7,07	12	2,80	13,35
13	1,23	2,84	13	1,34	6,84	13	2,88	12,95
14	1,25	2,80	14	1,38	6,64	14	2,96	12,60
15	1,26	2,76	15	1,42	6,47	15	3,04	12,29
16	1,28	2,72	16	1,45	6,31	16	3,11	12,02
17	1,29	2,69	17	1,48	6,18	17	3,17	11,78
18	1,31	2,67	18	1,51	6,05	18	3,23	11,57
19	1,32	2,64	19	1,54	5,94	19	3,28	11,37
20	1,33	2,62	20	1,57	5,84	20	3,34	11,19
21	1,34	2,60	21	1,59	5,75	21	3,38	11,03
22	1,35	2,58	22	1,62	5,67	22	3,43	10,88
23	1,36	2,56	23	1,64	5,59	23	3,47	10,74
24	1,37	2,54	24	1,66	5,52	24	3,52	10,62
25	1,38	2,53	25	1,68	5,45	25	3,56	10,50
26	1,39	2,51	26	1,70	5,39	26	3,59	10,39
27	1,40	2,50	27	1,72	5,33	27	3,63	10,29
28	1,40	2,48	28	1,74	5,28	28	3,66	10,19
29	1,41	2,47	29	1,75	5,23	29	3,70	10,10
30	1,42	2,46	30	1,77	5,18	30	3,73	10,02
31	1,42	2,45	31	1,78	5,13	31	3,76	9,94
32	1,43	2,44	32	1,80	5,09	32	3,79	9,86
33	1,44	2,43	33	1,81	5,05	33	3,81	9,79
34	1,44	2,42	34	1,83	5,01	34	3,84	9,72
35	1,45	2,41	35	1,84	4,98	35	3,87	9,66
36	1,45	2,40	36	1,85	4,94	36	3,89	9,59
37	1,46	2,39	37	1,87	4,91	37	3,92	9,54
38	1,46	2,39	38	1,88	4,88	38	3,94	9,48
39	1,47	2,38	39	1,89	4,85	39	3,96	9,43
40	1,47	2,37	40	1,90	4,82	40	3,98	9,37
41	1,48	2,36	41	1,91	4,79	41	4,00	9,33
42	1,48	2,36	42	1,92	4,76	42	4,02	9,28
43	1,48	2,35	43	1,93	4,74	43	4,04	9,23
44	1,49	2,35	44	1,94	4,72	44	4,06	9,19
45	1,49	2,34	45	1,95	4,69	45	4,08	9,15
46	1,49	2,33	46	1,96	4,67	46	4,10	9,11
47	1,50	2,33	47	1,97	4,65	47	4,12	9,07
48	1,50	2,32	48	1,98	4,63	48	4,13	9,03
49	1,51	2,32	49	1,99	4,61	49	4,15	8,99
50	1,51	2,31	50	2,00	4,59	50	4,17	8,96
60	1,54	2,27	60	2,07	4,42	60	4,31	8,67
70	1,56	2,24	70	2,13	4,30	70	4,42	8,44
80	1,58	2,21	80	2,18	4,20	80	4,51	8,27
90	1,59	2,19	90	2,22	4,13	90	4,59	8,13
100	1,61	2,17	100	2,26	4,06	100	4,66	8,01
110	1,62	2,16	110	2,29	4,01	110	4,72	7,91
120	1,63	2,14	120	2,31	3,96	120	4,77	7,82
130	1,64	2,13	130	2,34	3,92	130	4,82	7,75
140	1,64	2,12	140	2,36	3,88	140	4,86	7,68
150	1,65	2,11	150	2,38	3,85	150	4,90	7,62

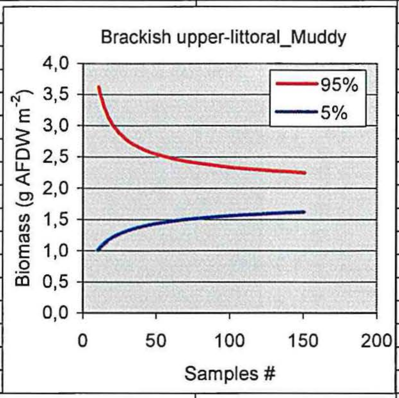
4-5.- Brackish sub-littoral

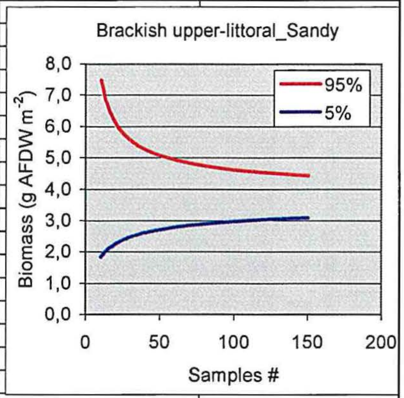




	4			5	
	Brackish sub-littoral deep			Brackish sub-littoral shallow	
avg	0,494110293	cv	avg	0,480763851	cv
std	0,842682062	171	std	0,79433687	165
n	265		n	182	
	4			**5**	
	5%	95%		5%	95%
	ECO04-	ECO04+		ECO05-	ECO05+
10	0,97	2,76	10	0,99	2,65
11	1,00	2,70	11	1,01	2,59
12	1,02	2,64	12	1,03	2,54
13	1,04	2,59	13	1,05	2,49
14	1,05	2,55	14	1,07	2,45
15	1,07	2,51	15	1,08	2,42
16	1,08	2,48	16	1,10	2,39
17	1,10	2,45	17	1,11	2,36
18	1,11	2,42	18	1,12	2,33
19	1,12	2,39	19	1,13	2,31
20	1,13	2,37	20	1,14	2,29
21	1,14	2,35	21	1,15	2,27
22	1,15	2,33	22	1,16	2,25
23	1,16	2,31	23	1,17	2,24
24	1,17	2,30	24	1,18	2,22
25	1,18	2,28	25	1,18	2,21
26	1,19	2,27	26	1,19	2,19
27	1,19	2,25	27	1,20	2,18
28	1,20	2,24	28	1,21	2,17
29	1,21	2,23	29	1,21	2,16
30	1,21	2,22	30	1,22	2,15
31	1,22	2,21	31	1,22	2,14
32	1,22	2,19	32	1,23	2,13
33	1,23	2,19	33	1,23	2,12
34	1,23	2,18	34	1,24	2,11
35	1,24	2,17	35	1,24	2,10
36	1,24	2,16	36	1,25	2,10
37	1,25	2,15	37	1,25	2,09
38	1,25	2,14	38	1,26	2,08
39	1,26	2,14	39	1,26	2,08
40	1,26	2,13	40	1,26	2,07
41	1,27	2,12	41	1,27	2,06
42	1,27	2,11	42	1,27	2,06
43	1,27	2,11	43	1,28	2,05
44	1,28	2,10	44	1,28	2,05
45	1,28	2,10	45	1,28	2,04
46	1,28	2,09	46	1,29	2,03
47	1,29	2,09	47	1,29	2,03
48	1,29	2,08	48	1,29	2,02
49	1,29	2,08	49	1,29	2,02
50	1,30	2,07	50	1,30	2,02
60	1,32	2,03	60	1,32	1,98
70	1,35	2,00	70	1,34	1,95
80	1,36	1,97	80	1,36	1,92
90	1,38	1,95	90	1,37	1,91
100	1,39	1,93	100	1,38	1,89
110	1,40	1,92	110	1,39	1,88
120	1,41	1,91	120	1,40	1,86
130	1,42	1,89	130	1,41	1,85
140	1,43	1,88	140	1,42	1,84
150	1,43	1,88	150	1,42	1,84

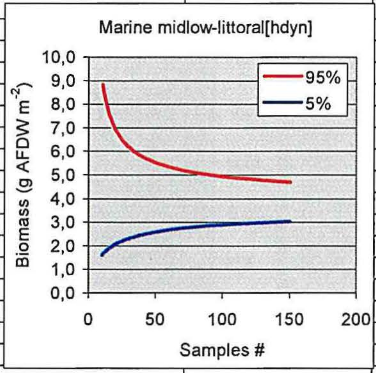
6-7.-Brackish upper-littoral

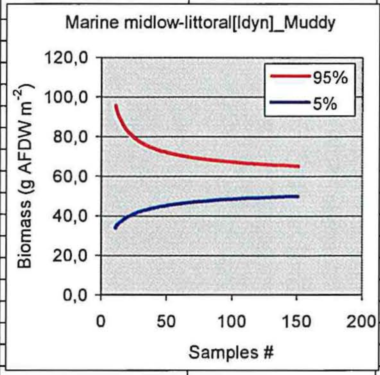


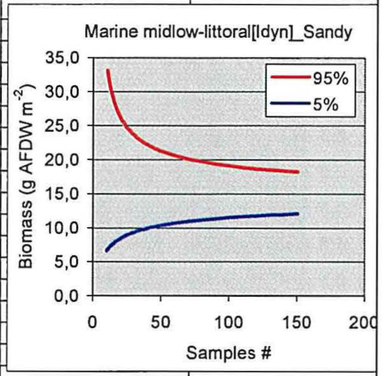


	6			7	
	Brackish upper-littoral_Muddy			Brackish upper-littoral_Sandy	
avg	0,644710371	cv	avg	1,309489887	cv
std	1,033261992	160	std	1,132444261	86
n	60		n	28	
	6			**7**	
	5%	95%		5%	95%
	ECO06-	ECO06+		ECO07-	ECO07+
10	1,00	3,62	10	1,84	7,47
11	1,03	3,51	11	1,90	7,23
12	1,06	3,42	12	1,95	7,03
13	1,09	3,34	13	2,00	6,86
14	1,11	3,27	14	2,05	6,70
15	1,13	3,21	15	2,09	6,57
16	1,15	3,16	16	2,13	6,45
17	1,17	3,11	17	2,16	6,35
18	1,18	3,07	18	2,20	6,25
19	1,20	3,03	19	2,23	6,16
20	1,21	3,00	20	2,26	6,08
21	1,22	2,96	21	2,28	6,01
22	1,24	2,93	22	2,31	5,95
23	1,25	2,91	23	2,33	5,88
24	1,26	2,88	24	2,35	5,83
25	1,27	2,86	25	2,38	5,77
26	1,28	2,83	26	2,40	5,72
27	1,29	2,81	27	2,42	5,68
28	1,30	2,79	28	2,44	5,63
29	1,31	2,78	29	2,45	5,59
30	1,32	2,76	30	2,47	5,56
31	1,32	2,74	31	2,49	5,52
32	1,33	2,73	32	2,50	5,48
33	1,34	2,71	33	2,52	5,45
34	1,35	2,70	34	2,53	5,42
35	1,35	2,68	35	2,55	5,39
36	1,36	2,67	36	2,56	5,36
37	1,37	2,66	37	2,57	5,34
38	1,37	2,65	38	2,58	5,31
39	1,38	2,64	39	2,60	5,29
40	1,38	2,62	40	2,61	5,26
41	1,39	2,61	41	2,62	5,24
42	1,39	2,60	42	2,63	5,22
43	1,40	2,59	43	2,64	5,20
44	1,40	2,59	44	2,65	5,18
45	1,41	2,58	45	2,66	5,16
46	1,41	2,57	46	2,67	5,14
47	1,42	2,56	47	2,68	5,12
48	1,42	2,55	48	2,69	5,10
49	1,43	2,54	49	2,70	5,09
50	1,43	2,54	50	2,71	5,07
60	1,47	2,47	60	2,78	4,93
70	1,50	2,43	70	2,84	4,83
80	1,52	2,39	80	2,89	4,75
90	1,54	2,36	90	2,93	4,68
100	1,56	2,33	100	2,97	4,62
110	1,57	2,31	110	3,00	4,58
120	1,58	2,29	120	3,02	4,54
130	1,60	2,28	130	3,05	4,50
140	1,61	2,26	140	3,07	4,47
150	1,62	2,25	150	3,09	4,44

8-10.-Marine midlow-littoral



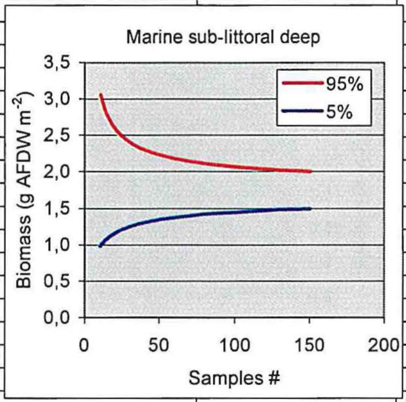


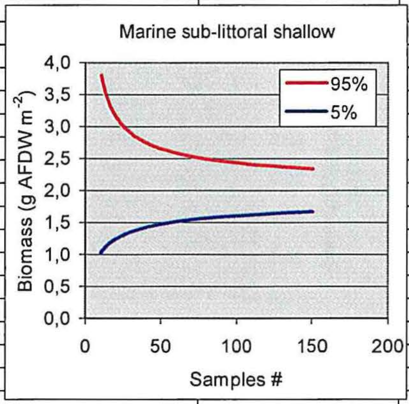


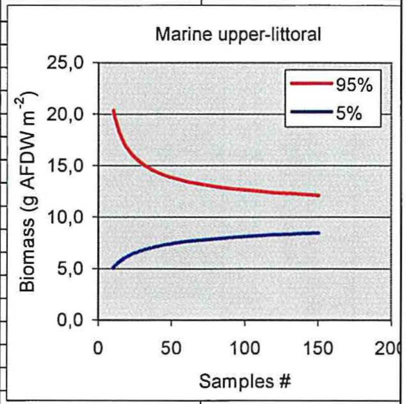
	8			9			10	
	Marine midlow-littoral[hdyn]			Marine midlow-littoral[ldyn]_Muddy			Marine midlow-littoral[ldyn]_Sandy	
avg	1,326415167	cv	avg	4,042742612	cv	avg	2,695421873	cv
std	1,373157308	104	std	0,834465677	21	std	1,295611833	48
n	156		n	38		n	65	

	8			9			10	
	5%	95%		5%	95%		5%	95%
	ECO08-	ECO08+		ECO09-	ECO09+		ECO10-	ECO10+
10	1,61	8,82	10	33,97	95,58	10	6,64	33,06
11	1,67	8,48	11	34,80	93,31	11	6,89	31,85
12	1,73	8,19	12	35,54	91,37	12	7,12	30,83
13	1,79	7,95	13	36,20	89,69	13	7,32	29,96
14	1,84	7,73	14	36,80	88,22	14	7,51	29,20
15	1,88	7,55	15	37,35	86,92	15	7,69	28,53
16	1,92	7,38	16	37,86	85,77	16	7,85	27,95
17	1,96	7,24	17	38,32	84,73	17	8,00	27,42
18	2,00	7,10	18	38,75	83,78	18	8,14	26,95
19	2,03	6,99	19	39,15	82,93	19	8,27	26,52
20	2,06	6,88	20	39,53	82,14	20	8,39	26,13
21	2,09	6,78	21	39,88	81,42	21	8,51	25,78
22	2,12	6,69	22	40,21	80,76	22	8,62	25,45
23	2,15	6,60	23	40,52	80,14	23	8,72	25,15
24	2,18	6,53	24	40,81	79,57	24	8,82	24,87
25	2,20	6,45	25	41,08	79,03	25	8,91	24,61
26	2,22	6,39	26	41,35	78,53	26	9,00	24,37
27	2,24	6,32	27	41,60	78,06	27	9,09	24,15
28	2,27	6,27	28	41,83	77,62	28	9,17	23,93
29	2,29	6,21	29	42,06	77,20	29	9,24	23,74
30	2,30	6,16	30	42,27	76,81	30	9,32	23,55
31	2,32	6,11	31	42,48	76,44	31	9,39	23,37
32	2,34	6,06	32	42,68	76,09	32	9,45	23,20
33	2,36	6,02	33	42,86	75,75	33	9,52	23,05
34	2,37	5,98	34	43,05	75,43	34	9,58	22,90
35	2,39	5,94	35	43,22	75,13	35	9,64	22,75
36	2,41	5,90	36	43,39	74,84	36	9,70	22,62
37	2,42	5,86	37	43,55	74,56	37	9,76	22,49
38	2,43	5,83	38	43,70	74,30	38	9,81	22,36
39	2,45	5,80	39	43,85	74,04	39	9,86	22,24
40	2,46	5,77	40	44,00	73,80	40	9,91	22,13
41	2,47	5,74	41	44,14	73,57	41	9,96	22,02
42	2,49	5,71	42	44,27	73,34	42	10,01	21,92
43	2,50	5,68	43	44,40	73,12	43	10,06	21,82
44	2,51	5,65	44	44,53	72,92	44	10,10	21,72
45	2,52	5,63	45	44,65	72,72	45	10,14	21,63
46	2,53	5,60	46	44,77	72,52	46	10,19	21,54
47	2,54	5,58	47	44,89	72,34	47	10,23	21,45
48	2,55	5,56	48	45,00	72,15	48	10,27	21,37
49	2,56	5,53	49	45,11	71,98	49	10,31	21,29
50	2,57	5,51	50	45,22	71,81	50	10,34	21,21
60	2,66	5,33	60	46,14	70,38	60	10,67	20,56
70	2,73	5,20	70	46,86	69,29	70	10,93	20,06
80	2,79	5,09	80	47,46	68,42	80	11,15	19,67
90	2,84	5,00	90	47,96	67,70	90	11,33	19,36
100	2,88	4,93	100	48,38	67,11	100	11,49	19,09
110	2,91	4,87	110	48,75	66,60	110	11,63	18,87
120	2,95	4,82	120	49,08	66,16	120	11,75	18,68
130	2,98	4,77	130	49,37	65,77	130	11,85	18,51
140	3,00	4,73	140	49,63	65,43	140	11,95	18,36
150	3,02	4,69	150	49,86	65,12	150	12,04	18,22

11-13.-Marine sub-littoral and upper-littoral







	11			12			13	
	Marine sub-littoral deep			Marine sub-littoral shallow			Marine upper-littoral	
avg	0,547752731	cv	avg	0,680671087	cv	avg	2,31427147	cv
std	0,914292018	167	std	1,055838379	155	std	1,12626794	49
n	334		n	396		n	64	

	11			12			13	
	5%	95%		5%	95%		5%	95%
	ECO11-	ECO11+		ECO12-	ECO12+		ECO13-	ECO13+
10	0,98	3,05	10	1,03	3,80	10	5,03	20,33
11	1,01	2,97	11	1,06	3,69	11	5,20	19,68
12	1,03	2,90	12	1,09	3,59	12	5,35	19,13
13	1,05	2,84	13	1,11	3,51	13	5,49	18,66
14	1,07	2,79	14	1,14	3,43	14	5,61	18,25
15	1,09	2,75	15	1,16	3,37	15	5,72	17,89
16	1,10	2,71	16	1,18	3,31	16	5,83	17,57
17	1,12	2,67	17	1,20	3,26	17	5,92	17,28
18	1,13	2,64	18	1,21	3,22	18	6,01	17,02
19	1,15	2,61	19	1,23	3,18	19	6,10	16,79
20	1,16	2,58	20	1,24	3,14	20	6,18	16,57
21	1,17	2,56	21	1,26	3,10	21	6,25	16,38
22	1,18	2,53	22	1,27	3,07	22	6,32	16,20
23	1,19	2,51	23	1,28	3,04	23	6,39	16,03
24	1,20	2,49	24	1,29	3,01	24	6,45	15,88
25	1,21	2,47	25	1,31	2,99	25	6,51	15,73
26	1,22	2,46	26	1,32	2,96	26	6,56	15,60
27	1,22	2,44	27	1,33	2,94	27	6,62	15,47
28	1,23	2,43	28	1,34	2,92	28	6,67	15,36
29	1,24	2,41	29	1,34	2,90	29	6,72	15,24
30	1,25	2,40	30	1,35	2,88	30	6,76	15,14
31	1,25	2,39	31	1,36	2,86	31	6,81	15,04
32	1,26	2,37	32	1,37	2,85	32	6,85	14,95
33	1,27	2,36	33	1,38	2,83	33	6,89	14,86
34	1,27	2,35	34	1,39	2,82	34	6,93	14,77
35	1,28	2,34	35	1,39	2,80	35	6,97	14,69
36	1,28	2,33	36	1,40	2,79	36	7,00	14,62
37	1,29	2,32	37	1,41	2,78	37	7,04	14,54
38	1,29	2,31	38	1,41	2,76	38	7,07	14,47
39	1,30	2,30	39	1,42	2,75	39	7,10	14,41
40	1,30	2,30	40	1,42	2,74	40	7,14	14,34
41	1,31	2,29	41	1,43	2,73	41	7,17	14,28
42	1,31	2,28	42	1,44	2,72	42	7,20	14,22
43	1,32	2,27	43	1,44	2,71	43	7,23	14,17
44	1,32	2,27	44	1,45	2,70	44	7,25	14,11
45	1,32	2,26	45	1,45	2,69	45	7,28	14,06
46	1,33	2,25	46	1,46	2,68	46	7,31	14,01
47	1,33	2,25	47	1,46	2,67	47	7,33	13,96
48	1,34	2,24	48	1,47	2,66	48	7,36	13,91
49	1,34	2,23	49	1,47	2,65	49	7,38	13,87
50	1,34	2,23	50	1,47	2,65	50	7,40	13,82
60	1,37	2,18	60	1,51	2,58	60	7,61	13,45
70	1,40	2,14	70	1,54	2,53	70	7,77	13,17
80	1,42	2,11	80	1,57	2,49	80	7,90	12,95
90	1,43	2,09	90	1,59	2,46	90	8,02	12,77
100	1,45	2,07	100	1,61	2,43	100	8,11	12,62
110	1,46	2,05	110	1,62	2,41	110	8,20	12,49
120	1,47	2,04	120	1,64	2,39	120	8,27	12,38
130	1,48	2,02	130	1,65	2,37	130	8,34	12,28
140	1,49	2,01	140	1,66	2,35	140	8,40	12,19
150	1,49	2,00	150	1,67	2,34	150	8,45	12,12