

UKTAG COASTAL WATER ASSESSMENT METHOD  
BENTHIC INVERTEBRATE FAUNA

INVERTEBRATES IN SOFT SEDIMENTS (INFAUNAL QUALITY  
INDEX (IQI))

by

Water Framework Directive - United Kingdom Technical Advisory Group  
(WFD-UKTAG)



**Publisher: Water Framework Directive - United Kingdom Technical Advisory Group (WFD-UKTAG)**

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[www.wfduk.org](http://www.wfduk.org)

December 2008

ISBN: 978-1-906934-13-2

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## **HEALTH AND SAFETY STATEMENT**

**WARNING**— working in or around water is inherently dangerous; persons using this standard should be familiar with normal laboratory and field practice. This published monitoring system does not purport to address all of the safety problems, if any, associated with its use. It is the responsibility of the user to establish appropriate health and safety practices and to ensure compliance with any national regulatory guidelines.

It is also the responsibility of the user if seeking to practise the method outlined here, to gain appropriate permissions for access to water courses and their biological sampling.

## **1. INTRODUCTION**

This method statement describes a monitoring system for monitoring, assessing and classifying coastal waters in accordance with the requirements of Article 8; Section 1.3 of Annex II; and Annex V of the Water Framework Directive (2000/60/EC).

### **1.1. Geographic application of the method**

The method can be applied to the coastal waters in England, Northern Ireland, Scotland and Wales in parts of those waters that are subtidal and have a bed composed of fine muddy sand to mud.

### **1.2. Quality element assessed by the method**

The method enables an assessment of the condition of the quality element, "benthic invertebrate fauna", listed in Tables 1.2.3 and 1.2.4 of Annex V to the Water Framework Directive.

### **1.3. Pressures to which the method is known to be sensitive**

The method has been designed to detect the impact on the quality element of general disturbance, particularly of organic enrichment and toxins.

### **1.4 Parameters used to assess the quality element**

The method uses a multi-parameter index, "Infaunal Quality Index" (IQI) for the purpose of assessing the condition of the quality element. The IQI is based on three parameters:

- (i) number of taxa;
- (ii) AZTI\* Marine Biotic Index (AMBI); and
- (iii) Simpson's Evenness.

## **2. SAMPLING AND ANALYSIS**

### **2.1. Sampling method**

Within this method, "sampling" means the collection for identification of samples of benthic invertebrate fauna at a site for the purpose of estimating the ecological quality ratio at that site on the occasion of the sampling.

#### **2.1.1. Sampling Sites**

Sampling sites should be in sub-tidal areas consisting of fine muddy sand to mud.

#### **2.1.2. Method**

Sampling should comply with the provisions of ISO 16665:2005, which gives guidelines for the

quantitative collection and processing of sub-tidal, soft-bottom macro-faunal samples in coastal waters and specifies development of the sampling programme; requirements for sampling equipment; sampling and sample treatment in the field.

## 2.2. Analytical method

Samples should be sorted, and macro-invertebrate fauna taken from the samples should be identified and counted to create a site taxa and abundance list. The taxa eligible for inclusion in the site taxa list should be determined according to a standard contemporary list of taxa eligible to be unambiguously identified as invertebrate benthic fauna.

The analysis of the samples should comply with the provisions of ISO 16665:2005, which provides guidelines on sorting, species identification, and storage of collected and processed material.

## 3. PROCEDURE FOR DERIVING THE ECOLOGICAL QUALITY RATIO FOR THE PARAMETERS

### 3.1. Calculation of the observed value for each parameter

#### 3.1.1. Number of taxa

The observed value for the parameter, number of taxa, should be the number of taxa listed and identified as present at the site.

#### 3.1.2. AZTI Marine Biotic Index (AMBI)

The observed value for the parameter, AZTI Marine Biotic Index (AMBI), should be calculated according to the following steps:

- (i) Each taxon listed in columns 1,3,5,7 or 9 of Table 1 and identified as being present at the site should be attributed to its corresponding ecological group (I, II, III, IV, V) in Column 2,4,6,8 or 10 of that Table.
- (ii) The abundance of taxa in each group ("gI", "gII", "gIII", "gIV" and "gV") should be estimated as the number of specimens of taxa in that group per sample.
- (iii) The relative abundance ("GI", "GII", "GIII", "GIV", "GV") of each group should be calculated using the equation:  
$$G\# = g\# \div (gI + gII + gIII + gIV + gV)$$
- (iv)  $G\# = g\# \div (gI + gII + gIII + gIV + gV)$

where:

"#" varies through I, II, III, IV, V.

- (v) The observed value of the AZTI Marine Biotic Index (AMBI) should be calculated using the equation:

Observed value of AMBI = [(0 x GI) + (1.5 x GII) + (3 x GIII) + (4.5 x GIV) + (6 x GV)]

### 3.1.3. Simpson's Evenness

The observed value of the parameter, Simpson's Evenness ( $\lambda'$ ), of a sample should be calculated by the method of Simpson (1949) using the equation:

$$\text{Observed value of Simpson's evenness} = \frac{\sum_{p=1}^s n_p \times (n_p - 1)}{N \times (N - 1)}$$

where

"N" is the total number of individual invertebrates identified as present in the sample;

"S" is the number of taxa identified as present in the sample;

" $n_p$ " is the number of individual invertebrates of taxon "p" identified as present in the sample;

"p" represents a taxon identified as present in the sample; "p" varies through values of 1 to "S".

## 3.2. Calculation of the reference values for each parameter

Reference conditions were derived using a combination of best available data and expert judgement. Reference conditions are habitat specific and defined for the surface area sampled and the sieve mesh used for sample processing. The following reference conditions relate to fine muddy sands to muds, with a sample area of 0.1m<sup>2</sup> processed through a 1 mm sieve.

### 3.2.1.1. Number of taxa

The value for the parameter, number of taxa, in the reference conditions ( $S_{ref}$ ) applicable to areas of coastal waters with subtidal beds composed of fine muddy sand to mud for samples of 0.1m<sup>2</sup>, processed through a 1mm sieve, should be taken as:

$$S_{ref} = 68$$

### 3.2.1.2. AZTI Marine Biotic Index

The value for the parameter, AZTI Marine Biotic Index, in the reference conditions ( $AMBI_{ref}$ ) applicable to areas of coastal waters with subtidal beds composed of fine muddy sand to mud for samples of 0.1m<sup>2</sup>, processed through a 1mm sieve, should be taken from:

$$(1 - AMBI_{ref} \div 7) = 0.96$$

### 3.2.1.3. Simpson's Evenness

The value for the parameter, Simpson's Evenness, in the reference conditions ( $\lambda'_{ref}$ ) applicable to areas of coastal waters with subtidal beds composed of fine muddy sand to mud for samples of 0.1m<sup>2</sup>, processed through a 1mm sieve, should be taken from:

$$(1-\lambda'_{ref}) = 0.97$$

### 3.3. Calculation of the ecological quality ratio for the combined parameters

The ecological quality ratio for the combined parameters,  $EQR_{IQL}$  should be calculated using the following equation:

$$EQR_{IQL} = \left[ \begin{array}{l} 0.38 \times (1 - AMBI \div 7) \div (1 - AMBI_{ref} \div 7) \\ + 0.08 \times (1 - \lambda') \div (1 - \lambda'_{ref}) \\ + 0.54 \times (S \div S_{ref})^{0.1} \\ - 0.4 \end{array} \right] \div 0.6$$

## 4. DEFINITION OF TERMS

\* AZTI: Technological Institute for Fisheries and Food (AZTI), San Sebastian, Spain

**Table 1: List of benthic invertebrate taxa and associated ecological group**

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7	Column 8	Column 9	Column 10
Taxa	Ecological Group	Taxa	Ecological Group	Taxa	Ecological Group	Taxa	Ecological Group	Taxa	Group
Abarenicola claparedi	I	Angulus tenuis	I	Bela powisiana	I	Chone infundibuliformis	II	Diastylis rugosa	I
Abarenicola sp.	I	Anomia ephippium	I	Bela sp.	I	Chone sp.	II	Diastylis sp.	I
Abissonioe hibernica	II	Anoplodactylus petiolatus	N.A	Bittium reticulatum	I	Chthamalus stellatus	I	Diastylis tumida	I
Abra alba	III	Anoplodactylus pygmaeus	N.A	Boccardia chilensis	I	Circe minima	I	Diodora apertura	I
Abra nitida	III	Antenella sp.	I	Boccardia polybranchia	I	Circulus striatus	I	Diogenes pugilator	II
Abra prismatica	III	Anthozoa sp.	I	Boccardia sp.	I	Cirratulus chrysoderma	IV	Diopatra neapolitana	I
Abra sp.	III	Anthura gracilis	I	Bodotria arenosa	II	Cirratulus cirratus	IV	Diplocirrus glaucus	I
Abra tenuis	III	Aonides oxycephala	III	Bodotria scorpioides	II	Cirriformia tentaculata	IV	Dispio uncinata	III
Acanthocardia aculeata	I	Aora gracilis	I	Brada villosa	N.A	Cirripedo sp.	I	Divaricella divaricata	I
Acanthocardia echinata	I	Aora typica	I	Branchiomma vesiculosum	I	Clausinella fasciata	I	Donax trunculus	I
Acanthocardia paucicostata	I	Aphelochatea multibranchiis	N.A	Branchiostoma lanceolata	I	Clavidae	I	Doris sp.	I
Acanthocardia sp.	I	Apherusa cirrus	I	Brania oculata	II	Clymene cf. praetermisa	I	Dosinia exoleta	I
Acanthocardia tuberculata	I	Apherusa ovalipes	I	Brania pusilla	II	Clymene lumbricoides	I	Dosinia juv. Indet.	I
Acanthochitona crinitus	I	Aphonupis grubei	I	Bugula sp.	I	Clymene modesta	I	Dosinia lupinus	I
Acanthochitona fascicularis	I	Aphrodite aculeata	N.A	Callianassa sp.	III	Clymene oerstedii	I	Dosinia sp.	I
Achelia hispida	I	Apicularia guerini	I	Callianassa subterranea	III	Clytia sp.	I	Drilonereis fillum	II
Achelia simplex	I	Apistobranthus tullbergi	I	Callianassa truncata	III	Cnidaria sp.	I	Ebalia sp.	N.A
Acclis gulsonae	N.A	Aponuphis bilineata	II	Calliostoma papillosum	I	Cochlodesma praetenue	N.A	Ebalia tuberosa	N.A
Acronida brachiata	I	Aporrhais pespelecani	I	Calliostoma zizyphinum	I	Copepoda indet.	N.A	Echinocardium cordatum	I
Acteon sp.	I	Aporrhais sp.	I	Calyptrea sinensis	I	Copepoda sp.	N.A	Echinocyamus pusillus	I
Actinia equina	I	Apseudes latreillei	III	Campylaspis glabra	N.A	Corbula gibba	III	Echinoidea sp.	I
Aglaophamus rubella	N.A	Arcturella sp.	N.A	Capitella capitata	V	Corophium acherusicum	III	Echiuroidea sp.	I
Aglaophamus sp.	N.A	Arenicola marina	N.A	Capitella sp.	V	Corophium acutum	III	Echiurus echiurus	I
Aiptasia mutabilis	N.A	Aricia latreilli	I	Capitellides giardi	V	Corophium arenarium	III	Edwardsia sp.	II



Alcyonacea indet	N.A	Aricidea catherinae	I	Capitomastus minimus	IV	Corophium insidiosum	III	Ehlersia ferrugina	N.A
Alkmaria romijni	III	Aricidea cerruti	I	Caprella fretensis	N.A	Corophium multisetosum	III	Ensis sp.	I
Alpheus glaber	N.A	Aricidea cf. assimilis	I	Caprella linearis	N.A	Corophium sp.	III	Eocuma dimorpha	II
Alvania crassa	I	Aricidea fragilis	I	Caprella penantis	N.A	Corophium volutator	III	Eocuma dollfusi	II
Alvania semistriata	I	Aricidea jeffreysii	I	Carcinus maenas	III	Coryne pusilla	I	Epilepton clarkiae	I
Alvania sp.	I	Aricidea minuta	I	Caryophyllia smithi	I	Corystes cassivelaunus	I	Epithonium clathrus	I
Amatea trilobata	I	Aricidea sp.	I	Cauleriella alata	III	Cossura longocirrata	N.A	Epitonium turtoni	I
Amathia pruvot	I	Armandia cirrosa	I	Cauleriella bioculata	III	Cossura pygodactylata	N.A	Erichthonius brasiliensis	N.A
Ampelisca brevicornis	I	Armandia spp	I	Cauleriella sp.	III	Cossura sp.	N.A	Eteone longa	II
Ampelisca cf. spooneri	I	Aspidosiphon muelleri	I	Cauleriella zetlandica	III	Crangon allmani	I	Eteone picta	II
Ampelisca heterodactyla	I	Astacilla longicornis	I	Cavernularia pusilla	I	Crangon crangon	I	Euclymede praetermissa	I
Ampelisca juv. Indet.	I	Astarte sp.	I	Ceradocus semiserratus	I	Crassostrea angulata	III	Euclymene aenaris	I
Ampelisca sarsi	I	Astarte sulcata	I	Cerastoderma edule	III	Crepidula fornicata	III	Euclymene oerstedii	I
Ampelisca sp.	I	Astarte triangularis	I	Cerastoderma lamarcki	III	Cucumaria elongata	I	Euclymene sp.	I
Ampelisca spinifer	I	Asterina gibosa	I	Ceratostoma erinaceum	I	Cucumaria sp.	I	Euclymenidae indet.	I
Ampelisca spinimana	I	Astropecten irregularis	I	Cerebratulus marginatus	III	Cultellus pellucidus	I	Eudorella truncatula	N.A
Ampelisca tenuicornis	I	Astropecten irregularis typicus	I	Cerebratulus sp.	III	Cumopsis fagei	II	Eulalia bilineata	II
Ampelisca toulemoniti	I	Athanas nitescens	I	Cereus pedunculatus	I	Cumopsis sp.	II	Eulalia mustela	II
Ampharete filmarchica	I	Athecata sp.	I	Ceriantario sp.	I	Cyathura carinata	III	Eulalia sanguinea	II
Ampharete grubei	I	Atylus falcatus	I	Cerianthus lloydii	I	Cyclope neritea	I	Eulalia sp.	II
Ampharete juv. Indet.	I	Atylus guttatus	I	Cerianthus membranaceus	I	Cylichna cylindracea	I	Eulalia tripunctata	II
Ampharete lindstroemi	I	Atylus sp.	I	Cerianthus sp.	I	Cylichna sp.	I	Eulalia viridis	II
Ampharete sp.	I	Atylus swammerdami	I	Cestopagurus timidus	I	Cylichnina subcylindrica	I	Eulimella acicuta	I
Amphicteis gunneri	III	Atylus vedlomensis	I	Chaetopterus variopedatus	I	Cymodoce truncata	I	Eulimella sp.	I
Amphipholis squamata	I	Audouinia tentaculata	IV	Chaetozone B spp	IV	Cythara attenuata	I	Eumida bahusiensis	II
Amphitrite johnstoni	I	Autolytus longeferiens	N.A	Chaetozone cf. gibber	IV	Cythara costata	I	Eumida sanguinea	II
Amphiura brachiata	I	Autolytus sp.	N.A	Chaetozone gibber	IV	Dardanus arrosor	N.A	Eumida sp.	I
Amphiura chiajei	I	Axonice maculata	N.A	Chaetozone setosa	IV	Demonax sp.	N.A	Eunice harassii	II
Amphiura filiformis	I	Bachycuma brevicornis	N.A	Chaetozone sp.	IV	Demospongia sp.	I	Eunice sp.	II
Amphiura juv.indet.	I	Balcis alba	I	Chamelea gallina	I	Dentalium novemcostatum	I	Eunice vittata	II

Amphiura sp.	I	Barleeia rubra	II	Chamelea gallina striatula	I	Dentalium sp.	I	Euphrosyne foliosa	I
Anaitides lineata	II	Bathyporeia elegans	I	Chamelea striatula	I	Desdemona cf. ornata	II	Eurydice a□nis	I
Anaitides maculata	II	Bathyporeia nana	I	Chauvetia brunnea	I	Desdemona ornata	II	Eurydice pulchra	I
Anaitides mucosa	II	Bathyporeia pelagica	I	Cheirocratus sundevallii	I	Devonia perrieri	I	Eurydice sp.	I
Anaitides sp.	II	Bathyporeia pilosa	I	Cherocratus sp.	I	Diastylis bradyi	I	Eurydice spinigera	I
Anapagurus hyndmani	I	Bathyporeia sarsi	I	Chironomida	IV	Diastylis cf. tumida	I	Eurynome aspera	I
Anapagurus laevis	I	Bathyporeia sp.	I	Chlamys varia	I	Diastylis cornuta	I	Eurynome spinosa	I
Anapagurus sp.	I	Bathyporeia tenuipes	I	Chone collaris	II	Diastylis laevis	I	Eurysyllis tuberculata	II
Anguilla anguilla	II	Bela nebula	I	Chone filicaudata	II	Diastylis lucifera	I	Exogone naidina	II
Exogone sp.	II	Hesionura elongata	II	Leucothoe spinicarpa	I	Marphysa fallax	II	Nephtys cirrosa	II
Fabricia sabella	N.A	Heterocirrus bioculatus	IV	Levinsenia gracilis	N.A	Marphysa sanguinea	II	Nephtys hombergi	II
Fabulina fabula	I	Heterocirrus spp	IV	Lilleborjia pallida	I	Marphysa sp.	II	Nephtys hystericis	II
Filograna implexa	N.A	Heteromastus filiformis	III	Liocarcinus arcuatus	I	Marphysa sp. (belli?)	II	Nephtys incisa	II
Galathea intermedia	I	Hexacorallia sp.	I	Liocarcinus arcuatus	I	Martastherias glacialis	I	Nephtys juv. Spp	II
Galathea sp.	I	Hiatella artica	I	Liocarcinus depurator	I	Mediomastus fragilis	III	Nephtys kersivalensis	II
Galathea squamifera	I	Hinia incrassata	II	Liocarcinus holsatus	I	Megaluropus agilis	I	Nephtys paradoxa	II
Galathowenia oculata	I	Hinia juv. indet.	II	Liocarcinus marmoreus	I	Megamphopus cornutus	I	Nephtys sp.	II
Galeomna turtoni	I	Hinia pygmaea	II	Liocarcinus pusillus	I	Melinna cristata	III	Nephtys sp. juv.	II
Gammarella fucicola	III	Hinia reticulata	II	Liocarcinus sp.	I	Melinna palmata	III	Nephtys spp	II
Gammaridea	I	Hippolyte varians	I	Liocarcinus vernalis	I	Melinna sp.	III	punctata	III
Gammaropsis palmata	I	Hippomedon denticulatus	I	Liocarcinus zariquieyi	I	Melita gladiosa	I	Nereiphylla rubiginosa	N.A
Gammaropsis shophiae	I	Hyala vitrea	I	Listriella picta	I	Melita palmata	III	Nereis caudata	IV
Gammaropsis sp.	I	Hyale nilssoni	I	Loripes lucinalis	I	Merceriella enigmatica	II	Nereis cf. lamellosa	III
Gammarus insensibilis	I	Hyalinoecia bilineata	N.A	Lucinoma borealis	I	Metaphoxus fultoni	I	Nereis diversicolor	III
Gammarus sp.	I	Hyalinoecia fauveli	N.A	Lucinoma borealis	I	Metaphoxus pectinatus	I	Nereis longissima	III
Gari costulata	I	Hyalinoecia sp.	N.A	Lumbrinerides sp.	II	Metazoea de porcellanidae	N.A	Nereis sp.	III
Gari depressa	I	Hydrobia ulvae	III	Lumbrineriopsis paradoxa	II	Microdeutopus anomalus	I	Nothria geofilliformis	II
Gari fervensis	I	Hydroides norvegica	N.A	Lumbrineris cf. gracilis	II	Microdeutopus damnoniensis	I	Nothria lepta	II
Gari tellinella	I	Idotea linearis	N.A	Lumbrineris emandibulata	II	Microdeutopus sp.	I	Nothria sp.	II

Gariidae indet.	I	Idunella picta	N.A	Lumbrineris emandibulata mabiti	II	Microdeutopus stationis	I	Notirus irus	I
Gattyana cirrosa	N.A	Inachus dorsettensis	I	Lumbrineris gracilis	II	Microdeutopus versiculatus	I	Notocirrus sp.	N.A
Gibbula magus	I	Inachus sp. larva	I	Lumbrineris impatiens	II	Microphthalmus sczelkowi	N.A	Notomastus latericeus	III
Glycera alba	II	Iphimedia obesa	I	Lumbrineris latreilli	II	Microspio sp.	N.A	Notomastus lineatus	III
Glycera capitata	II	Iphinoe serrata	I	Lumbrineris latreilli	II	Micrura sp.	N.A	Notomastus sp.	III
Glycera convoluta	II	Iphinoe sp.	I	Lumbrineris sp.	II	Modiolula phaseolina	I	Nucula nitida	I
Glycera lapidum	II	Jaera albifrons	I	Lunatia alderi	II	Modiolus barbatus	I	Nucula nitidosa	I
Glycera rouxii	II	Jaera sp.	I	Lutrania angustior	I	Modiolus gallicus	I	Nucula nucleus	I
Glycera sp.	II	Janira maculosa	N.A	Lutrania lutrania	I	Modiolus modiolus	I	Nucula sp.	I
Glycera tessellata	II	Jasmineira elegans	N.A	Lutrania lutrania	I	Monocolodes carinatus	I	Nucula sulcata	I
Glycera tridactyla	II	Jupiteria minuta	N.A	Lutrania sp.	I	Monopylephorus irroratus	V	Nucula turgida	I
Glycera unicornis	II	Kefersteinia cirrata	N.A	Lyonsia norvegicum	I	Montacuta ferruginosa	II	Ocenebra erinacea	II
Glycinde nordmani	II	Kellia suborbicularis	I	Lysianassa ceratina	I	Musculus discors	I	Odostomia sp.	II
Glycinde nordmanni	II	Labidoplax cf. thomsoni	I	Lysianassa insperata	I	Mya arenaria	II	Oligochaeta	V
Gnathia oxyurea	I	Labidoplax digitata	I	Lysidice ninetta	II	Myrtea spinifera	I	Onuphidae juvenil	II
Gobius niger	III	Labidoplax spp	I	Lysippe labiata	N.A	Mysella bidentata	I	Onuphis cf. geophiliformis	II
Goniada maculata	II	Lacydonia miranda	N.A	Macoma baltica	I	Mysia undata	I	Onuphis conchylega	II
Goniada sp.	II	Lagisca extenuata	II	Macropodia rostrata	I	Mysidacea	II	Onuphis eremita	II
Goodallia triangularis	I	Lanice cirrata	III	Mactra corallina	I	Mystides elongata	II	Ophelia bicornis	I
Gouldia minima	I	Lanice cirrata	III	Mactra stultorum	I	Mystides limbata	II	Ophelina acuminata	N.A
Gregariella barbatella	I	Lanice conchilega	II	Mactracea indet.	I	Mytilaster minimun	I	Ophiocentrus brachiatus	I
Guernea coalita	N.A	Lanice conchilega	II	Maera grossimana	I	Mytilus edulis	III	Ophiocornina nigra	I
Gymnammodytes semisquamatus	N.A	Lanice spp	II	Maera othonis	I	Nassarius incrassatus	II	Ophiodromus exuosus	II
Gyptis capensis	II	Laonice sp.	N.A	Maera sp.	I	Nassarius reticulatus	II	Ophiopsila aranea	I
Gyptis rosea	II	Leanira yhleni	N.A	Magelona alleni	I	Natantia sp.	N.A	Ophiotrix fragilis	I
Halcompa sp.	I	Lembos sp.	N.A	Magelona filliformis	I	Natica alderi	II	Ophiura albida	II
Haminoea navicula	II	Lepidonotus clava	II	Magelona minuta	I	Natica catena	II	Ophiura ophiura	II
Harmothoe antilopes	II	Lepidonotus squamatus	II	Magelona mirabilis	I	Neanthes caudata	III	Ophiura sp.	II
Harmothoe cf. lunulata	II	Leptocheirus pectinatus	III	Magelona papillicornis	I	Neanthes irrorata	III	Ophiura texturata	II

Harmothoe glabra	II	Leptocheirus pilosus	III	Magelona sp.	I	Neanthes juv. indet.	III	Ophiura texturata juv.	II
Harmothoe imbricata	II	Leptochelia savignyi	N.A	Magelona wilsoni	I	Neanthes sp.	III	Ophryotrocha labronica	II
Harmothoe impar	II	Leptochiton asellus	I	Malacoceros ciliata	III	Nebalia bipes	V	Ophryotrocha puerilis	II
Harmothoe lunulata	II	Leptochiton cancellatus	I	Malacoceros fuliginosus	V	Nebalia sp. indet.	V	Ophryotrocha sp.	II
Harmothoe sp.	II	Leptochiton inhaerens	I	Malacoceros girardi	III	Nebalia thyplops	II	Opistodonta pterochaeta	N.A
Harmothoe sp.(antilopes?)	II	Leptoneris glauca	III	Malacoceros sp.	III	Nematoda	III	Orbinia cuvieri	N.A
Harmothoe spinifera	II	Leptosynapta cf. gallienei	I	Malacoceros vulgaris	III	Nematoneis unicornis	II	Orchomene nana	N.A
Harpinia antennaria	I	Leptosynapta gallienei	I	Maldane glebifex	I	Nemertea	III	Orchomene similis	N.A
Harpinia pectinata	I	Leptosynapta inhaerens	I	Manayunkia aestuarina	II	Neoamphitrite a□nis	N.A	Oriopsis armandi	N.A
Harpinia sp.	I	Leucothoe incisa	I	Mangelia attenuata	I	Neoamphitrite cf. affinis	N.A	Oriopsis sp.	N.A
Haustorius arenarius	I	Leucothoe incisa	I	Mangelia nebula	I	Neoamphitrite sp.	N.A	Ostrea edulis	I
Hediste diversicolor	III	Leucothoe lilljeborgi	I	Mangelia smithi	I	Nephtys assimilis	II	Ovatella myosotis	N.A
Hermione hystrix	II	Leucothoe richiardii	I	Mangelia sp.	I	Nephtys caeca	II	Owenia filliformis	I
Hesione pantherina	II	Leucothoe sp.	I	Marphysa bellii	II	Nephtys cf. paradoxa	II	Owenia fusiformis	I
Pachygrapsus marmoratus	II	Phyllodoce rosea	II	Protodrilus sp.	N.A	Sphaerosyllis hystrix	II	Tholarus cranchii	I
Paguroidea indet.	I	Phyllodoce sp.	II	Psamechinus miliaris	I	Sphaerosyllis pyrifer	II	Thracia phaseolina	I
Pagurus bernhardus	I	Phylocheras bispinosus	I	Psammobia costulata	I	Sphaerosyllis sp.	II	Thracia villosiuscula	I
Pagurus prideauxi	I	Phylocheras monacantus	I	Psammolyce arenosa	II	Sphaerosyllis taylori	II	Thyasira exuosa	III
Pagurus sp. larva	I	Phylocheras trispinosus	I	Pseudobrania sp.	II	Sphenia binghami	I	Thyone fusus	I
Palaemon serratus	I	Pilargis verrucosa	I	Pseudocuma longicornis	II	Spio armata	III	Timoclea ovata	I
Pandora albida	I	Pilumnus hirtellus	I	Pseudocuma similis	II	Spio decoratus	III	Tonicella marmorea	I
Pandora inaequalvis	I	Pinnotheres pisum	N.A	Pseudocuma sp.	II	Spio fillicornis	III	Tricolia pullus	I
Pandora pinna	I	Pionosyllis serrata	II	Pseudopolydora antennata	IV	Spio martinensis	III	Triphora adversa	I
Panoploea minuta	I	Pisidia longicornis	I	Pseudopolydora paucibranchiata	IV	Spio sp.	III	Triphora aspera	I
Paradoneis armata	III	Pisidium sp. indet.	I	Pseudopolydora pulchra	IV	Spiochaetopterus costarum	III	Triphora perversa	I
Paradoneis lyra	III	Pisione remota	II	Pseudopolydora sp.	IV	Spiochaetopterus sp.	III	Trivia monacha	I
Paragnathia formica	III	Pista cristata	I	Pseudoprotella phasma	N.A	Spiochaetopterus typicus	III	Trophonopsis muricatus	I
Paramphitrite tetrabranchia	N.A	Plakosyllis brevipes	II	Pseudosyllis brevipennis	II	Spiophanes bombyx	III	Tryphosella nanoides	I
Paraonis fulgens	N.A	Plathelminthes	II	Pseudosyllis sp.	II	Spiophanes kroyeri	III	Tryphosella sarsi	I

<i>Paraonis gracilis</i>	N.A	<i>Platynereis dumerilii</i>	III	<i>Pygospio elegans</i>	III	<i>Spirobranchus polytrema</i>	N.A	<i>Trypanosoma longipes</i>	II
<i>Paraonis lyra</i>	N.A	Pleuronectidae sp.	II	<i>Quadrans serratus</i>	I	<i>Spisula elliptica</i>	I	<i>Tubifilicoides benedii</i>	V
<i>Parapionosyllis cf. gestans</i>	II	<i>Podoceus variegatus</i>	N.A	<i>Raphitoma purpurea</i>	I	<i>Spisula solida</i>	I	<i>Tubifilicoides pseudogaster</i>	V
<i>Parapionosyllis gestans</i>	II	<i>Poecilochaetus serpens</i>	I	<i>Raphitoma</i> sp.	I	<i>Spisula subtruncata</i>	I	<i>Tubulanus polymorphus</i>	II
<i>Parapionosyllis labronica</i>	II	<i>Poecilochaetus serpens</i>	I	<i>Retusa truncatula</i>	I	<i>Staurocephalus rudolphii</i>	IV	<i>Tubulanus</i> spp	II
<i>Parapionosyllis minuta</i>	II	<i>Polycirrus aurantiacus</i>	IV	<i>Retusa umbilicata</i>	I	<i>Stenothoe monoculoides</i>	II	<i>Turbelario</i> sp.	N.A
<i>Parapionosyllis</i> sp.	II	<i>Polycirrus cf. medusa</i>	IV	<i>Rhizorus acuminatus</i>	N.A	Stenothoidae	II	<i>Turboella parva</i>	I
<i>Parathelepus</i> sp.	I	<i>Polycirrus medusa</i>	IV	<i>Ringicula auriculata</i>	I	<i>Sternaspis scutata</i>	III	<i>Turbonilla acuta</i>	I
<i>Pariambus typicus</i>	III	<i>Polycirrus</i> sp.	IV	<i>Ringicula conformis</i>	I	<i>Sthenelais boa</i>	II	<i>Turbonilla elegantissima</i>	I
<i>Pariambus typicus varinermis</i>	III	<i>Polycirrus tenuisetis</i>	IV	<i>Ringicula</i> sp.	I	<i>Sthenelais cf. minor</i>	II	<i>Turbonilla lactea</i>	I
<i>Parvicardium exiguum</i>	I	<i>Polydora antennata</i>	IV	<i>Sabella pavonina</i>	I	<i>Sthenelais limicola</i>	II	<i>Turbonilla rufa</i>	I
<i>Parvicardium minimum</i>	I	<i>Polydora caeca</i>	IV	<i>Sabella</i> sp.	I	<i>Sthenelais minor</i>	II	<i>Turbonilla</i> spp	I
<i>Parvicardium ovale</i>	I	<i>Polydora ciliata</i>	IV	<i>Sabellaria alveolata</i>	I	<i>Sthenelais</i> sp.	II	<i>Turritella communis</i>	I
<i>Parvicardium papillosum</i>	I	<i>Polydora</i> sp.	IV	<i>Sabellaria spinulosa</i>	I	<i>Streblosoma bairdi</i>	N.A	<i>Turritella triplicata</i>	I
<i>Parvicardium scabrum</i>	I	<i>Polydora</i> juv. spp	IV	<i>Scalibregma inatum</i>	III	<i>Streblospio dekhuyzeni</i>	III	<i>Unciola crenatipalma</i>	N.A
<i>Pectinaria auricoma</i>	I	<i>Polydora ligerica</i>	IV	<i>Scaphander lignarius</i>	I	<i>Streblospio shrubsolii</i>	III	<i>Upogebia cf. typica</i>	I
<i>Pectinaria koreni</i>	I	<i>Polydora ligni</i>	IV	<i>Schistomeringos caeca</i>	II	<i>Streblosoma intestinalis</i>	N.A	<i>Upogebia deltaura</i>	I
<i>Pectinaria</i> sp.	I	<i>Polydora polybranchia</i>	IV	<i>Schistomeringos rudolphi</i>	IV	<i>Striarca lactea</i>	I	<i>Upogebia pusilla</i>	I
<i>Perinereis cultrifera</i>	III	<i>Polydora pulchra</i>	IV	<i>Scionella lornensis</i>	N.A	<i>Sycon ciliatum</i>	I	<i>Upogebia</i> sp.	I
<i>Pericolodes longimanus</i>	I	<i>Polydora</i> sp.	IV	<i>Sclerocheilus minutus</i>	N.A	<i>Sycon raphanus</i>	I	<i>Upogebia stellata</i>	I
<i>Pharus legumen</i>	I	<i>Polygordius apendiculatus</i>	I	<i>Scolaricia</i> sp.	I	<i>Syllis cornuta</i>	II	<i>Upogebia typica</i>	I
<i>Phascolion strombi</i>	I	<i>Polymnia nebulosa</i>	III	<i>Scolaricia typica</i>	I	<i>Syllis gerlachi</i>	II	<i>Urothoe brevicornis</i>	I
<i>Phascolion strombus</i>	I	<i>Polynoe scolopendrina</i>	II	<i>Scolecopsis fuliginosa</i>	V	<i>Syllis gracilis</i>	II	<i>Urothoe elegans</i>	I
<i>Phascolosoma elongatum</i>	I	<i>Polyophthalmus pictus</i>	I	<i>Scolecopsis</i> sp.	III	<i>Syllis prolifera</i>	II	<i>Urothoe poseidonis</i>	I
<i>Phascolosoma granulatum</i>	II	<i>Pomatoceros lamarckii</i>	N.A	<i>Scolecopsis squamata</i>	III	<i>Syllis</i> sp.	II	<i>Urothoe pulchella</i>	I
<i>Phascolosoma vulgare</i>	I	<i>Pomatoceros triqueter</i>	N.A	<i>Scoloplos armiger</i>	I	<i>Syllis variegata</i>	II	<i>Vauthompsonia cristata</i>	N.A
<i>Phaxas pellucidus</i>	I	<i>Pontocrates altamarinus</i>	I	<i>Scrobicularia plana</i>	III	<i>Synchelidium haplocheles</i>	I	<i>Veneracea</i> I	I
<i>Pherusa monilifera</i>	I	<i>Pontocrates arenarius</i>	I	<i>Scrupocellaria scrupea</i>	N.A	<i>Synchelidium maculatum</i>	I	<i>Venerupis aurea</i>	I
<i>Pherusa plumosa</i>	I	<i>Portumnus latipes</i>	I	<i>Semivermilia</i> sp.	N.A	<i>Tanais dulongii</i>	N.A	<i>Venerupis pullastra</i>	I

Pherusa sp.	I	Potamilla reniformis	N.A	Sertulariidae	I	Tapes decussata	I	Venerupis rhomboides	I
Philine aperta	II	Potamilla sp.	N.A	Sextonia longirostris	II	Telepsavus costarum	I	Venerupis senegalensis	I
Philine loweni	II	Potamilla torelli	N.A	Sigalion cf. mathildae	II	Telina tenuis	I	Venus casina	I
Philine spp	II	Potamopyrgus jenkinsi	II	Sigalion mathildae	II	Tellimya ferruginosa	II	Venus fasciata	I
Pholoe minuta	II	Praxillea oerstedii	N.A	Sigalion squamatum	II	Tellina compressa	I	Venus gallina	I
Pholoe synopthalmica	II	Prionospio caspersi	IV	Siphonoecetes kroyeranus	I	Tellina donacina	I	Venus juv. sp.	I
Phoronis psammophila	I	Prionospio cirrifera	IV	Siphonoecetes sp.	I	Tellina fabula	I	Venus ovata	I
Photis longicaudata	I	Prionospio ehlersi	IV	Siphonoecetes striatus	I	Tellina pusilla	I	Venus striatula	I
Phoxocephalus rudolphii	I	Prionospio fallax	IV	Sipuncula	I	Tellina pygmaea	I	Venus verrucosa	I
Phthisica marina	I	Prionospio malmgreni	IV	Skenea sp.	III	Tellina sp.	I	Veretillum cynomorium	I
Phyllochaetopterus sp.	N.A	Prionospio multibranchiata	IV	Skenia serpuloides	N.A	Tellina squalida	I	Veretillum sp.	I
Phyllodoce groelandica	II	Prionospio sp.	IV	Socarnes erythropthalmus	N.A	Tellina tenuis	I	Verruca stromia	I
Phyllodoce lamelligera	II	Prionospio steenstrupi	IV	Solen marginatus	I	Terebella lapidaria	I	Vituperis esribosa	V
Phyllodoce laminosa	II	Processa canaliculata	I	Solenacea	I	Terebellides stroemi	I	Xantho pilipes	N.A
Phyllodoce lineata	II	Processa modica	I	Sphaerodoropsis sp.	N.A	Terebellomorpha sp. indet	II	Xenosyllis scabra	II
Phyllodoce longipes	II	Processa nouveli	I	Sphaeroma monodi	II	Thalassema neptuni	I	Zenobiana prismatica	II
Phyllodoce maculata	II	Processa parva	I	Sphaeroma rugicaudata	II	Tharyx marioni	N.A	Zoantharia sp.	I
Phyllodoce mucosa	III	Processa sp.	I	Sphaeroma serratum	II	Thelepus setosus	N.A		
Phyllodoce paretti	II	Protodorvillea kefersteini	II	Sphaerosyllis bulbosa	II	Thia scutellata	II		

## Annex A WORKED EXAMPLE

A site was sampled with the following results:

### A.1 NUMBER OF TAXA (S)

The number (S) of taxa in the site species list was 30.

### A.2 AZTI MARINE BIOTIC INDEX (AMBI)

Species were attributed to the ecological groups as described in Section 3.1.2. The sample numbers in each group are shown in the Table below.

Group #	Abundance g#	Relative Abundance G#
0	400	0.08
I	500	0.10
II	900	0.18
III	1200	0.24
IV	2000	0.40

$gI + gII + gIII + gIV + gV = 5000$	$(GI + GII + GIII + GIV + GV) = 4.17$
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The observed value of AMBI according to 3.1.2 was 4.17.

### A.3 SIMPSON'S EVENNESS

The number of taxa found (S) was 30. The total number of organisms (N) was 5000.

The number of organisms found for each taxon is shown in Table 1.

Simpson's evenness was calculated in Table 1 according to 3.1.3.

**Table 1: Calculation of Simpson's Evenness**

Species P	$n_p$	$n_p (n_p - 1) \div (N(N-1))$
1	773	0.023875015
2	654	0.017085897
3	554	0.012256931
4	469	0.008781436
5	397	0.006289738
6	336	0.004503301
7	284	0.003215523
8	241	0.002314063
9	204	0.001656811

10	172	0.001176715
11	146	0.000846969
12	123	0.000600360
13	105	0.000436887
14	88	0.000306301
15	75	0.000222044
16	63	0.000156271
17	54	0.000114503
18	45	0.000079216
19	38	0.000056251
20	33	0.000042248
21	28	0.000030246
22	23	0.000020244
23	20	0.000015203
24	17	0.000010882
25	14	0.000007281
26	12	0.000005281
27	10	0.000003601
28	9	0.000002881
29	7	0.000001680
30	6	0.000001200
<b>Totals</b>	<b>5,000</b>	<b>0.084115 ( = λ' )</b>

#### A.4 IQI

In reference conditions, this site would have

$$\begin{aligned}
 [1 - \text{AMBI}_{\text{ref}} \div 7] & : 0.75 \\
 [1 - \lambda'_{\text{ref}}] & : 0.96 \\
 S_{\text{ref}} & : 35
 \end{aligned}$$

$\text{EQR}_{\text{IQI}} =$

$$\begin{aligned}
 & [0.38 \times (1 - \text{AMBI} \div 7) \div (1 - \text{AMBI}_{\text{ref}} \div 7) + 0.08 \times (1 - \lambda') \div (1 - \lambda'_{\text{ref}}) + 0.54 \times (S \div S_{\text{ref}})^{0.1} - 0.4] \div 0.6 \\
 = & [0.38 \times (1 - 4.17 \div 7) \div 0.75 + 0.08 \times (1 - 0.08) \div 0.96 + 0.54 \times (30 \div 35)^{0.1} - 0.4] \div 0.6 \\
 = & 0.69
 \end{aligned}$$



## **FURTHER READING**

ISO (2005) Water quality -- Guidelines for quantitative sampling and sample processing of marine soft-bottom macrofauna, ISO 16665.

[http://www.iso.org/iso/iso\\_catalogue/catalogue\\_tc/catalogue\\_detail.htm?csnumber=32348](http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=32348)

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Simpson, E.H. (1949) Measurement of diversity. *Nature* 163, 688

Borja, A., Josefson, A. B., Miles, A., Muxika, I., Olsgard, F., Phillips, G., Rodríguez, J. G., and Rygg, B. (2007). An approach to the intercalibration of benthic ecological status assessment in the North Atlantic ecoregion, according to the European Water Framework Directive. *Marine Pollution Bulletin* 55 (2007), 42–52