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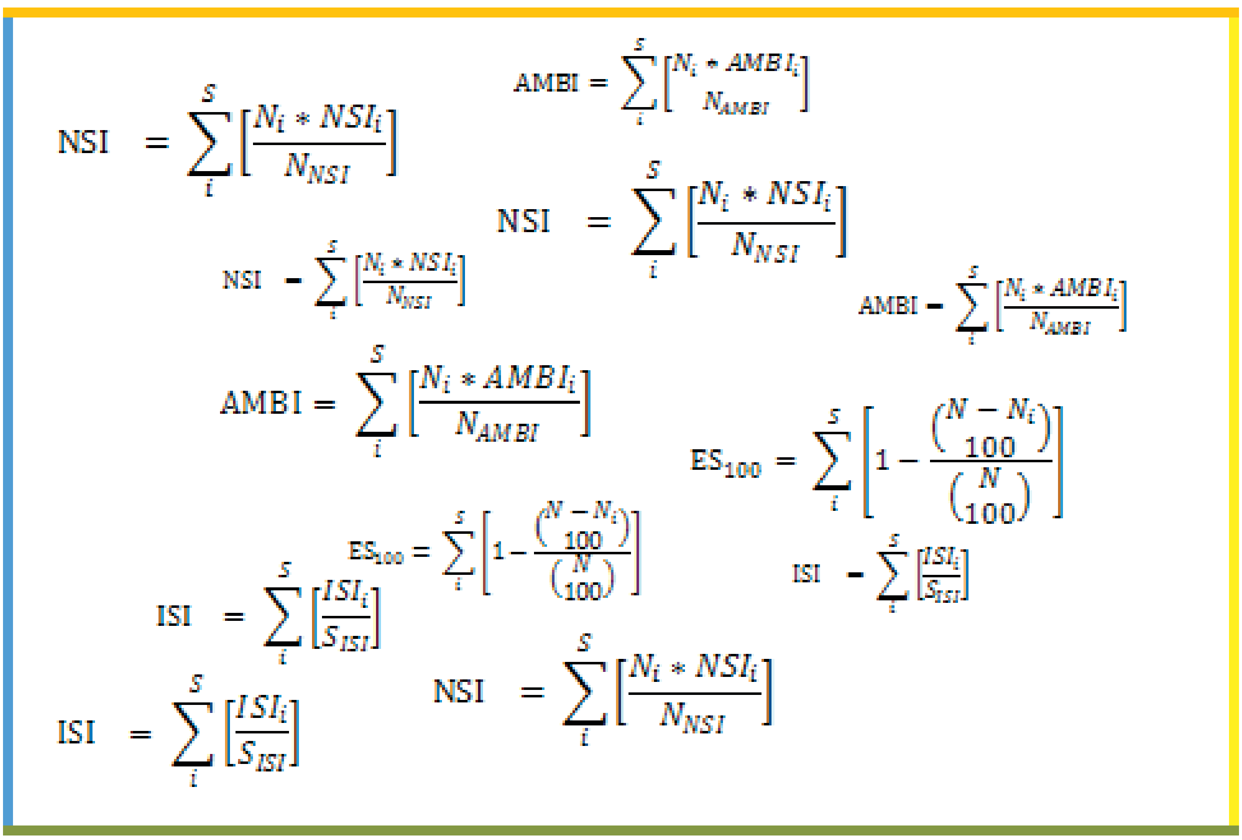
Norwegian Sensitivity Index (NSI) for marine macroinvertebrates, and an update of Indicator Species Index (ISI)



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- an institute in the Environmental Research Alliance of Norway

REPORT

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Abstract

This report describes the development of a new Norwegian species-sensitivity based index (NSI) for assessment of ecological quality status, and its comparison with the AMBI index. AMBI is an extensively used index in Europe, including Norway. Species sensitivity assignments of 516 taxa common to NSI and AMBI were compared. Significant discrepancies were revealed in the assignments. The performance of NSI and AMBI along different types of pressure gradients was compared. In most cases, NSI showed a better correlation with different pressures compared to AMBI. This was most pronounced in the fjords and coastal areas in Norway, less so at offshore sites in the North Sea. As a common set of taxa was used, differences in the correlations with pressures were entirely caused by different sensitivities assigned to the same taxa by NSI and AMBI. The results indicate that the Norwegian classification system will be improved by replacing AMBI with NSI as sensitivity component in assessing ecological status in coastal waters. The Indicator Species Index (ISI) from 2002 was updated for 591 taxa using data up to 2011.

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Norwegian Sensitivity Index (NSI) for marine macroinvertebrates, and an update of Indicator Species Index (ISI)

Preface

The classification system for ecological quality status in Norwegian coastal waters was under revision in 2012. This report describes recent development and performance of new species-sensitivity indices for the quality element *Marine macroinvertebrates.* Inclusion of these indices may constitute an improvement to the classification system compared to indices presently used.

Oslo, 29. January 2013

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Contents

Summary

Title: Norwegian Sensitivity Index (NSI) for marine macroinvertebrates and an update of Indicator Species Index (ISI)

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This report describes the development of a new Norwegian species-sensitivity based index (NSI) for assessment of ecological quality status, and its comparison with the AMBI index. AMBI is an extensively used index in Europe, including Norway. Species sensitivity assignments of 516 taxa common to NSI and AMBI were compared. Significant discrepancies were revealed in the assignments. The performance of NSI and AMBI along different types of pressure gradients was compared. In most cases, NSI showed a better correlation with different pressures compared to AMBI. This was most pronounced in the fjords and coastal areas in Norway, less so at offshore sites in the North Sea. As a common set of taxa was used, differences in the correlations with pressures were entirely caused by different sensitivities assigned to the same taxa by NSI and AMBI. The results indicate that the Norwegian classification system will be improved by replacing AMBI with NSI as sensitivity component in assessing ecological status in coastal waters. The Indicator Species Index (ISI) from 2002 was updated for 591 taxa using data up to 2011.

Sammendrag

Denne rapporten beskriver utviklingen av en ny norsk indeks (NSI) basert på artsømfintlighet, for bruk i klassifiseringen av økologisk status i marine vannforekomster. Det er gjort en sammenligning av NSI med AMBI. AMBI er en mye brukt indeks i Europa, inkludert Norge. Ømfintlighetsverdier for 516 taksa som var felles for NSI og AMBI ble sammenlignet. Betydelige uoverensstemmelser kom til syne. Responsen hos NSI og AMBI langs ulike typer av pressgradienter ble sammenlignet. I de fleste tilfellene viste NSI bedre korrelasjon med ulike påvikninger enn AMBI gjorde. Dette var mest markert i norske fjorder og kystnære områder, mindre utpreget offshore i Nordsjøen. Etter som et felles sett av taksa ble brukt ved beregningene av NSI og AMBI, skyldtes forskjellene i sin helhet uoverensstemmelser i artenes ømfintlighetsverdier i de to systemene. Resultatene indikerer at det norske klassifiseringssystemet kan forbedres ved at AMBI skiftes ut med NSI som ømfintlighetskomponent i tilstands klassifisering i kystvann. Indicator Species Index (ISI) fra 2002 ble oppdatert for 591 taxa med data til og med 2011.

1. Introduction

In coastal waters, benthic marine macroinvertebrate fauna is one of the biological elements indicated by the European Water Framework Directive for classification of ecological quality status (EQS). Several indices are currently in use. Two main index types are the diversity and sensitivity indices. They are applied singly or together in combination indices. Different indices correlate generally rather well to subtidal marine perturbations, but if a dominant indicator species is classified differently by different methods, the results will diverge.

Sensitivity or tolerance values of species are used in the AMBI index (Borja et al. 2000), in the Swedish BQI (Leonardsson et al. 2009) and in the Norwegian ISI (Rygg 2002). Outside Europe, similar types of indices have been developed, e.g. the BRI index in Southern California (Smith et al. 2001; Teixeira 2012).

Here, we describe a new Norwegian species sensitivity index (NSI), and compare its performance to AMBI along pressure gradients in coastal Norway and offshore (North Sea). The development of NSI is basically similar to the methods used for BQI (Rosenberg et al. 2004) and ISI (Rygg 2002).

AMBI is presently included as a sensitivity component in the Norwegian quality indices NQI1 and NQI2, applied by the Norwegian Climate and Pollution Agency (Klif) as metrics to characterise EQS in Norway (Direktoratsgruppa 2009; Carletti and Heiskanen 2009). Therefore, a main issue in the present report was to compare NSI and AMBI. The aim of the comparison was to detect if discrepancies in species sensitivity values in NSI and AMBI could cause the two indices to perform differently (not equally well) along pressure gradients. If NSI performed better, replacement of AMBI with NSI could improve the Norwegian classification system.

In addition calculated species ES_{100} have also been used to update the Indicator Species Index (ISI) from 2002, see Rygg (2002) and Appendix A for further details. ISI is a qualitative index. It gives a stronger signal than the quantitative sensitivity indices in cases where rare (low-abundant) species disappear.

Description and comparison of sensitivity indices and their performance along pressure gradients are presented in a number of publications (e.g. ICES 2008; Josefson et al. 2009; Marques et al. 2009; Pinto et al. 2009; Borja et al. 2011). Discrepancies between indices most likely result from differences in the assignment of sensitivity/tolerance levels to major species. Gremare et al. (2009) compared AMBI and BQI based on a very large dataset from the pan-European MacroBen database. They found that AMBI and the BQI sensitivity component correlated poorly.

In a study in the Gulf of Lions Labrune et al. (2006) found that BQI was efficient in distinguishing impacted from un-impacted sites, whereas AMBI was not. Labrune et al. (2012) compared several indices along a gradient of sedimentary organic carbon outside the mouth of the Rhône river and found that BQI correlated better than AMBI with organic carbon and with Benthic Habitat Quality index (BHQ) (Nilsson & Rosenberg 1997).

2. Material and methods

2.1 Sampling and identifications

The data used for developing NSI are from Norwegian fjords and coastal waters (Figure 1). The sampling stations are scattered along the entire coast, but are more numerous in the southern regions. They span a period from about 1980 to 2011. Some stations have been sampled several times.

Figure 1. Stations in Norway which supplied data for calculating species sensitivity values

The sample collection and treatment have been carried out according to *Water quality - Guidelines for quantitative sampling and sample processing of marine soft-bottom macrofauna* (ISO 16665:2005), using 1 mm mesh sieves for retaining animals from the sediment. The identifications were made to species level, when possible. All data are held in the NIVA database.

2.2 Data treatment

As the calculations involved use of the diversity measure ES_{100} (Hurlbert 1971), which requires at least 100 individuals, samples with lower abundancies could not be included. Also samples from very shallow sites (5 m or less) and from fresh-water influenced sites were excluded in order to ensure a more consistent dataset. A total of 3200 samples from 1835 station visits involving 1153 stations were used in the calculations. There are 1882 taxa in the NIVA database. 591 of them were found in more than 20 samples, which was required for sensitivity value assignments in NSI and ISI_{2012}. Total number of individuals in the base is 1.93 millions. The assigned taxa represent 87% of the total individuals.

The species codes in the NIVA database as well as the names in the AMBI species list were harmonised with WoRMS nomenclature (World Register of Marine Species, http://www.marinespecies.org) to ensure a common taxonomic basis.

2.3 Calculation of NSI species sensitivity values (ES_{100}avg)

Each individual of each species was assigned the ES_{100} value of the samples in which it occurred. The sum of all ES_{100} values for all individuals of each species was then divided by the total number of individuals of each species to obtain the ES_{100} average value, defining the sensitivity value (ES_{100}avg) of the species. Only species occurring in more than 20 samples (of the total of 3200 samples) were assigned sensitivity values. 591 taxa occurred in more than 20 samples. The procedure is similar to that used for obtaining species sensitivity values ($ES_{50\_0.05}$) in the Swedish BQI (Rosenberg et al. 2004). The difference is that NSI is based on ES_{100} instead of ES_{50}, and the average is used instead of the 5% percentile. The average was chosen because it is statistically independent of the number of observations, but this may possibly be at the cost of loosing some information on tolerant species in the extreme lower tail of the ES distribution. To remedy this, ISI is included in the classification system. Species sensitivity values in ISI are based on the lower tail of the ES distribution (Rygg 2002). ISI is a qualitative index. Only presence of species is used in the calculations. In contrast, NSI is a quantitative index, using the species abundances to weight different species sensitivity (ES_{100}) in the calculations. Behind NSI, ISI and BQI is the assumption that ES is related to faunal status, and that it is sound to use lowered ES as surrogate for environmental pressure.

$$\mathrm{ES}_{100} = \sum_{i}^{S}\left[1 - \frac{\binom{N-N_i}{100}}{\binom{N}{100}}\right]$$

ES_{100} describes an estimated number of species in a random subset of 100 individuals taken from a sample with N individuals, S species and N_i individuals of species i

2.4 Calculation of new ISI (ISI_{2012}) species sensitivity values (ES_{100}min5)

The methodology is described in Rygg (2002). Among the samples in which the taxon occurred, the five samples having the lowest ES_{100} values were selected and their average ES_{100} calculated. The average of the five lowest ES_{100} was defined as the sensitivity value of that taxon. Selecting the five lowest-diversity samples instead of e.g. only the one lowest-diversity sample was done as a precaution against random outliers. A suggestion to include more than five samples was rejected, as that could cause more high-diversity samples to contribute to the average and thus weaken the discrimination between the sensitivity values assigned to the different taxa.

$$\text{ISI} = \sum_{i}^{S} \left[\frac{ISI_i}{S_{ISI}}\right]$$

ISI_i is the sensitivity value of species i, S_{ISI} the number of species with assigned values

2.5 Calculation of AMBI sample index value

AMBI uses a semiquantitative scale for species specific tolerance (Borja et al., 2000). Each taxon is assigned one of five ecological groups (Table 1).

Table 1. Classification of species in the AMBI system

Description	Ecological group (EG)	Tolerance value
Sensitive species	I	0
Indifferent species	II	1.5
Tolerant species	III	3
Opportunistic species	IV	4.5
Pollution indicating species	V	6

Assignments in AMBI are made partly by expert judgement, whereas in NSI they are calculated in a fully objective and transparent way.

The formula for calculating AMBI sample index value is:
AMBI = 0*EGI + 1.5*EGII + 3*EGIII + 4.5*EGIV + 6*EGV, where EGI the proportion of individuals belonging to group I, etc.

$$\text{AMBI} = \sum_{i}^{S} \left[\frac{N_i * AMBI_i}{N_{AMBI}}\right]$$

$AMBI_i$ is the assigned tolerance value (0; 1.5; 3; 4.5 or 6), N_{AMBI} the total number of individuals with assigned values

2.6 Calculation of NSI sample index value

The NSI sensitivity index value of a sample is obtained by dividing the sum of ES_{100}avg values of all individuals in the sample, by the total number of individuals in the sample, giving the average species sensitivity value of all individuals in the sample. Only the species with an ES_{100} value assigned to them are to be included in the calculation. The NSI index is calculated with equal weight given to each individual.

The species values for NSI and AMBI rank in opposite order, with highest values for the most sensitivite species in NSI, lowest values for the most sensitivite species in AMBI. Thus, the coefficients in the AMBI formula represent tolerance values. In the correlation plots in the result chapter, the AMBI data are shown on reversed axes.

In the comparisons between NSI and AMBI, the average values from replicates pr. station and date (station visit) were used. The number of station visits was 1835, representing 1153 stations.

$$\text{NSI} = \sum_{i}^{S} \left[\frac{N_i * NSI_i}{N_{NSI}} \right]$$

N_i individuals of species i, NSI_i is the sensitivity value of species i, N_{NSI} the number of individuals with assigned values

2.7 Pressure gradients

Correlations between the indices and pressure data were assessed using simple linear regression models (Microsoft Excel trendlines). Figure 2 shows the locations of the coastal sites used. The offshore sites in the North Sea are not shown.

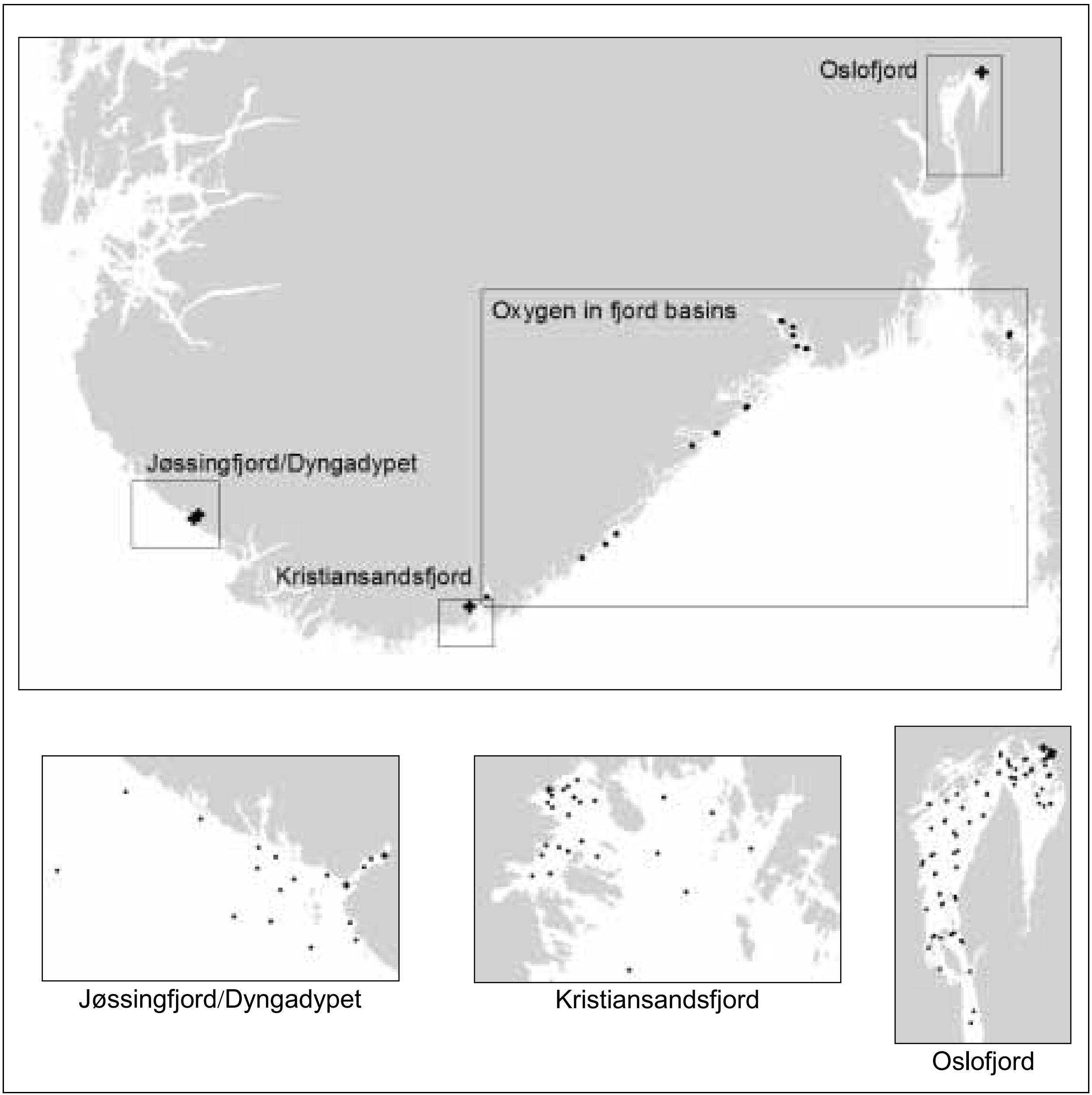

Figure 2. Areas and stations used for the pressure gradient studies. Crosses: Sources of pollution. Dots: Fauna stations. Some of the data used for effect of oxygen in fjords are from a project lead by the Institute of Marine Research 2003-2005 results reported in (Buhl-Mortensen et al. 2006).

2.7.1 Heavy metal pollution

Falconbridge Nikkelverk is a smelter and refinery plant at Kristiansand, South Norway. The plant is located close to a bay in the western part of the Kristiansandsfjord. The primary metals refined are nickel, copper and cobalt. Data of benthic fauna and sediments were available from 24 stations in the fjord, where 5 stations were sampled twice and the rest one time, during the last three decades. The fjord sediments in the vicinity of the plant are strongly contaminated with heavy metals (Oug et al. 2004; Berge et al. 2007). Here, fauna status is analysed vs. nickel concentrations in the sediments. Other metals in the sediments (e.g. copper), were significantly correlated with nickel levels, but had fewer data.

2.7.2 Urban effluents gradient (toxic compounds, etc.) in the Oslofjord

The Oslofjord penetrates inland over a distance of about 100 km from the open Skagerrak to the city of Oslo. Approximately 1 million people live in the area. The sediments in Oslo harbour and the innermost part of the fjord are contaminated as a result of industrial activities, boat traffic, urban road traffic, municipal wastewater, and small rivers draining from industrial areas. The fauna in the inner Oslofjord is affected by the urban effluent (Olsgard 1995). Using copper concentrations in sediment samples as an indicator of urban effluents shows a gradient with high concentrations close to the harbour of Oslo and decreasing concentrations with increasing distance from the harbour (Figure 7). Sediment levels of PCB, PAHs and other pollutants also are high in the innermost part of the fjord.

2.7.3 Physical disturbance from mine tailings

The Jøssingfjord area, Norway has been used for sea disposal of finely ground, inert tailings from a titanium mine since 1960 and discharged about 2 million tonnes/year in the 1980s. In 1984, the sub-marine outfall was relocated from the shallow Jøssingfjord (about 30 m) to the deep basin Dyngadypet (about 150 m) outside the fjord entrance. The relocation resulted in increased accumulation within 2-3 km from the new outfall. Tailings were detectable in the sediments as particles with high titanium content, i.e. 10-15% TiO_2 in tailings compared to a background level of 0.5-1%. Changes in the benthic fauna at varying distances from the old and new outfall sites were followed, and biological impacts of mine tailings analysed (Olsgard & Hasle 1993). A sedimentation of 4-5 cm of tailings per year at some locations resulted in changes in faunal composition. At less than 4-5 cm of tailings, effects on the fauna were reduced. At less than 1 mm per year, no impact was observed.

2.7.4 Oxygen levels in fjord basins

In August 2003 and August 2008 samples for biological and environmental analyses were obtained from fjord basins along the Norwegian Skagerrak coast, NE North Sea (Figure 2). In 2003, 11 stations, one in each of 11 basins were sampled (Buhl-Mortensen et al. 2006). In 2008, 27 stations (including 9 of the stations sampled in 2003) in 15 basins were sampled (Bouchet et al. 2012).

The oxygen concentrations used for the correlation with NSI and AMBI were minimum values during the five years prior to the sampling in 2003 (Buhl-Mortensen et al. 2006) or values measured close to the bottom at the time of sampling in 2008 (Bouchet et al. 2012). Stations at the largest depths in the basins experienced the lowest oxygen concentrations.

2.7.5 Petroleum hydrocarbons around oil platforms in the North Sea

Around the oil platforms in the North Sea, several studies have shown reduced faunal status at sites with elevated sediment levels of petroleum hydrocarbons (Olsgard & Gray 1995; Muxica & al. 2005; Ugland et al. 2008). The data used in the present report were extracted from the Norwegian MOD base (http://projects.dnv.com/MOD/First.aspx)[1] and the British base (http://www.oilandgasuk.co.uk/knowledgecentre/uk_benthos_database.cfm.)

[1] Thanks are due to Thomas Moskeland at DNV for providing access to the MOD database

3. Results

3.1 Species sensitivity values in NSI (ES_{100}avg) compared to AMBI (EG)

In the ES_{100}avg-list for NSI, 591 taxa were assigned sensitivity values (Appendix A). Among these, 75 lacked classifications in AMBI. However, these were less important species, all together representing only 1% of the individuals in the whole dataset.

NSI and AMBI sample values were calculated using the common 516 taxa. Any difference between status must therefore be due to the discrepancies in the species specific sensitivity values in the two systems.

In the AMBI list, most of the species are classified as sensitive (EGI) or indifferent (EGII). Using the same percentiles in a grouping of ES_{100}avg values, their corresponding intervals to EG were defined (Table 2, Figure 3).

Table 2. Percentage of AMBI taxa belonging to each ecological group and corresponding ES_{100}avg intervals in NSI

Number of taxa	% of all 516 taxa	AMBI EG	NSI ES_{100}avg intervals
8	1.5	V	<10.4
41	7.5	IV	10.4-18.8
89	17	III	18.8-23.1
168	33	II	23.1-27.4
210	41	I	>27.4

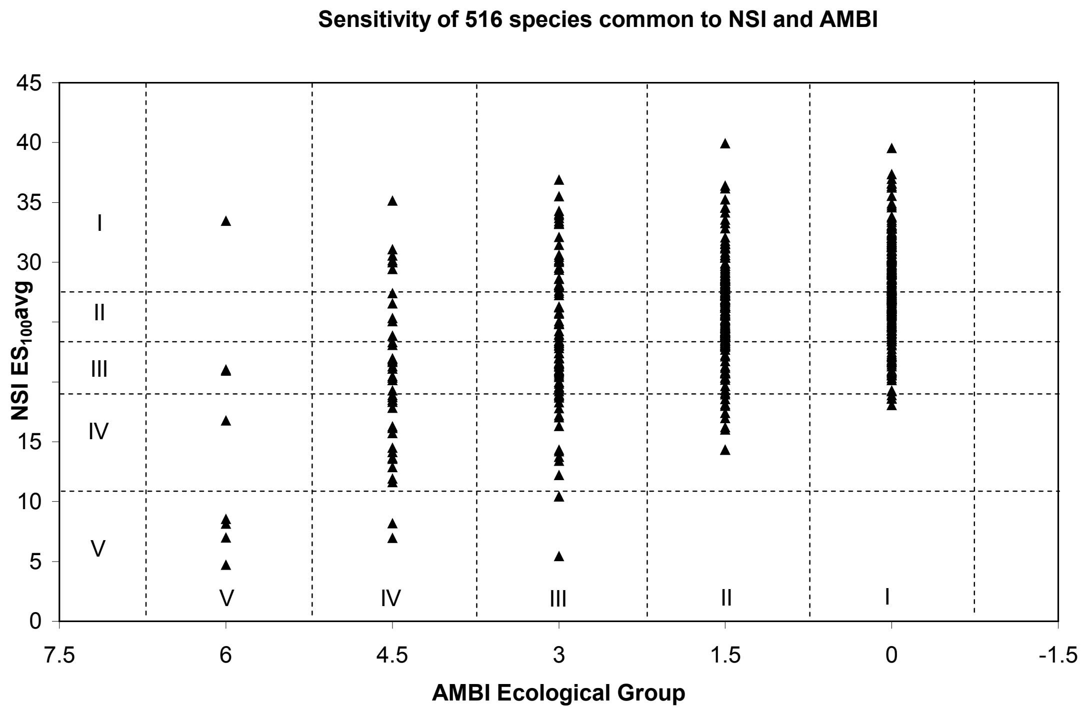

Figure 3. Species sensitivity values of NSI (ES_{100}avg) vs AMBI (ecological groups and tolerance values) for the 516 taxa compared. Border values between ES_{100}avg intervals corresponding to EG are presented as broken lines

3.2 Correlation between NSI and AMBI sample values

NSI and AMBI sample values were calculated for the whole set of fjord and coastal data (offshore data excluded) and are shown in Figure 4.

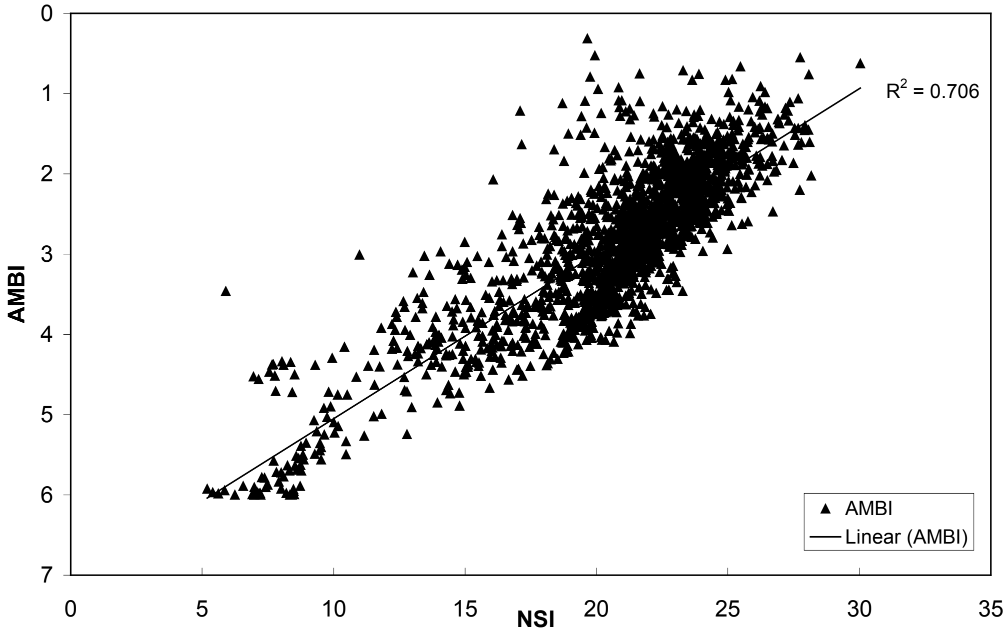

Figure 4. AMBI relation to NSI at 1835 station visits show high squared correlation coefficient (R^2=0.706)

3.3 Comparison of NSI and AMBI values along pressure gradients

Relations between different pressures and the two indices (NSI and AMBI) were investigated along pressure gradients that are shown in Figure 5,7 and 8-12.

In the gradient of metal contaminated sediments outside the Falconbridge Nikkelverk the two indices showed improvements in relation to decreasing sediment concentrations of nickel (Figure 5). Other metals had patterns similar to nickel, but had fewer data.

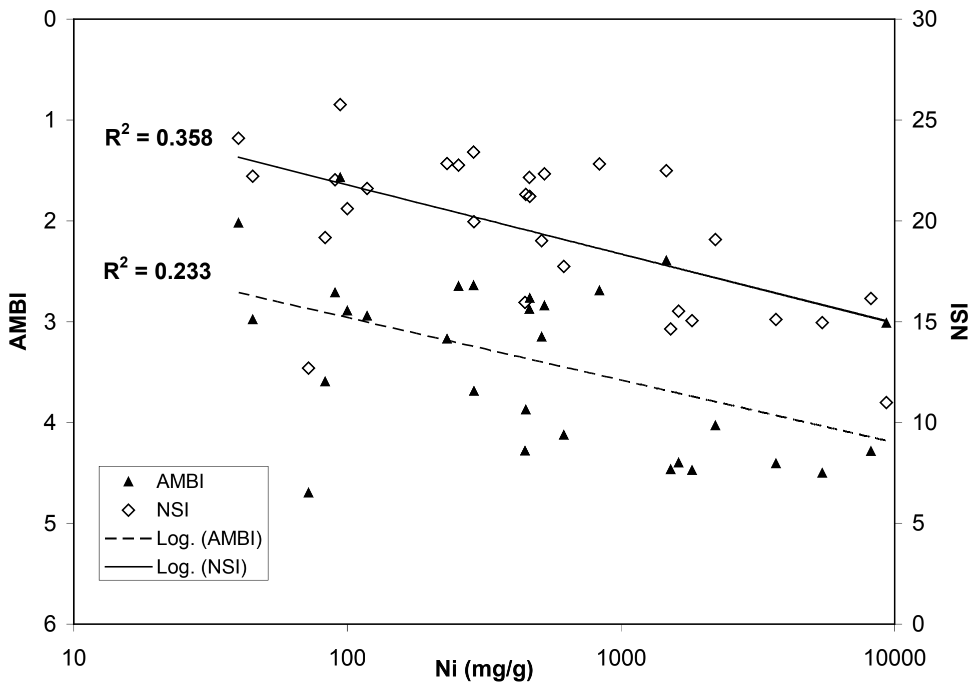

Figure 5. AMBI and NSI relation to sediment nickel (Ni) concentration gradient in Kristiansandsfjorden

In the Oslofjord there is a spatial gradient in urban/industrial effluents with inputs of organics, heavy metals as well as polychlorinated hydrocarbons, PCB (Olsgard 1995) with the main point sources located in the harbour area of Oslo (Figure 2, 6). Plotting the indices against distance from the point source showed a clear improvement with increasing distance from the city harbour area (Figure 7).

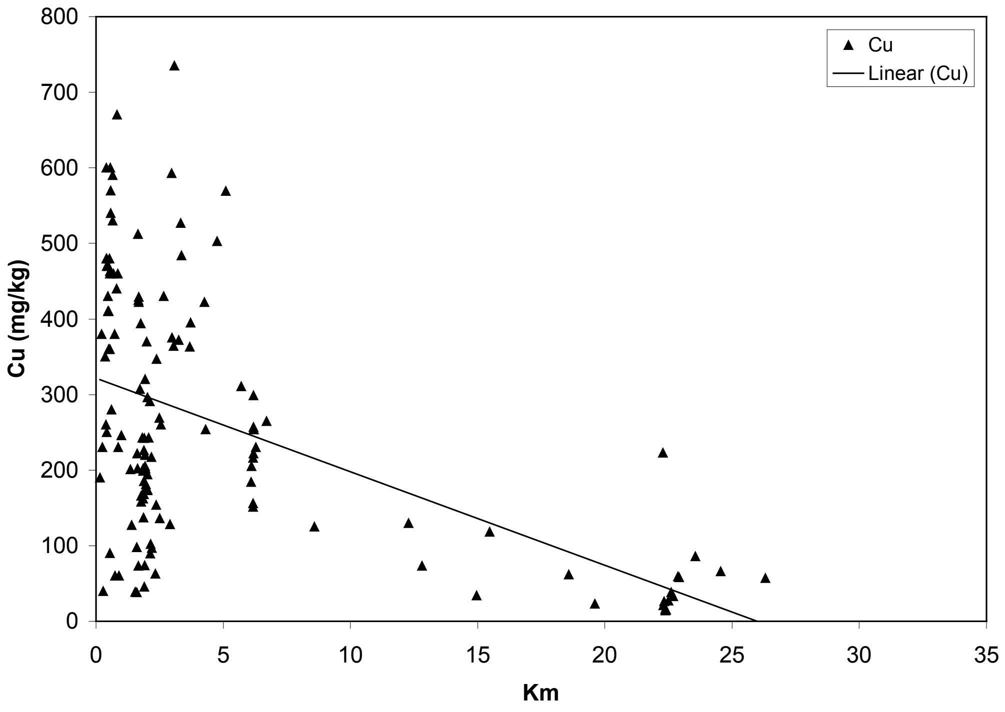

Figure 6. Sediment copper concentrations with increasing distance (km) from Oslo harbour

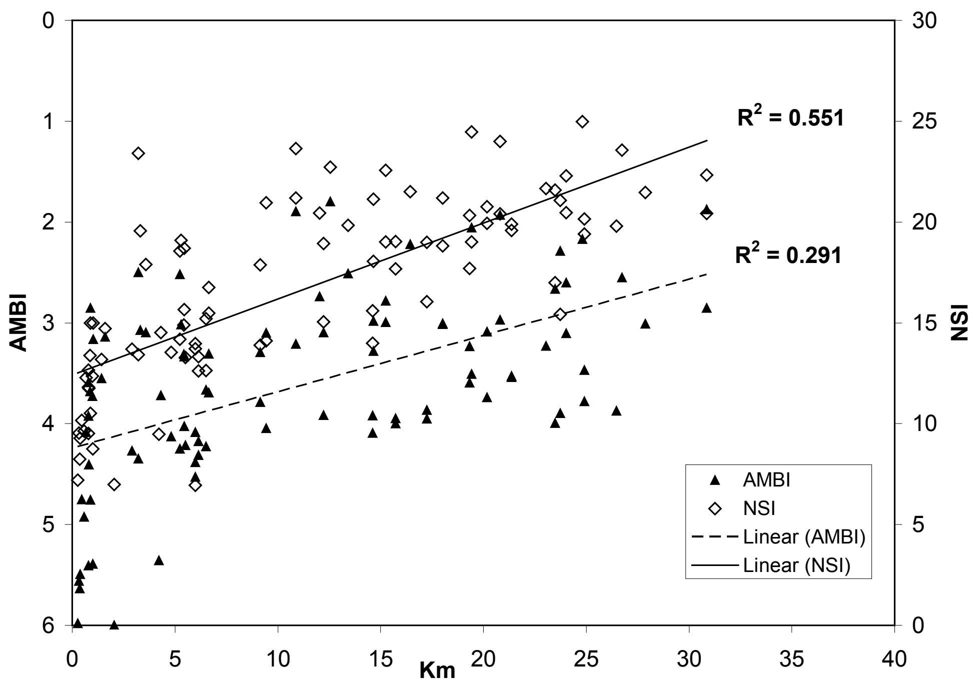

Figure 7. AMBI and NSI relation to distance (km) from Oslo harbour. In the gradient of tailing deposition in the Jøssingfjord/Dyngadypet area both indices improved in relation to decreasing sediment concentration of TiO_2 which reflected the amount of tailings deposited

(Figure 8).The main significance of its presence was considered as indicator of physical disturbance by tailing deposition.

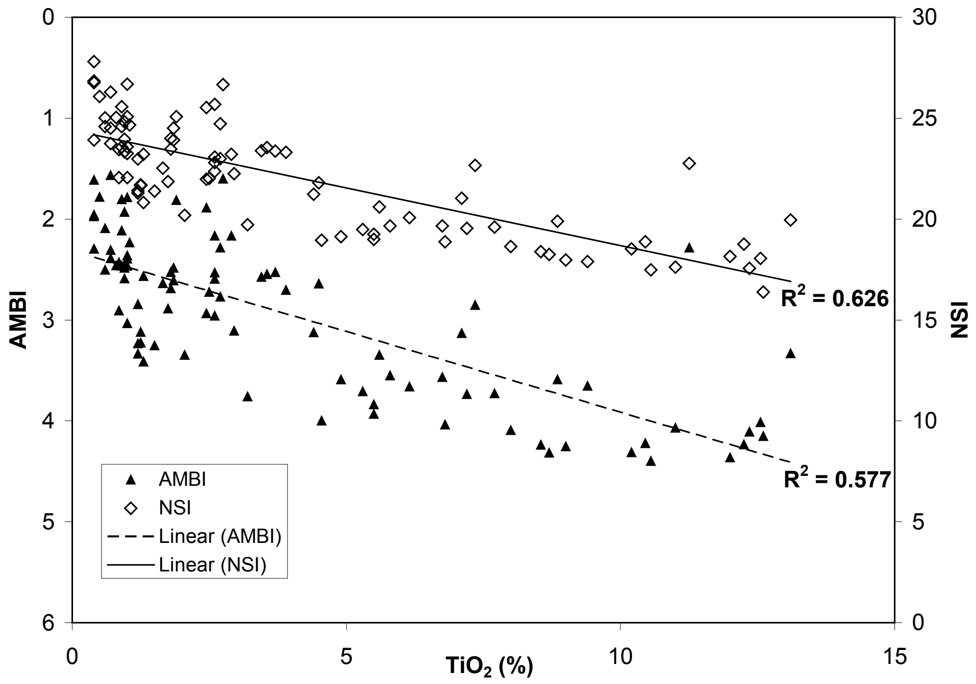

Figure 8. AMBI and NSI relation to sediment TiO_2 concentration gradient in Jøssingfjorden/Dyngadypet

Deep water oxygen is one of the most important environmental gradients in fjord basins inside sills along the Norwegian coast of Skagerrak (Figure 9). Deep water renewal and oxygen consumption rates govern the oxygen fluctuations and minima in the fjords.

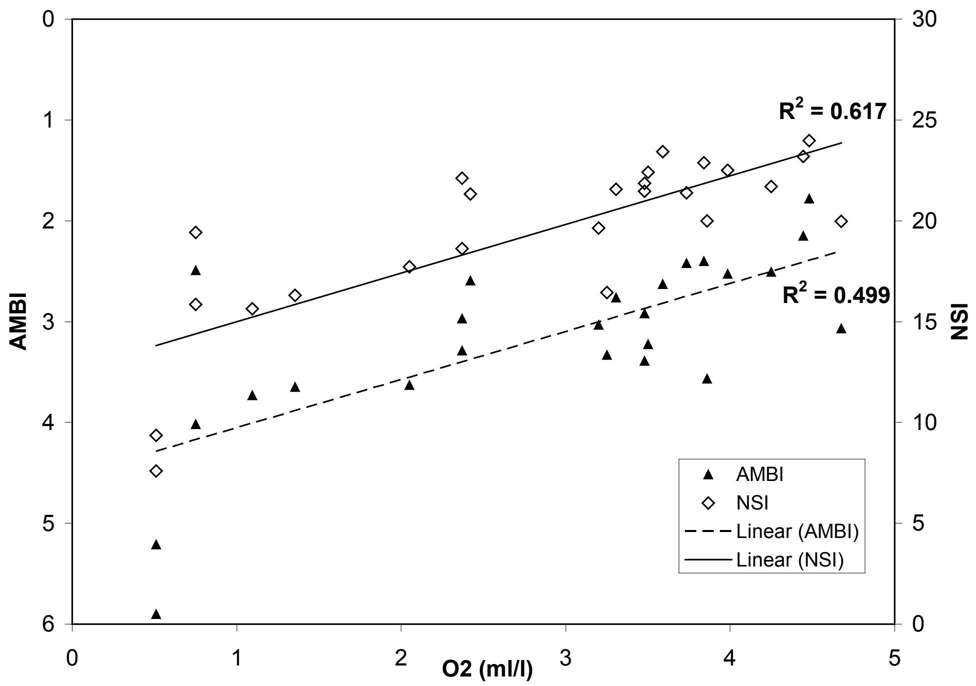

Figure 9. AMBI and NSI in relation to minimum oxygen (O_2) concentrations in fjord basins in Southern Norway. Oxygen data are partly from Buhl-Mortensen et al. 2006. The squared correlation coefficient show better fit for NSI (R^2=0.62) compared to AMBI (R^2=0.50), see Table 3.

In Figures 10-12, NSI and AMBI are plottet against total hydrocarbons (THC) in the sediments in the vicinity of two Norwegian and one British oil installation.

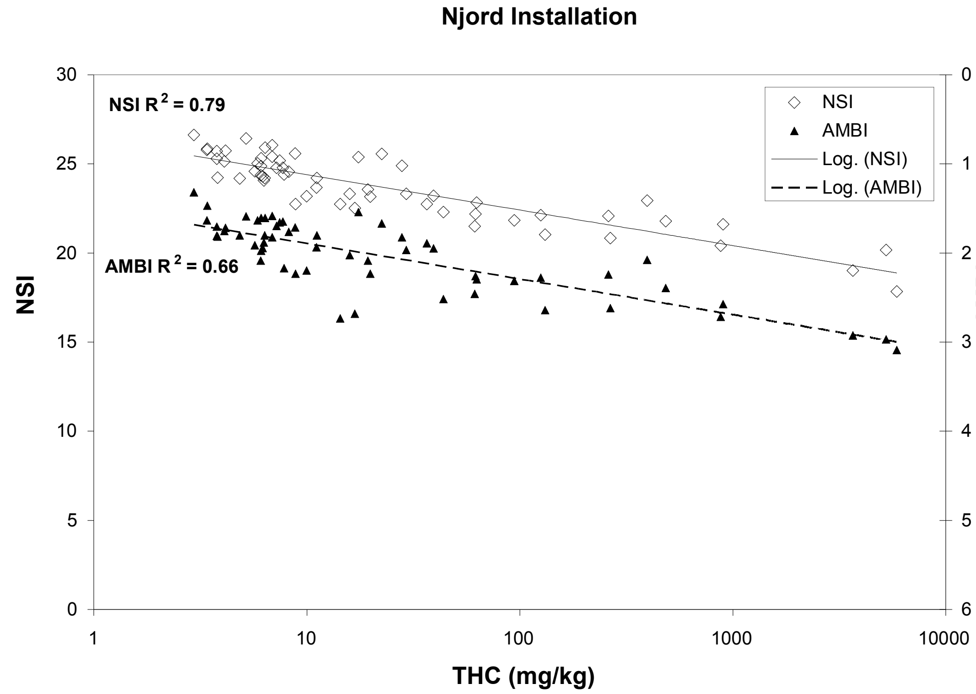

Figure 10. NSI and AMBI relation to petroleum hydrocarbons (THC) in sediments around the Njord installation, Norwegian North Sea. The squared correlation coefficient show better fit for NSI (R^2=0.79) compared to AMBI (R^2=0.66), see Table 3.

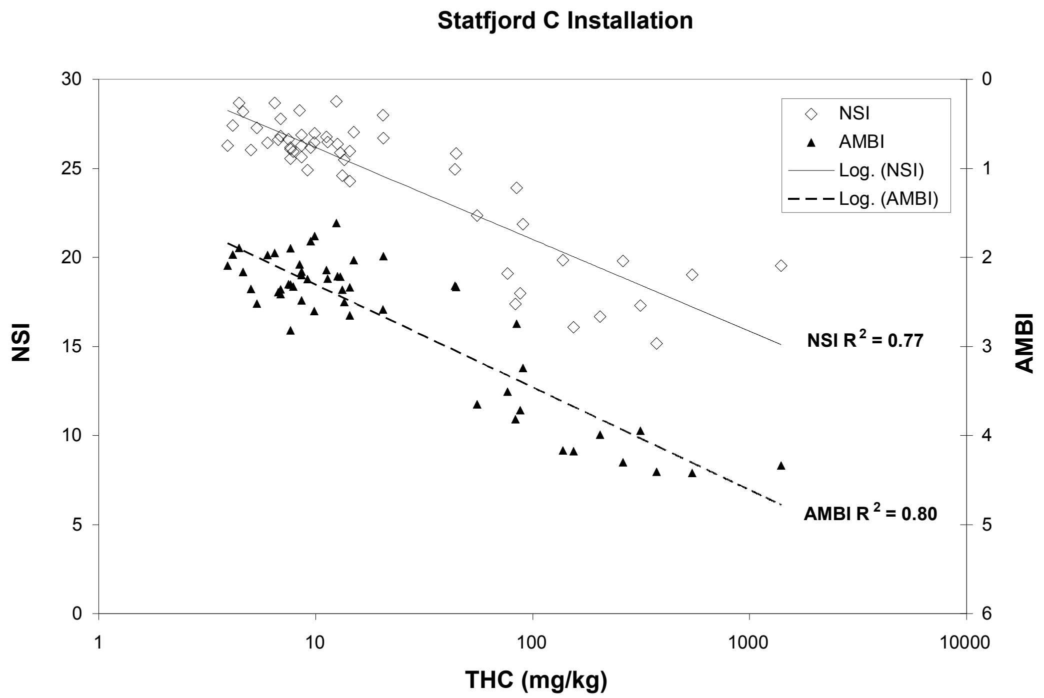

Figure 11. NSI and AMBI relation to petroleum hydrocarbons (THC) in sediments around the Statfjord C installation, Norwegian North Sea. The squared correlation coefficients for NSI (R^2=0.77) and AMBI (R^2=0.80) are similar, see Table 3.

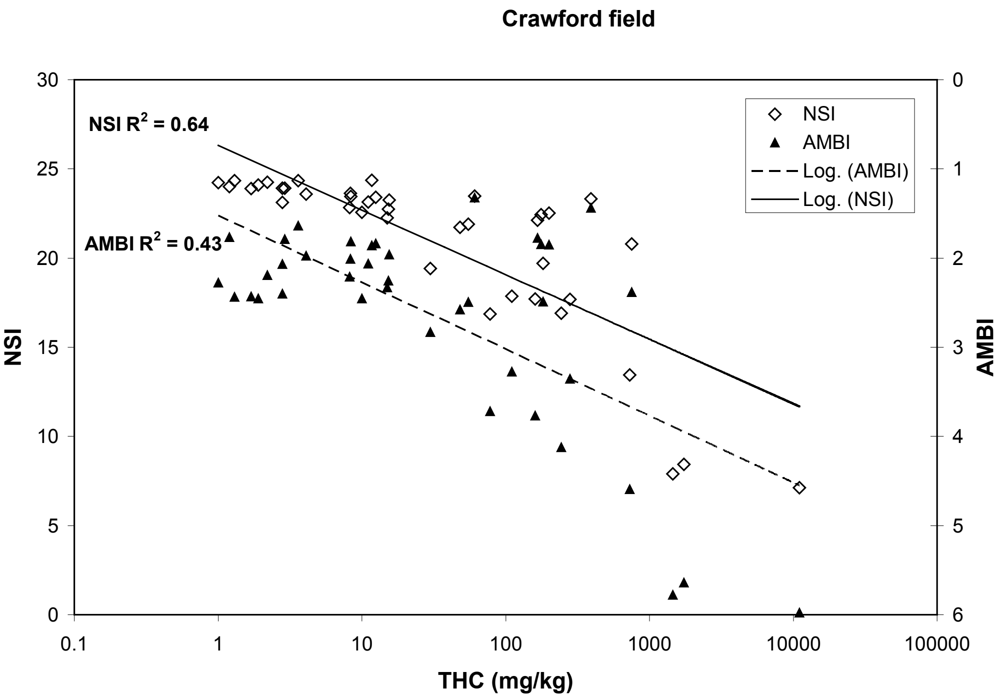

Figure 12. NSI and AMBI relation to total petroleum hydrocarbons (THC) in the sediments around the Crawford field, British North Sea. The squared correlation coefficient show better fit for NSI (R^2=0.64) compared to AMBI (R^2=0.43), see Table 3.

Table 3 shows correlations of NSI and AMBI with all the tested pressure gradients. The results indicate that NSI performs better than AMBI in the Norwegian fjords and coastal areas. Also, NSI seems to be at least equally well suited as AMBI for classifying ecological status at offshore sites in the North Sea.

Table 3. Squared correlation coefficients of NSI and AMBI with pressure gradients. The better of the two are shown in bold. *** O2 data partly from Buhl-Mortensen et al. 2006.

Pressure gradient	**Correlation NSI R^2**	**Correlation AMBI R^2**
Coast, NO		
Kristiansandsfjord, metaller	**0.36**	0.23
Oslofjord, distance from harbour	**0.55**	0.29
Titania, mine tailings	**0.63**	0.58
Fjordbassenger, reduced O_{2***}	**0.62**	0.50
North Sea, NO		
Brage	**0.64**	0.38
Njord	**0.79**	0.66
Statfjord A	0.73	**0.74**
Statfjord B	**0.57**	**0.57**
Statfjord C	0.77	**0.80**
Veslefrikk	**0.73**	0.65
Yme Gamma	**0.71**	0.68
North Sea, UK		
13/24B-3, UK	**0.58**	0.33
Alba	**0.74**	0.73
Angus	0.60	**0.72**
Britannia	**0.87**	0.76
Captain	**0.64**	0.38
Clair	0.51	**0.61**
Crawford	**0.64**	0.43
Donan	0.43	**0.51**
Gannet	0.27	**0.48**
Hutton	0.88	**0.89**
Lomond	**0.63**	**0.63**
Miller	**0.75**	0.74
Monan	**0.84**	0.79
Murchison	0.47	**0.54**
Nelson	**0.56**	0.44

3.4 Comparison of ISI_{2012} and NSI values along pressure gradients

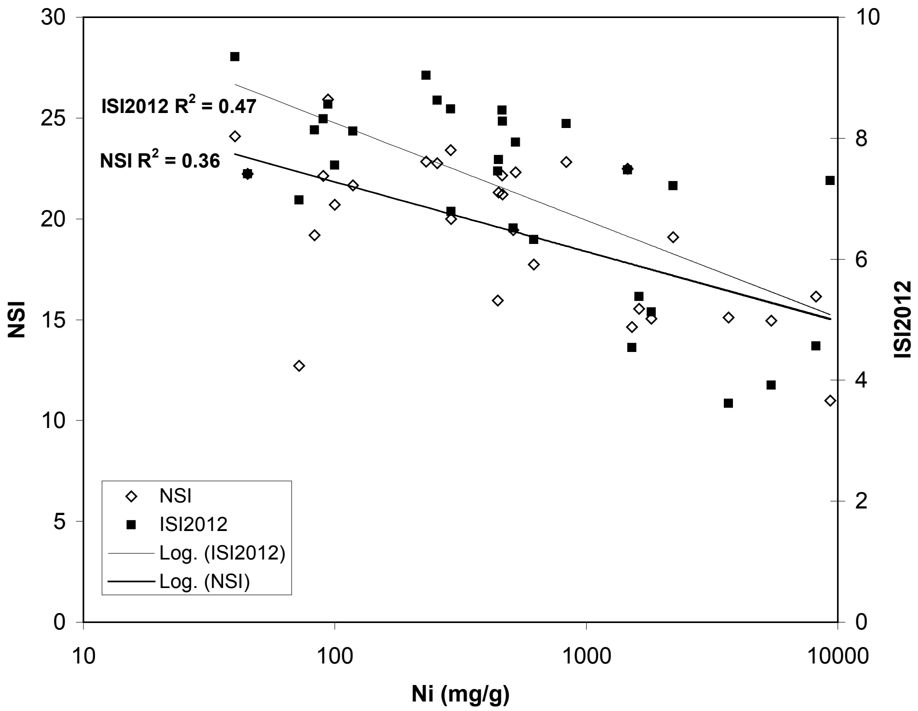

Figure 13. ISI_{2012} and NSI relation to sediment nickel (Ni) concentration gradient in Kristiansandsfjorden

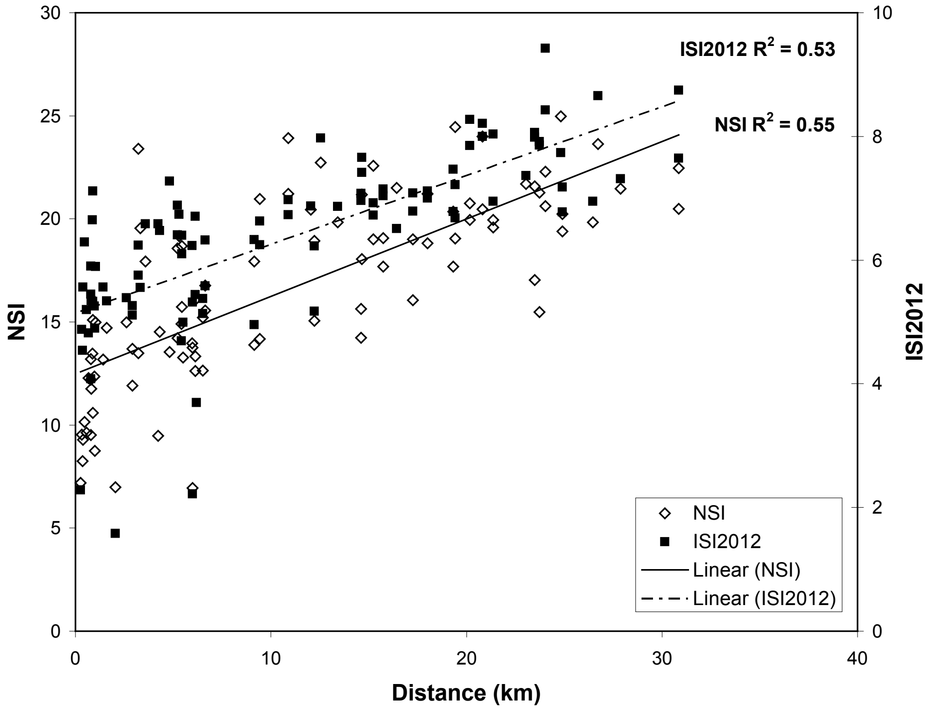

Figure 14. ISI_{2012} and NSI relation to distance (km) from Oslo harbour that describe a multiple stressor (fresh water, organic material, metal and contaminant concentrations) gradient of disturbance on benthic habitats.

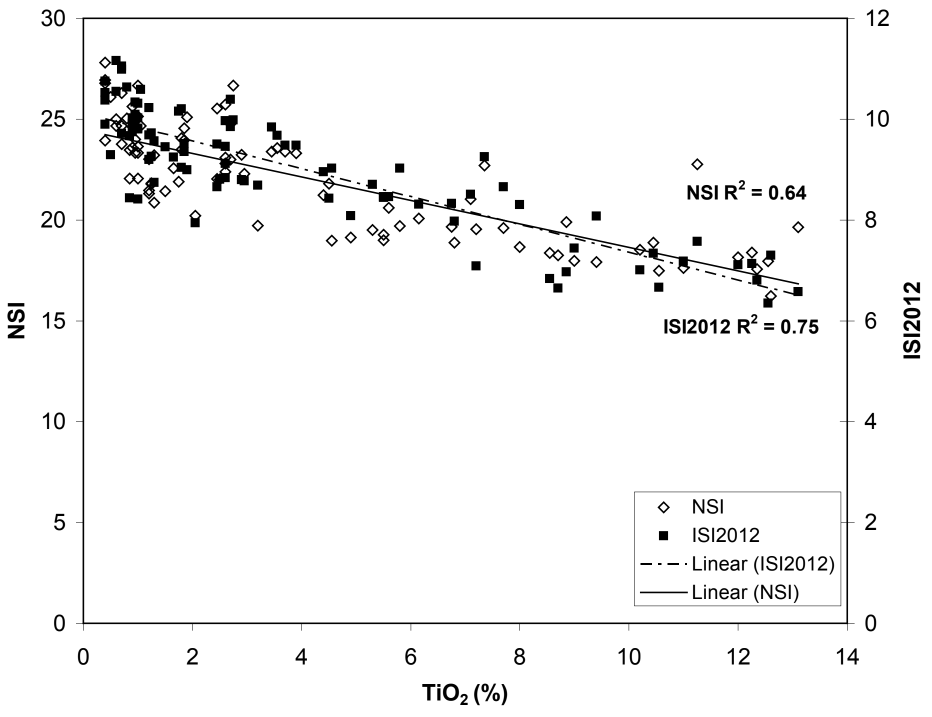

Figure 15. ISI_{2012} and NSI relation to sediment TiO_2 concentration gradientin Jøssingfjorden/Dyngadypet

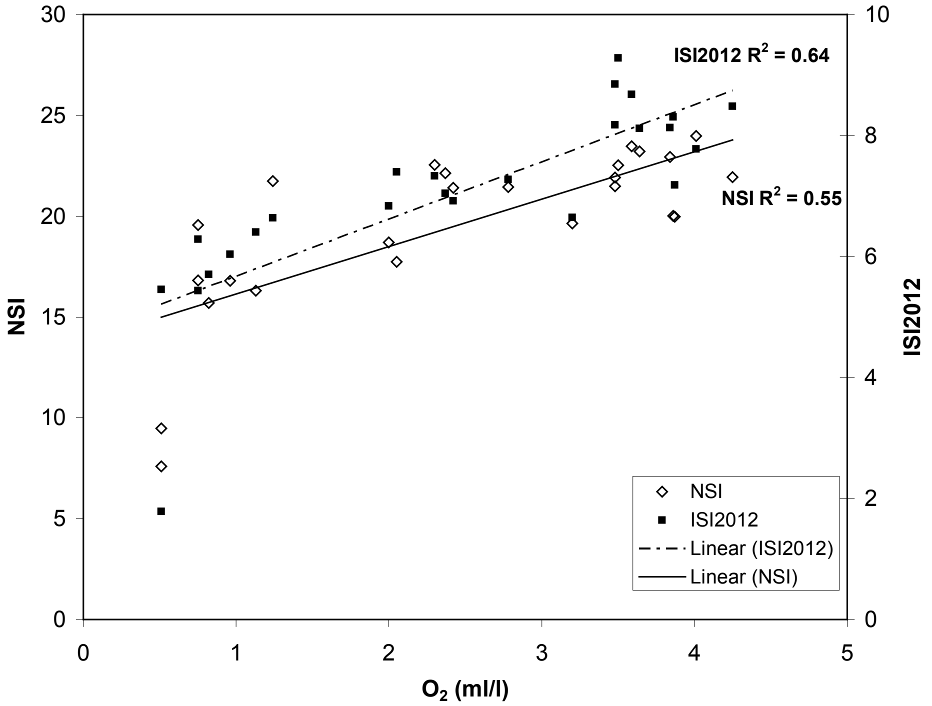

Figure 16. ISI_{2012} and NSI relation to minimum oxygen (O_2) concentrations in bottom water of fjord basins in Southern Norway.

Total organic carbon (TOC) can be regarded as an indicator of general pressure. TOC shows high levels in oxygen-poor basins, harbour areas, recipients of high terrestrial runoff, aquaculture and other situations of increased organic loading. Correlations between the indices and TOC in sediment are shown in **Figure 17**.

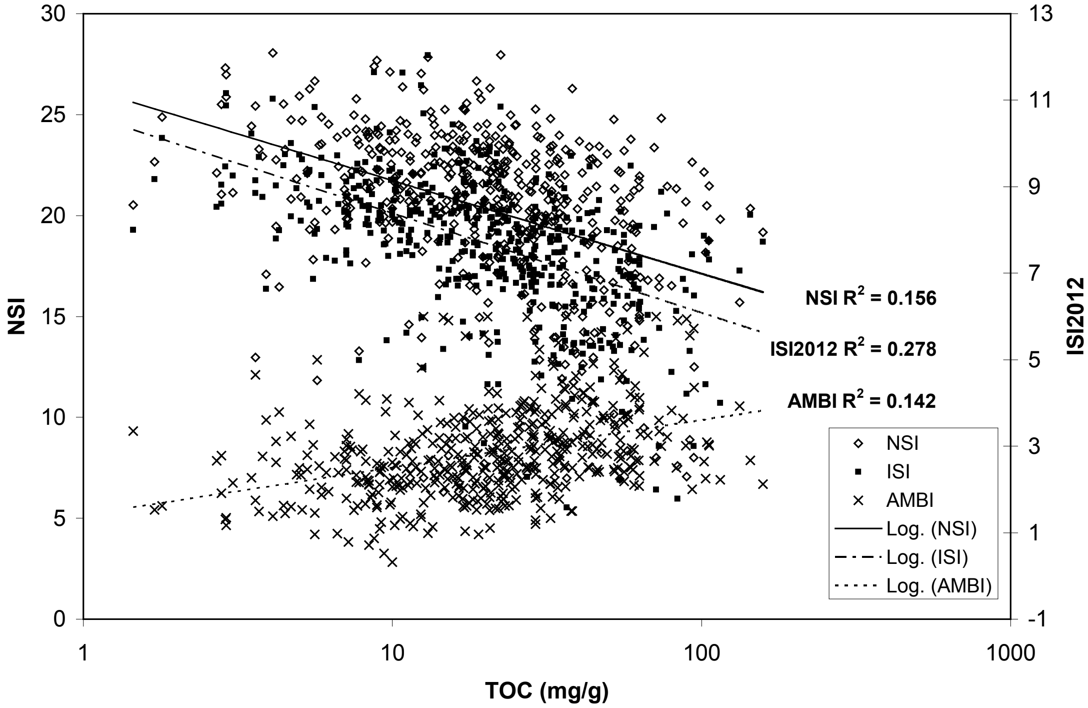

Figure 17. TOC vs NSI, ISI_{2012} and AMBI (mg/g) in sediment.

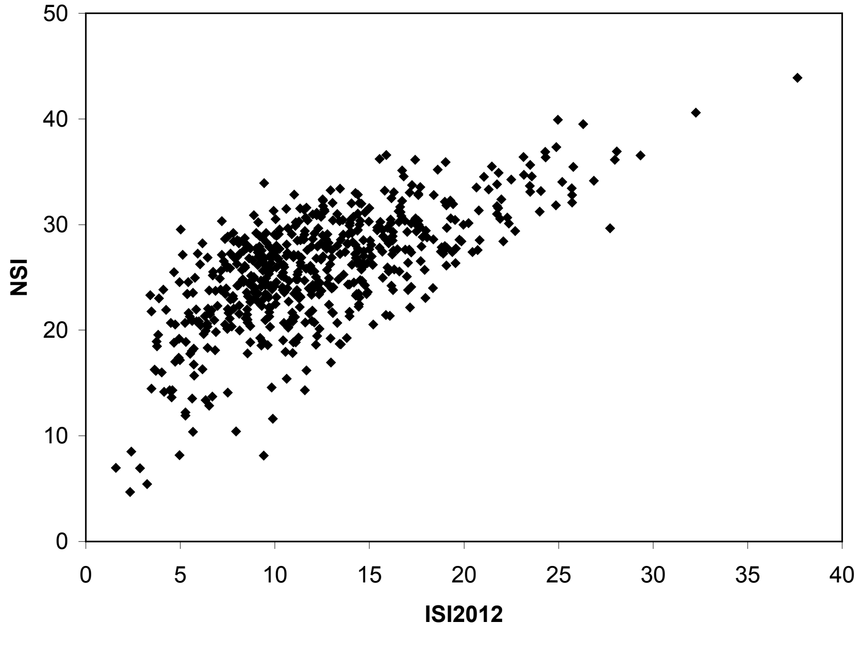

Figure 18. Sensitivity values of the 591 taxa common to NSI and ISI_{2012}. R^2=0.47

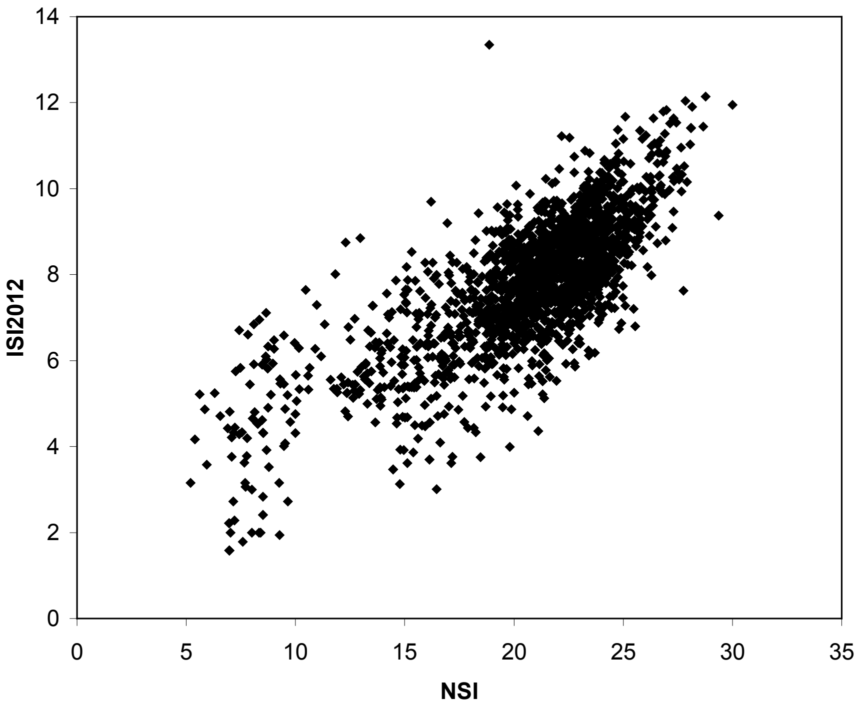

Figure 19. Correlation between sample values of NSI and ISI_{2012} at 1947 station visits. R^2=0.59

3.4.1 Intercalibration and status class borders of ISI_{2012}

To determine class borders for ISI_{2012}, intercalibration with NQI1 was performed. NQI1 class borders have previously been obtained by intercalibration with various European indices in NEAGIG (Carletti and Heiskanen, 2009).

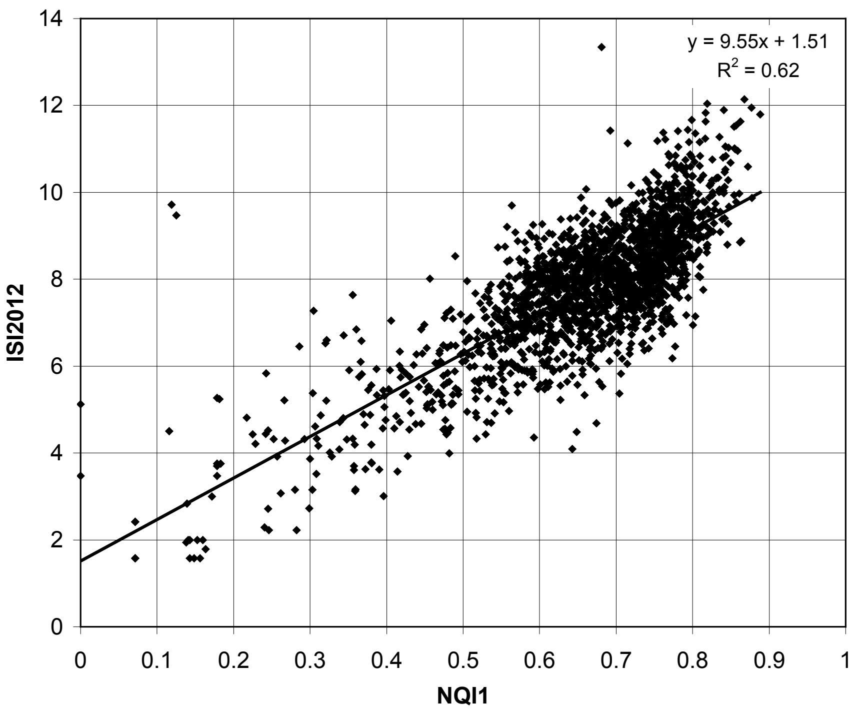

Figure 20. Correlation between NQI1 and ISI_{2012} at 1855 station visits.

Table 4. Status class borders of ISI_{2012}.

Index/Status	High	Good	Moderate	Poor	Bad
ISI_{2012}	13-9.6	9.6-7.5	7.5-6.2	6.2-4.5	4.5-0

The border values of ISI_{2012} are very close to the border values of the old (2002) ISI index.

4. Discussion

Many discrepancies were found between species-specific sensitivities used by NSI and AMBI indices during the descriptive part of this work (Figure 3).

NSI is based on Norwegian macroinvertebrate data, whereas AMBI is based also on South European data of macroinvertebrates. Discrepancies between indices may be caused by changes of sensitivity in the same species/taxa from one geographical region to another (Gremare et al. 2009), or by the sensitivity values of one of them being more accurate sensitivity values in one of the systems. Also a possible reason for the better performance of NSI than AMBI may be that NSI assigns sensitivities on a continuous scale, wheras AMBI lumps the species stepwise into five groups, thus decreasing precision and relative sensitivity among species.

The correlation coefficient between NSI and AMBI was reasonably good, with $R^2 = 0.7$ (Figure 4). This may seem not to be in concordance with the pronounced mismatch of species sensitivities, but can be explained by a reasonable match among the most common species which also contributed most to the sample sensitivity values.

In most examples, NSI and AMBI showed similar slope of the response with pressure gradients, but NSI showed a better correlation compared to AMBI (Table 3). This was more pronounced in the fjords and coastal areal and less so at offshore sites in the North Sea. As an identical list of taxa were used for the calculations of NSI and AMBI sample values, the difference in performance was entirely due to discrepancies in the species sensitivity assignments. The results indicate that the Norwegian classification system can be improved by replacing AMBI with NSI as sensitivity component when determining ecological status.

The updating of ISI (Rygg 2002) to the new ISI_{2012} was based on the same 591 taxa that were included in NSI. The performances of ISI_{2012} and NSI along pressure gradients were compared. In three out of four cases ISI_{2012} performed better than NSI, suggesting ISI_{2012} a candidate sensitivity index in the Norwegian quality status classification system together with NSI.

5. Acknowledgement

We wish to thank Thomas Moskeland at DNV for providing access to the Norwegian MOD database (http://projects.dnv.com/MOD/First.aspx) and Oil & Gas UK for providing access to the the British base (http://www.oilandgasuk.co.uk/knowledgecentre/uk_benthos_database.cfm.) and NIVA for strategic funding through the "NSI-TOC" project and to all NIVA partners and projects for making data available.

6. References

Berge, J., Bjerkeng, B., Næs, K., Oug, E., Ruus, A., 2007. Undersøkelse av miljøtilstanden i Kristiansandsfjorden 2006. Miljøgifter i sediment og organismer og sammensetning av bløtbunnsfauna. Norwegian Institute for Water Research. Report 5506.

Borja, A., Muxika, I., Franco, J., 2000. The application of a Marine Biotic Index to different impact sources affecting soft-bottom benthic communities along European coasts. Marine Pollution Bulletin 40-12, 1100–1114.

Borja A., Barbone, E., Basset, A., Borgersen, G., Brkljacic, M., Elliott, M., Garmendia, J. M., Marques, J.C., Mazik, K., Muxika, I., Neto, J.M., Norling, K., Rodríguez, J.G., Rosati, I., Rygg, B., Teixeira, H., Trayanova A., 2011. Response of single benthic metrics and multimetric methods to anthropogenic pressure gradients, in five distinct European coastal and transitional ecosystems. Marine Pollution Bulletin 62, 499-513.

Bouchet, V.M.P., Alve, E., Rygg, B., Telford, R.J., 2012. Benthic foraminifera provide a promising tool for Ecological Quality assessment of marine waters. Ecological indicators (In Press)

Buhl-Mortensen, L. Aure, J. Alve, E., Oug, E. & Husum K. 2006. Effects of hypoxia on fjordfauna: The bottomfauna and environment in fjords on the Skagerrak coast [in Norwegian]. Fisken og Havet 3:108 p

Carletti, A., Heiskanen, A-S., 2009. Water Framework Directive intercalibration technical report. Part 3, Coastal and Transitional waters. EUR 23838 EN/3. JRC Scientific and Technical Reports. 108 pp.

Direktoratsgruppa, 2009. Veileder 01,2009. Klassifisering av miljøtilstand i vann. Økologisk og kjemisk klassifiseringssystem for kystvann, innsjøer og elver i henhold til vannforeskriften. Direktoratsgruppa for gjennomføringen av vanndirektivet, Norway. 180 pp.

Grémare, A., Labrune, C., Vanden Berghe, E., Amouroux, J.M., Bachelet, G., Zettler, M.L., Vanaverbeke, J., Fleischer, D., Bigot, L., Maire, O., Deflandre, B., Craeymeersch, J., Degraer, S., Dounas, C., Duineveld, G., Heip, C., Herrmann, M., Hummel, H., Karakassis, I., Kędra, M., Kendall, M., Kingston, P., Laudien, J., Occhipinti-Ambrogi, A., Rachor, E., Sardá, R., Speybroeck, J., Van Hoey, G., Vincx, M., Whomersley, P., Willems, W., Wlodarska-Kowalczuk, M., Zenetose, A., 2009. Comparison of the performances of two biotic indices based on the MacroBen database. Mar. Ecol. Prog. Ser. Vol. 382, 297–311

Hurlbert, S.H., 1971. The nonconcept of species diversity, a critique and alternative parameters. Ecology 52, 577-586.

ICES., 2008. Report of the Workshop on Benthos Related Environment Metrics (WKBEMET), 11–14 February 2008, Oostende, Belgium. ICES CM 2008/MHC,01. 53 pp.

Josefson, A.B., Blomqvist, M., Hansen, J.L.S., Rosenberg, R., Rygg, B., 2009. Assessment of marine benthic quality change in gradients of disturbance, Comparison of different Scandinavian multi-metric indices. Marine Pollution Bulletin 58,1263-1277.

Labrune, C., Amouroux, J.M., Sarda, R., Dutrieux, E., Thorin, S., Rosenberg, R., Grémare, A., 2006. Characterization of the ecological quality of the coastal Gulf of Lions (NW Mediterranean). A comparative approach based on three biotic indices. Marine Pollution Bulletin 52, 43–47.

Labrune, C., Romero-Ramirez, A., Amouroux, J.M., Duchêne, J.C., Desmalades, M., Escoubeyrou, K., Buscail, R., Grémare, A., 2012. Comparison of ecological quality indices based on benthic macrofauna and sediment profile images, A case study along an organic enrichment gradient off the Rhône River. Ecological Indicators 12,133–142.

Leonardsson, K., Blomqvist, M., Rosenberg, R., 2009. Theoretical and practical aspects on benthic quality assessment according to the EU-Water Framework Directive – examples from Swedish waters. Marine Pollution Bulletin 58, 1286–1296.

Marques, J.C., Salas, F., Patrício, J., Teixeira, H., Neto, J.M., 2009. Ecological Indicators for Coastal and Estuarine Environmental Assessment, A User Guide. Wit Press, Southampton, Boston. 183 pp.

Nilsson, H., Rosenberg, R., 1997. Benthic habitat quality assessment of an oxygen stressed fjord by surface and sediment profile images. J. Mar. Syst. 11, 249–264.

Olsgard, F., 1995. Overvåking av forurensningssituasjonen i indre Oslofjord. Undersøkelse av bløtbunnsfauna 1993. Overvåkingsrapport 622\95 TA nr. 1258\1995.

Olsgard, F., Hasle, J.R., 1993. Impact of waste from titanium mining on benthic fauna. Journal of Experimental Marine Biology and Ecology 172, 185-213.

Oug, E., Ruus, A., Håvardstun, J., 2004. Miljøtilstanden i Hanneviksbukta og Vesterhavn, Kristiansands-fjorden, før tildekking av forurensede bunnsedimenter. Bunnfauna og miljøgifter i organismer. Norwegian Institute for Water Research. Report 4915.

Pinto, R., Patrício, J., Baeta, A., Fath, B.D., Neto, J.M., Marques, J.C., 2009. Review and Evaluation of Estuarine Biotic Indices to Assess Benthic Condition. Ecological Indicators 9, 1–25.

Rosenberg, R., Blomqvist, M., Nilsson, H.C., Cederwall, H., Dimming, A., 2004. Marine quality assessment by use of benthic species–abundance distributions, a proposed new protocol within the European Union Water Framework Directive. Marine Pollution Bulletin 49, 728–739.

Rygg, B., 2002. Indicator species index for assessing benthic ecological quality in marine waters of Norway, Norwegian Institute for Water Research. Report 4548. 23 pp.

Smith, R.W., Bergen, M., Weisberg, S.B., Cadien, D., Dalkey, A., Montagne, D., Stull, J. K, Velarde, R.G., 2001. Benthic Response Index for Assessing Infaunal Communities on the Southern California Mainland Shelf. Ecological Applications 4, 1073-1087.

Teixeira, H., Weisberg, S.B., Borja, A., Ranasinghe, J.A., Cadien, D.B., Velarde, R.G., Lovell, L.L., Pasko, D., Phillips, C.A., Montagne, D.E., Ritter, K.J., Salas, F., Marques, J.C., 2012. Calibration and Validation of the AZTI's Marine Biotic Index (AMBI) for Southern California Marine Bays. Ecological In Indicators, 12, 84-95.

Appendix A. Sensitivity values for NSI- and ISI-taxa and corresponding AMBI-taxa

TAXON NAME	ISI2012 SEN-SITI-VITY VALUE	NSI SEN-SITI-VITY VALUE	NSI ECO-LOGI-CAL GROUP	AMBI ECO-LOGI-CAL GROUP	AMBI TOLE-RANCE VALUE	GROUP DIFFE-RENCE	COUNT	SUM ABUN-DANCE
Abra alba	3.82	19.55	III	III	3	0	270	1134
Abra longicallus	9.40	22.99	III	III	3	0	57	320
Abra nitida	5.84	21.96	III	III	3	0	2534	35184
Abra prismatica	25.72	32.08	I	III	3	-2	23	90
Abyssoninoe hibernica	12.55	31.74	I	II	1.5	-1	121	811
Acanthocardia echinata	14.54	26.11	II	I	0	1	37	54
Acidostoma obesum	21.31	33.33	I	I	0	0	36	51
Acteon tornatilis	16.90	27.62	I	I	0	0	33	56
Actiniaria	18.98	32.17	I	n.a.			25	68
Aglaophamus malmgreni	14.29	23.28	II	II	1.5	0	55	298
Aglaophamus pulcher	12.06	23.94	II	II	1.5	0	108	189
Alvania testae	24.88	37.33	I	I	0	0	72	196
Amaeana trilobata	10.04	27.42	I	I	0	0	534	1375
Amage auricula	14.67	28.51	I	I	0	0	189	609
Ampelisca aequicornis	13.59	30.43	I	I	0	0	201	713
Ampelisca brevicornis	13.36	24.80	II	I	0	1	67	134
Ampelisca gibba	17.26	33.72	I	I	0	0	99	156
Ampelisca macrocephala	21.80	31.57	I	I	0	0	31	45
Ampelisca sp.	5.02	29.54	I	I	0	0	142	362
Ampelisca tenuicornis	11.47	28.65	I	I	0	0	316	1109
Ampelisca typica	15.88	21.43	III	I	0	2	24	247
Ampharete falcata	11.08	29.85	I	II	1.5	-1	38	113
Ampharete finmarchica	12.10	25.55	II	I	0	1	212	815
Ampharete sp.	9.76	27.82	I	I	0	0	343	898
Ampharetidae	8.88	30.90	I	n.a.			357	2296
Amphicteis gunneri	5.60	20.97	III	III	3	0	502	2293
Amphilepis norvegica	10.66	27.32	II	I	0	1	787	4669
Amphipholis squamata	11.70	27.60	I	I	0	0	53	171
Amphipoda	7.18	27.13	II	n.a.			177	344
Amphitrite cirrata	13.80	19.27	III	I	0	2	35	77
Amphiura chiajei	7.65	27.26	II	II	1.5	0	1093	10959
Amphiura filiformis	7.80	22.96	III	II	1.5	1	986	30462
Amphiura sp.	9.70	21.29	III	II	1.5	1	110	2379
Amythasides macroglossus	11.01	32.83	I	I	0	0	496	4775
Anobothrus gracilis	5.37	23.41	II	III	3	-1	889	5660
Anobothrus laubieri	14.17	30.74	I	n.a.			138	920
Antalis entalis	11.62	30.66	I	I	0	0	181	313
Antalis occidentalis	17.60	30.00	I	I	0	0	49	77
Anthozoa	8.09	28.22	I	II	1.5	-1	306	670
Aonides paucibranchiata	15.80	33.22	I	III	3	-2	77	974

TAXON NAME	ISI_{2012}	NSI	NSI EG	AMBI EG	AMBI VALUE	GROUP DIFF	COUNT	ABUN-DANCE
Aphelochaeta marioni	11.06	21.27	III	IV	4.5	-1	57	904
Aphelochaeta mcintoshi	19.97	29.97	I	IV	4.5	-3	50	547
Aphelochaeta sp.	9.68	25.32	II	IV	4.5	-2	154	986
Aphrodita aculeata	11.35	28.54	I	I	0	0	214	313
Aphroditidae	9.73	27.02	II	n.a.			82	162
Apistobranchus tullbergi	11.36	26.41	II	I	0	1	232	1209
Apseudes spinosus	18.81	27.84	I	n.a.			91	316
Arctica islandica	8.10	22.35	III	III	3	0	244	633
Aricidea (Acmira) catherinae	16.16	32.50	I	I	0	0	35	132
Aricidea sp.	12.22	30.89	I	I	0	0	513	3090
Aricidea suecica	12.62	31.24	I	I	0	0	32	358
Arrhis phyllonyx	10.46	26.19	II	III	3	-1	121	287
Artacama proboscidea	10.51	23.59	II	I	0	1	60	157
Ascidiacea	8.47	28.12	I	III	3	-2	115	355
Astacilla dilatata	24.97	39.90	I	II	1.5	-1	41	106
Astarte elliptica	12.52	32.38	I	I	0	0	148	373
Astarte montagui	12.00	30.97	I	I	0	0	106	868
Astarte sulcata	13.07	30.38	I	I	0	0	133	368
Asterias rubens	9.24	22.41	III	III	3	0	43	87
Asteroidea	6.41	20.60	III	I	0	2	148	325
Astropecten irregularis	15.10	28.06	I	I	0	0	48	79
Asychis biceps	12.25	27.92	I	II	1.5	-1	414	1144
Atylus vedlomensis	17.38	30.21	I	I	0	0	68	262
Augeneria tentaculata	14.57	31.97	I	I	0	0	133	678
Axinulus croulinensis	14.97	30.29	I	I	0	0	227	597
Axinulus eumyarius	19.10	29.70	I	II	1.5	-1	148	458
Bathyarca pectunculoides	20.65	33.51	I	I	0	0	95	142
Bathymedon longimanus	10.75	24.67	II	II	1.5	0	80	95
Bathymedon saussurei	13.01	24.08	II	II	1.5	0	49	62
Bivalvia	8.11	28.41	I	n.a.			221	714
Bodotria scorpioides	18.04	28.78	I	n.a.			21	53
Brachydiastylis resima	12.87	24.91	II	n.a.			73	445
Brada sp.	15.16	26.22	II	I	0	1	60	312
Brada villosa	9.27	24.68	II	I	0	1	479	1820
Brisaster fragilis	13.03	21.68	III	n.a.			67	112
Brissopsis lyrifera	8.83	26.63	II	I	0	1	690	1134
Byblis crassicornis	29.33	36.55	I	I	0	0	87	415
Bylgides sarsi	10.91	21.68	III	I	0	2	123	257
Caeconyx caeculus	14.77	24.25	II	n.a.			41	52
Calathura norvegica	37.65	43.91	I	n.a.			28	66
Callianassa sp.	19.30	30.59	I	III	3	-2	70	103
Calocarides coronatus	17.21	27.37	II	II	1.5	0	37	40
Calocaris macandreae	9.42	26.90	II	II	1.5	0	582	1237
Campylaspis costata	16.53	31.24	I	II	1.5	-1	77	94
Capitella capitata	1.58	6.98	5	V	6	0	472	54020
Capitella sp.	10.86	20.92	III	V	6	-2	25	61
Capitellidae	8.56	21.00	III	V	6	-2	43	192
Caprella sp.	9.75	20.33	III	II	1.5	1	33	153
Cardiidae	16.16	24.21	II	III	3	-1	40	86

TAXON NAME	ISI_{2012}	NSI	NSI EG	AMBI EG	AMBI VALUE	GROUP DIFF	COUNT	ABUN-DANCE
Cardiomya costellata	21.83	34.89	I	I	0	0	32	35
Cardium exiguum	9.62	18.58	IV	I	0	3	37	100
Caudofoveata	6.43	26.89	II	n.a.			1580	4289
Caulleriella killariensis	12.18	25.03	II	IV	4.5	-2	134	1517
Caulleriella serrata	15.21	20.53	III	III	3	0	50	600
Caulleriella sp.	6.07	20.46	III	IV	4.5	-1	1473	20608
Ceratocephale loveni	7.65	22.89	III	II	1.5	1	1358	7178
Cerianthus lloydii	4.73	20.52	III	I	0	2	298	959
Chaetoderma nitidulum	9.11	23.45	II	II	1.5	0	161	417
Chaetoderma sp.	8.64	26.79	II	II	1.5	0	115	770
Chaetognatha	12.78	24.39	II	n.a.			41	134
Chaetoparia nilssoni	14.07	26.19	II	II	1.5	0	78	122
Chaetopterus variopedatus	16.14	30.14	I	I	0	0	43	53
Chaetozone setosa	3.47	14.46	IV	IV	4.5	0	2869	115170
Chaetozone sp.	10.98	18.86	III	IV	4.5	-1	94	2474
Chamelea gallina	13.95	21.75	III	I	0	2	73	222
Chamelea striatula	12.77	27.81	I	I	0	0	47	165
Cheirocratus sp.	9.55	28.31	I	I	0	0	59	97
Cheirocratus sundevalli	17.76	27.92	I	I	0	0	43	190
Chirimia biceps	14.65	26.16	II	II	1.5	0	61	165
Chone duneri	7.51	28.85	I	II	1.5	-1	117	892
Chone infundibuliformis	9.78	24.19	II	II	1.5	0	32	133
Chone sp.	9.00	27.72	I	II	1.5	-1	353	1711
Cirratulidae	6.52	12.86	IV	IV	4.5	0	194	1209
Cirratulus cirratus	4.54	13.65	IV	IV	4.5	0	211	4166
Cirratulus sp.	19.37	27.40	I	IV	4.5	-3	26	54
Cistenides hyperborea	12.94	19.21	III	I	0	2	42	297
Clausinella fasciata	14.11	28.33	I	I	0	0	27	54
Clymenura borealis	24.08	33.19	I	III	3	-2	33	133
Clymenura sp.	19.53	30.44	I	III	3	-2	74	300
Conchoecia elegans	13.95	21.32	III	n.a.			56	122
Corbula gibba	3.70	16.14	IV	IV	4.5	0	887	8716
Corophium sp.	9.05	22.80	III	III	3	0	97	203
Cossura longocirrata	5.72	15.69	IV	IV	4.5	0	732	16257
Crenella decussata	21.74	31.00	I	I	0	0	35	318
Ctenodiscus crispatus	10.72	20.30	III	I	0	2	122	234
Cumacea	15.68	27.45	I	n.a.			40	82
Cuspidaria cuspidata	14.69	27.03	II	I	0	1	44	69
Cuspidaria obesa	11.19	25.27	II	I	0	1	285	430
Cuspidaria rostrata	14.36	29.42	I	I	0	0	31	35
Cylichna alba	12.84	28.26	I	II	1.5	-1	377	1202
Cylichna cylindracea	9.87	27.25	II	II	1.5	0	170	778
Cylichnina umbilicata	11.58	14.30	IV	II	1.5	2	55	135
Cylindroleberis mariae	17.00	29.31	I	n.a.			42	50
Cypridina (Vargula) norvegica	17.45	30.59	I	II	1.5	-1	124	375
Dacrydium vitreum	17.11	27.61	I	n.a.			82	357
Decapod larver	10.40	24.05	II	n.a.			40	85
Decapoda	11.81	21.59	III	n.a.			36	57
Delectopecten vitreus	11.10	18.86	III	I	0	2	108	417

TAXON NAME	ISI_{2012}	NSI	NSI EG	AMBI EG	AMBI VALUE	GROUP DIFF	COUNT	ABUN-DANCE
Desmosomatidae	24.86	31.81	I	n.a.			34	164
Diastylidae	13.95	29.90	I	n.a.			52	233
Diastylis cornuta	9.36	28.70	I	I	0	0	387	1459
Diastylis lucifera	5.29	18.91	III	III	3	0	154	1665
Diastylis rathkei	6.33	13.40	IV	III	3	1	84	1838
Diastylis rostrata	8.45	21.12	III	n.a.			59	272
Diastylis sp.	9.54	29.20	I	I	0	0	94	294
Diastyloides biplicatus	10.08	28.94	I	I	0	0	109	209
Diastyloides serratus	10.44	25.43	II	I	0	1	266	555
Diplocirrus glaucus	7.98	26.89	II	I	0	1	1716	17253
Dipolydora caulleryi	4.95	8.17	5	IV	4.5	1	190	4557
Dipolydora coeca	16.74	35.12	I	IV	4.5	-3	42	493
Dipolydora socialis	7.50	20.13	III	IV	4.5	-1	81	6016
Dorvilleidae	9.69	22.16	III	n.a.			64	117
Dosinia exoleta	24.01	31.24	I	I	0	0	26	34
Dosinia lupinus	13.08	21.62	III	I	0	2	61	262
Drilonereis filum	9.98	24.19	II	II	1.5	0	452	1499
Echinocardium cordatum	8.88	25.02	II	I	0	1	356	2235
Echinocardium flavescens	10.19	29.08	I	II	1.5	-1	263	1185
Echinocardium sp.	14.45	22.46	III	I	0	2	74	521
Echinocucumis hispida	24.32	36.36	I	I	0	0	101	227
Echinocyamus pusillus	14.05	32.01	I	I	0	0	111	908
Echinoidea	14.06	29.20	I	I	0	0	78	282
Echiuroidea	14.33	26.36	II	II	1.5	0	24	85
Edwardsia danica	12.26	24.07	II	II	1.5	0	61	481
Edwardsia longicornis	10.09	24.55	II	II	1.5	0	66	348
Edwardsia sp.	7.79	23.22	II	II	1.5	0	207	1442
Edwardsia tuberculata	18.78	27.43	I	II	1.5	-1	25	189
Edwardsiidae	8.62	24.42	II	II	1.5	0	258	1716
Ennucula tenuis	5.66	23.54	II	II	1.5	0	1789	16951
Entalina tetragona	14.00	29.30	I	I	0	0	173	426
Ericthonius rubricornis	23.16	34.71	I	I	0	0	41	138
Eriopisa elongata	10.36	25.15	II	I	0	1	1482	7533
Erycinacea	12.19	26.82	II	n.a.			22	64
Eteone flava	6.18	16.30	IV	III	3	1	36	119
Eteone longa	4.72	17.02	IV	III	3	1	238	1466
Eteone sp.	4.66	18.80	IV	III	3	1	585	2043
Euchone papillosa	10.44	19.05	III	II	1.5	1	203	1428
Euchone sp.	5.36	23.43	II	II	1.5	0	460	1524
Euclymene sp.	13.71	27.42	I	n.a.			351	1224
Euclymeninae	9.69	27.88	I	III	3	-2	821	4194
Eudorella emarginata	8.69	22.66	III	II	1.5	1	930	3981
Eudorella hirsuta	16.02	25.55	II	n.a.			33	76
Eudorella sp.	16.03	28.22	I	n.a.			44	70
Eudorella truncatula	11.36	26.12	II	I	0	1	435	995
Eudorellopsis deformis	15.73	28.90	I	n.a.			22	396
Eugerda tenuimana	19.42	31.92	I	n.a.			28	40
Eumida bahusiensis	15.71	29.49	I	II	1.5	-1	74	218
Eumida sp.	12.20	31.12	I	II	1.5	-1	42	96

TAXON NAME	ISI_{2012}	NSI	NSI EG	AMBI EG	AMBI VALUE	GROUP DIFF	COUNT	ABUN-DANCE
Eunereis longissima	7.51	22.00	III	III	3	0	41	46
Eunice pennata	23.16	36.38	I	II	1.5	-1	31	65
Eunoe nodosa	14.31	23.43	II	II	1.5	0	33	97
Eupolymnia nebulosa	8.58	23.22	II	III	3	-1	39	103
Eupolymnia nesidensis	11.53	31.42	I	III	3	-2	64	138
Eurycope cornuta	14.17	24.52	II	I	0	1	46	54
Euspira montagui	10.38	26.22	II	II	1.5	0	129	186
Euspira pallida	12.37	24.47	II	II	1.5	0	24	32
Euspira pulchella	8.08	24.27	II	II	1.5	0	246	517
Exogone (Exogone) naidina	14.39	27.71	I	II	1.5	-1	23	71
Exogone (Exogone) verugera	9.06	27.72	I	II	1.5	-1	282	5136
Exogone (Parexogone) hebes	14.99	31.56	I	II	1.5	-1	127	7087
Exogone sp.	8.75	25.15	II	II	1.5	0	876	4051
Fabriciinae	9.70	21.71	III	n.a.			27	136
Flabelligera affinis	14.48	32.04	I	II	1.5	-1	52	75
Flabelligeridae	8.90	23.62	II	n.a.			93	141
Galathea strigosa	17.59	32.80	I	I	0	0	40	101
Galathowenia fragilis	25.78	35.47	I	III	3	-2	61	463
Galathowenia oculata	5.25	20.69	III	III	3	0	1903	63197
Gammaropsis sophiae	6.80	20.96	III	I	0	2	58	149
Gastropoda	14.00	30.47	I	n.a.			35	53
Gattyana cirrhosa	5.92	27.24	II	III	3	-1	234	620
Glycera alba	3.42	23.30	II	IV	4.5	-2	1338	5040
Glycera capitata	9.01	29.20	I	II	1.5	-1	510	3427
Glycera lapidum	8.01	28.54	I	II	1.5	-1	283	800
Glycera rouxii	8.52	27.78	I	II	1.5	-1	693	1798
Glycera sp.	7.13	23.82	II	II	1.5	0	213	454
Glycinde nordmanni	8.41	28.72	I	II	1.5	-1	313	494
Glyphohesione klatti	9.29	24.14	II	II	1.5	0	323	570
Gnathia maxillaris	15.41	29.74	I	I	0	0	60	105
Gnathia oxyuraea	15.48	29.83	I	I	0	0	35	42
Gnathia sp.	19.08	31.83	I	I	0	0	26	33
Golfingia (Golfingia) margaritacea	14.28	26.84	II	I	0	1	94	143
Golfingia minuta	13.01	26.87	II	I	0	1	110	366
Golfingia sp.	9.10	27.38	II	I	0	1	865	4628
Goniada maculata	4.66	25.50	II	II	1.5	0	1568	6463
Goniada sp.	10.57	17.97	IV	II	1.5	2	27	176
Goniadella bobrezkii	18.60	35.21	I	II	1.5	-1	24	186
Gyptis rosea	7.47	25.95	II	I	0	1	278	625
Haliella stenostoma	17.05	26.37	II	I	0	1	38	57
Haploops setosa	24.30	36.88	I	III	3	-2	71	297
Haploops tubicola	14.26	28.06	I	III	3	-2	67	193
Harmothoe sp.	4.95	24.54	II	II	1.5	0	1312	3181
Harpinia antennaria	19.57	27.75	I	I	0	0	29	203
Harpinia crenulata	15.41	29.45	I	I	0	0	24	65
Harpinia pectinata	12.72	28.60	I	I	0	0	153	398
Harpinia sp.	11.27	23.03	III	I	0	2	650	2289
Hauchiella tribullata	27.72	29.65	I	I	0	0	35	129
Hemichordata	17.67	29.78	I	n.a.			31	88

TAXON NAME	ISI_{2012}	NSI	NSI EG	AMBI EG	AMBI VALUE	GROUP DIFF	COUNT	ABUN-DANCE
Hemilamprops roseus	26.86	34.14	I	II	1.5	-1	33	46
Hesionidae	8.18	24.52	II	II	1.5	0	98	122
Heteroclymene robusta	25.71	33.44	I	V	6	-4	21	52
Heteromastus filiformis	3.76	18.47	IV	IV	4.5	0	3438	199682
Heteromastus sp.	6.44	18.31	IV	IV	4.5	0	554	93344
Hiatella arctica	7.18	30.32	I	I	0	0	122	254
Hippomedon denticulatus	14.39	32.85	I	I	0	0	58	123
Hippomedon propinquus	17.21	24.10	II	I	0	1	24	70
Holothuroidea	16.47	27.67	I	I	0	0	36	109
Hyala vitrea	11.90	25.65	II	I	0	1	328	2859
Hydroides norvegicus	13.45	33.40	I	III	3	-2	48	89
Hydrozoa	10.09	25.92	II	I	0	1	76	222
Ilyarachna longicornis	16.27	27.56	I	n.a.			48	59
Irregularia	11.67	31.61	I	n.a.			64	147
Ischnomesus bispinosus	22.29	30.65	I	n.a.			50	95
Ischyrocerus megacheir	19.03	35.90	I	n.a.			28	56
Isopoda	19.29	32.26	I	n.a.			50	84
Janira maculosa	32.27	40.58	I	n.a.			37	62
Jasmineira caudata	9.85	23.86	II	II	1.5	0	144	1196
Jasmineira sp.	6.53	23.76	II	II	1.5	0	110	1548
Kefersteinia cirrata	9.77	25.72	II	II	1.5	0	101	419
Kelliella abyssicola	10.95	20.83	III	I	0	2	684	11744
Kophobelemnon stelliferum	15.96	25.94	II	I	0	1	45	54
Kurtiella bidentata	4.43	14.32	IV	III	3	1	729	31744
Kurtiella tumidula	18.98	27.95	I	III	3	-2	48	227
Labidoplax buskii	6.74	25.54	II	I	0	1	617	6568
Laetmatophilus tuberculatus	17.82	28.82	I	n.a.			23	61
Lagis koreni	3.63	16.26	IV	IV	4.5	0	451	3033
Lanassa venusta	10.99	27.15	II	I	0	1	222	1459
Laonice bahusiensis	25.19	34.03	I	III	3	-2	38	64
Laonice cirrata	10.24	29.55	I	III	3	-2	579	1787
Laonice sarsi	23.49	33.66	I	III	3	-2	41	95
Laonice sp.	14.46	30.00	I	III	3	-2	32	78
Laphania boecki	14.76	26.20	II	n.a.			77	1332
Leptanthura tenuis	22.08	28.40	I	n.a.			30	74
Leptochiton asellus	16.30	33.07	I	I	0	0	62	749
Leptopentacta elongata	13.45	27.22	II	I	0	1	43	64
Leptophoxus falcatus	16.32	25.76	II	n.a.			85	192
Leptostylis longimana	17.55	29.89	I	II	1.5	-1	95	149
Leptostylis sp.	16.23	28.91	I	II	1.5	-1	37	52
Leptostylis villosa	22.71	29.38	I	II	1.5	-1	21	30
Leptosynapta sp.	7.83	26.91	II	I	0	1	96	337
Leucon (Leucon) nasica	8.93	22.99	III	II	1.5	1	550	2647
Leucothoe lilljeborgi	16.24	29.29	I	I	0	0	64	84
Levinsenia gracilis	9.62	25.77	II	III	3	-1	759	4013
Liljeborgia fissicornis	22.37	30.08	I	I	0	0	32	38
Liljeborgia macronyx	14.63	26.28	II	I	0	1	133	242
Liljeborgia pallida	28.07	36.93	I	I	0	0	37	71
Limatula gwyni	16.72	32.22	I	I	0	0	89	152

TAXON NAME	ISI_{2012}	NSI	NSI EG	AMBI EG	AMBI VALUE	GROUP DIFF	COUNT	ABUN-DANCE
Limatula nivea	17.58	32.92	I	I	0	0	27	59
Liocarcinus depurator	16.12	30.47	I	I	0	0	34	39
Liocarcinus pusillus	14.38	27.49	I	I	0	0	46	57
Lucinoma borealis	6.16	28.21	I	I	0	0	142	335
Lumbrineridae	17.03	23.81	II	II	1.5	0	51	206
Lumbrineris aniara	13.31	28.01	I	II	1.5	-1	113	401
Lumbrineris fragilis	7.37	23.41	II	II	1.5	0	250	1857
Lumbrineris gracilis	7.83	28.42	I	II	1.5	-1	153	663
Lumbrineris mixochaeta	11.66	16.19	IV	II	1.5	2	64	1197
Lumbrineris scopa	10.89	29.10	I	I	0	0	220	1351
Lumbrineris sp.	7.42	23.96	II	II	1.5	0	1865	13048
Lysianassidae	9.97	29.05	I	I	0	0	103	151
Lysilla loveni	16.68	30.80	I	II	1.5	-1	98	209
Lysippe labiata	18.37	23.97	II	III	3	-1	35	224
Macoma balthica	7.95	10.41	IV	III	3	1	31	257
Macoma calcarea	4.92	17.38	IV	II	1.5	2	210	2145
Macrochaeta clavicornis	14.51	30.36	I	II	1.5	-1	54	287
Macrochaeta sp.	8.48	21.14	III	II	1.5	1	99	212
Macrocypris minna	14.25	33.00	I	n.a.			89	128
Maera loveni	21.75	33.81	I	I	0	0	23	53
Magelona alleni	15.08	26.94	II	I	0	1	74	151
Magelona minuta	12.31	24.60	II	I	0	1	288	1571
Magelona papillicornis	19.55	26.34	II	I	0	1	25	210
Magelona sp.	20.24	30.15	I	I	0	0	36	55
Malacoceros fuliginosus	2.34	4.68	5	V	6	0	48	10339
Maldane sarsi	5.61	18.03	IV	I	0	3	678	18739
Maldanidae	10.61	27.04	II	n.a.			236	974
Mediomastus fragilis	5.27	12.21	IV	III	3	1	455	20006
Mediomastus sp.	9.34	18.95	III	III	3	0	66	766
Melinna cristata	7.10	24.89	II	III	3	-1	1622	14526
Melinna elisabethae	13.01	23.94	II	III	3	-1	23	43
Mendicula ferruginosa	8.70	27.74	I	II	1.5	-1	1159	7849
Mendicula pygmaea	10.41	23.79	II	I	0	1	369	3844
Microdeutopus sp.	12.69	27.82	I	I	0	0	60	89
Modiolula phaseolina	15.90	36.58	I	I	0	0	66	626
Modiolus modiolus	7.81	29.18	I	I	0	0	98	276
Modiolus sp.	7.36	28.65	I	I	0	0	32	116
Monoculodes packardi	11.35	23.14	II	I	0	1	29	46
Monoculodes sp.	17.12	33.01	I	I	0	0	52	68
Montacuta substriata	17.59	30.35	I	II	1.5	-1	27	45
Mugga wahrbergi	8.44	25.94	II	II	1.5	0	473	2017
Musculus niger	16.55	30.26	I	I	0	0	22	36
Mya arenaria	4.58	14.31	IV	II	1.5	2	124	1279
Mya sp.	7.72	20.36	III	II	1.5	1	41	59
Mya truncata	14.42	22.23	III	II	1.5	1	28	45
Myriochele heeri	12.23	19.44	III	III	3	0	191	8674
Myriochele sp.	9.42	26.28	II	III	3	-1	290	3692
Myrtea spinifera	8.15	27.23	II	II	1.5	0	287	1092
Mysia undata	15.18	26.19	II	I	0	1	46	80

TAXON NAME	ISI_{2012}	NSI	NSI EG	AMBI EG	AMBI VALUE	GROUP DIFF	COUNT	ABUN-DANCE
Mytilidae	10.71	20.24	III	n.a.			38	153
Mytilus edulis	6.69	13.72	IV	III	3	1	67	2228
Nassarius pygmaeus	11.60	20.72	III	II	1.5	1	22	40
Nassarius reticulatus	9.29	18.53	IV	II	1.5	2	50	176
Natatolana borealis	16.81	34.57	I	II	1.5	-1	85	209
Nebalia bipes	5.71	16.75	IV	V	6	-1	46	255
Nebalia sp.	9.40	8.13	5	V	6	0	23	304
Nemertea	4.25	21.93	III	III	3	0	3671	56228
Neoamphitrite grayi	11.98	21.85	III	I	0	2	58	89
Neohela monstrosa	15.11	26.99	II	I	0	1	100	157
Neoleanira tetragona	8.56	20.73	III	II	1.5	1	637	1574
Nephtys caeca	11.40	26.86	II	II	1.5	0	42	55
Nephtys ciliata	6.56	21.70	III	II	1.5	1	469	1186
Nephtys cirrosa	16.59	25.58	II	II	1.5	0	39	86
Nephtys hombergii	7.98	26.29	II	II	1.5	0	294	684
Nephtys hystricis	9.09	26.16	II	II	1.5	0	82	172
Nephtys incisa	11.19	28.49	I	II	1.5	-1	428	1126
Nephtys longosetosa	12.44	26.68	II	II	1.5	0	32	95
Nephtys paradoxa	8.96	24.04	II	II	1.5	0	467	752
Nephtys sp.	6.71	25.18	II	II	1.5	0	279	422
Nereimyra punctata	5.71	18.26	IV	III	3	1	531	1768
Nereis sp.	3.25	5.43	5	III	3	2	63	515
Nicippe tumida	13.29	30.99	I	I	0	0	152	202
Nicomache lumbricalis	14.88	26.34	II	II	1.5	0	31	144
Nicomache sp.	17.69	33.55	I	II	1.5	-1	33	79
Nothria conchylega	12.95	33.25	I	II	1.5	-1	112	765
Notomastus latericeus	9.11	30.21	I	III	3	-2	731	3003
Nucula delphinodonta	13.94	24.33	II	I	0	1	28	76
Nucula hanleyi	17.15	22.14	III	I	0	2	24	402
Nucula nitidosa	9.30	22.30	III	I	0	2	198	1620
Nucula sp.	13.09	24.07	II	I	0	1	63	271
Nucula sulcata	11.87	26.08	II	I	0	1	513	2117
Nucula tumidula	11.24	27.11	II	I	0	1	730	4375
Nucula turgida	12.76	25.70	II	I	0	1	151	498
Nuculana minuta	10.24	27.71	I	I	0	0	209	475
Nuculana pernula	11.93	23.36	II	I	0	1	110	235
Nudibranchia	10.03	22.47	III	n.a.			66	126
Oligochaeta	2.41	8.51	5	V	6	0	670	55718
Onchnesoma squamatum	23.50	33.09	I	I	0	0	74	111
Onchnesoma steenstrupii steenstrupii	11.57	29.06	I	I	0	0	947	8141
Onuphis quadricuspis	11.72	30.40	I	I	0	0	380	860
Ophelia limacina	21.97	32.40	I	I	0	0	40	140
Ophelina acuminata	6.87	23.71	II	III	3	-1	365	1150
Ophelina cylindricaudata	11.95	27.92	I	I	0	0	202	969
Ophelina minima	14.85	23.43	II	I	0	1	49	104
Ophelina modesta	10.97	21.25	III	III	3	0	192	1478
Ophelina norvegica	10.67	23.94	II	I	0	1	544	2017
Ophelina sp.	6.95	22.29	III	n.a.			402	1167
Ophiacantha bidentata	25.72	32.81	I	II	1.5	-1	26	55

TAXON NAME	ISI_{2012}	NSI	NSI EG	AMBI EG	AMBI VALUE	GROUP DIFF	COUNT	ABUN-DANCE
Ophiocten affinis	9.75	22.11	III	II	1.5	1	169	1002
Ophiocten sericeum	11.26	19.30	III	II	1.5	1	42	142
Ophiodromus flexuosus	3.73	18.93	III	II	1.5	1	894	2237
Ophiopholis aculeata	19.86	28.41	I	II	1.5	-1	27	45
Ophiura albida	12.01	24.27	II	II	1.5	0	133	625
Ophiura robusta	14.23	27.21	II	II	1.5	0	43	141
Ophiura sarsii	10.08	23.12	II	II	1.5	0	114	395
Ophiura sp.	5.12	27.14	II	II	1.5	0	568	2319
Ophiurida	15.53	27.81	I	II	1.5	-1	97	802
Ophiuroidea	7.41	26.19	II	II	1.5	0	389	2436
Ophryotrocha sp.	7.50	14.11	IV	IV	4.5	0	45	221
Orbinia (Orbinia) sertulata	19.08	26.11	II	I	0	1	33	60
Orbinia norvegica	9.53	24.92	II	I	0	1	822	2864
Ostracoda	11.57	24.69	II	n.a.			28	129
Owenia fusiformis	8.35	24.54	II	II	1.5	0	462	6700
Oweniidae	8.70	18.84	III	n.a.			37	813
Paguridae	15.96	29.67	I	n.a.			32	56
Pagurus bernhardus	13.62	25.25	II	II	1.5	0	47	77
Paradiopatra fiordica	10.72	22.73	III	I	0	2	163	549
Paradiopatra quadricuspis	17.68	29.77	I	I	0	0	53	89
Paradoneis eliasoni	11.21	24.82	II	III	3	-1	74	682
Paradoneis lyra	8.30	24.83	II	III	3	-1	1034	11772
Paraedwardsia arenaria	12.08	20.72	III	II	1.5	1	91	384
Paramphinome jeffreysii	5.99	20.83	III	III	3	0	2501	77228
Paramphitrite tetrabranchia	13.42	30.33	I	I	0	0	148	451
Paraonis fulgens	10.47	25.03	II	III	3	-1	107	1123
Paraonis gracilis	8.54	21.47	III	III	3	0	910	6986
Paraphoxus oculatus	14.51	24.73	II	II	1.5	0	54	121
Pardalisca tenuipes	14.99	27.68	I	I	0	0	79	99
Parvicardium minimum	10.09	29.01	I	I	0	0	790	2728
Parvicardium pinnulatum	10.47	20.70	III	I	0	2	107	675
Pectinaria (Amphictene) auricoma	9.97	27.08	II	I	0	1	861	2645
Pectinaria (Pectinaria) belgica	10.49	25.96	II	I	0	1	228	398
Pectinaria sp.	12.61	31.41	I	I	0	0	53	197
Pennatula phosphorea	20.82	28.52	I	I	0	0	49	56
Perioculodes longimanus	16.98	25.06	II	II	1.5	0	46	133
Phascolion strombi	10.15	26.76	II	I	0	1	400	745
Phaxas pellucidus	9.49	24.26	II	I	0	1	87	160
Pherusa plumosa	9.50	20.95	III	III	3	0	61	222
Pherusa sp.	12.93	26.22	II	I	0	1	65	123
Philine aperta	14.47	23.08	III	II	1.5	1	49	176
Philine quadrata	9.60	23.29	II	II	1.5	0	104	321
Philine scabra	8.00	24.20	II	II	1.5	0	595	2282
Philine sp.	9.49	23.42	II	II	1.5	0	206	598
Philocheras bispinosus	14.57	25.75	II	I	0	1	27	41
Philomedes (Philomedes) lilljeborgi	11.24	25.54	II	II	1.5	0	315	2694
Philomedes globosus	9.31	27.56	I	II	1.5	-1	225	1974
Phisidia aurea	18.39	32.78	I	I	0	0	79	295
Pholoe anoculata	13.49	28.55	I	I	0	0	128	330

TAXON NAME	ISI_{2012}	NSI	NSI EG	AMBI EG	AMBI VALUE	GROUP DIFF	COUNT	ABUN-DANCE
Pholoe assimilis	7.83	22.02	III	I	0	2	53	265
Pholoe baltica	5.51	21.28	III	I	0	2	231	1836
Pholoe inornata	9.22	19.26	III	IV	4.5	-1	83	727
Pholoe minuta	3.86	23.02	III	II	1.5	1	1331	8108
Pholoe pallida	12.77	29.07	I	I	0	0	390	1040
Pholoe sp.	7.16	25.64	II	II	1.5	0	352	4645
Phoronis muelleri	9.78	26.35	II	II	1.5	0	57	690
Phoronis sp.	17.40	30.41	I	II	1.5	-1	23	46
Phtisica marina	10.18	26.75	II	I	0	1	87	197
Phyllodoce groenlandica	3.47	21.79	III	IV	4.5	-1	449	1733
Phyllodoce maculata	6.83	18.10	IV	II	1.5	2	87	704
Phyllodoce mucosa	5.68	10.40	5	III	3	2	69	405
Phyllodoce rosea	8.34	27.50	I	II	1.5	-1	160	353
Phyllodoce sp.	4.50	20.70	III	II	1.5	1	316	1168
Phyllodocidae	5.78	24.95	II	n.a.			501	1027
Phyllodocinae	7.36	20.56	III	n.a.			37	63
Phylo norvegicus	12.45	23.74	II	I	0	1	133	355
Pilargis papillata	17.91	25.71	II	I	0	1	52	80
Pisione remota	20.79	31.33	I	I	0	0	33	1095
Pista cristata	9.14	26.97	II	I	0	1	577	2816
Pista lornensis	6.05	26.23	II	I	0	1	211	1068
Platyhelminthes	9.81	26.80	II	II	1.5	0	234	367
Platynereis dumerilii	8.11	21.55	III	III	3	0	42	183
Podarkeopsis helgolandica	16.25	23.82	II	II	1.5	0	39	47
Polychaeta	12.52	28.96	I	n.a.			46	95
Polycirrus arcticus	17.97	23.05	III	IV	4.5	-1	30	228
Polycirrus medusa	13.97	30.13	I	IV	4.5	-3	78	291
Polycirrus norvegicus	13.42	18.71	IV	IV	4.5	0	95	992
Polycirrus plumosus	9.34	26.54	II	IV	4.5	-2	443	1430
Polycirrus sp.	10.05	30.52	I	IV	4.5	-3	323	1247
Polydora ciliata	2.86	6.95	5	IV	4.5	1	128	5502
Polydora sp.	5.63	13.54	IV	IV	4.5	0	314	20903
Polynoidae	11.01	23.47	II	n.a.			97	188
Polyphysia crassa	4.93	19.19	III	III	3	0	833	8190
Polyplacophora	16.64	31.19	I	n.a.			52	208
Pontophilus norvegicus	14.61	24.67	II	I	0	1	24	25
Porifera	23.49	35.63	I	n.a.			43	70
Praxillella affinis	17.49	29.35	I	III	3	-2	54	264
Praxillella gracilis	13.49	18.68	IV	III	3	1	55	216
Praxillella praetermissa	9.36	25.66	II	III	3	-1	161	894
Praxillura longissima	22.50	34.25	I	III	3	-2	73	121
Priapulus caudatus	6.56	21.50	III	III	3	0	295	760
Prionospio banyulensis	17.97	29.41	I	IV	4.5	-3	27	75
Prionospio cirrifera	6.65	21.89	III	IV	4.5	-1	1894	32462
Prionospio dubia	19.09	27.80	I	II	1.5	-1	226	759
Prionospio fallax	4.10	23.83	II	IV	4.5	-2	1620	29058
Prionospio multibranchiata	13.01	27.58	I	III	3	-2	376	1535
Prionospio ockelmanni	14.39	31.05	I	IV	4.5	-3	47	208
Prionospio sp.	8.54	21.95	III	IV	4.5	-1	283	2292

TAXON NAME	ISI_{2012}	NSI	NSI EG	AMBI EG	AMBI VALUE	GROUP DIFF	COUNT	ABUN-DANCE
Prionospio steenstrupi	11.16	23.82	II	IV	4.5	-2	151	1477
Processa canaliculata	20.72	27.60	I	I	0	0	28	42
Proclea grafii	9.64	24.28	II	I	0	1	367	5211
Proclea malmgreni	17.71	26.53	II	I	0	1	28	208
Prosobranchia	10.15	29.01	I	n.a.			61	106
Protodorvillea kefersteini	4.02	15.99	IV	II	1.5	2	128	1986
Protomedeia fasciata	12.97	16.95	IV	II	1.5	2	31	265
Pseudamussium peslutrae	15.87	28.60	I	II	1.5	-1	89	158
Pseudopolydora antennata	6.44	20.33	III	IV	4.5	-1	158	5682
Pseudopolydora paucibranchiata	8.55	17.80	IV	IV	4.5	0	273	10379
Pseudopolydora pulchra	9.88	11.61	IV	IV	4.5	0	28	462
Pseudopolydora sp.	5.26	11.91	IV	IV	4.5	0	616	82466
Pseudosphyrapus anomalus	20.45	27.41	I	III	3	-2	104	347
Pterolysippe vanelli	10.69	29.64	I	I	0	0	642	8322
Pycnogonida	12.00	28.65	I	II	1.5	-1	61	96
Regularia	27.97	36.13	I	n.a.			34	65
Rhodine gracilior	12.09	29.16	I	I	0	0	250	911
Rhodine loveni	9.37	26.68	II	II	1.5	0	934	2964
Rhodine sp.	13.82	28.18	I	II	1.5	-1	94	435
Sabellidae	5.42	24.56	II	I	0	1	962	6273
Sabellides borealis	13.30	20.67	III	II	1.5	1	30	249
Sabellides octocirrata	8.51	28.08	I	II	1.5	-1	459	1493
Samytha sexcirrata	12.56	32.28	I	I	0	0	228	482
Scalibregma inflatum	5.43	21.61	III	III	3	0	1246	12484
Scalibregmatidae	14.69	27.49	I	n.a.			43	80
Scaphander punctostriatus	21.75	31.73	I	I	0	0	33	43
Scaphopoda	14.42	23.48	II	n.a.			25	37
Schistomeringos sp.	12.30	29.66	I	II	1.5	-1	25	39
Scolelepis (Scolelepis) foliosa	14.38	29.51	I	III	3	-2	203	975
Scolelepis (Scolelepis) squamata	18.37	28.60	I	III	3	-2	46	170
Scolelepis korsuni	19.75	28.58	I	III	3	-2	44	108
Scolelepis sp.	10.63	28.12	I	III	3	-2	222	606
Scolelepis tridentata	9.66	23.07	III	III	3	0	54	171
Scoloplos (Scoloplos) armiger	6.34	19.94	III	III	3	0	630	12858
Scutopus ventrolineatus	13.86	24.32	II	I	0	1	75	206
Siboglinidae	15.58	30.23	I	I	0	0	36	95
Sige fusigera	8.70	20.39	III	III	3	0	90	216
Similipecten similis	23.59	34.55	I	I	0	0	48	81
Sipuncula	8.51	23.57	II	I	0	1	341	904
Sosane sulcata	10.60	31.49	I	II	1.5	-1	251	1995
Sosanopsis wireni	9.93	31.29	I	I	0	0	141	385
Spatangus purpureus	16.63	31.67	I	I	0	0	37	133
Sphaerodorum gracilis	7.30	26.53	II	II	1.5	0	257	740
Sphaerodorum sp.	15.71	24.95	II	II	1.5	0	52	155
Sphaerosyllis hystrix	17.41	36.13	I	II	1.5	-1	58	1014
Spio filicornis	8.14	19.97	III	III	3	0	134	4045
Spio sp. sp.	11.31	23.22	II	III	3	-1	48	165
Spiochaetopterus typicus	5.52	17.76	IV	III	3	1	409	7259
Spionidae	6.46	22.05	III	n.a.			132	280

TAXON NAME	ISI_{2012}	NSI	NSI EG	AMBI EG	AMBI VALUE	GROUP DIFF	COUNT	ABUN-DANCE
Spiophanes bombyx	12.33	23.37	II	III	3	-1	102	884
Spiophanes kroyeri	5.63	20.87	III	III	3	0	2431	37109
Spiophanes sp.	17.22	30.11	I	III	3	-2	50	660
Spiophanes urceolata	9.44	33.91	I	III	3	-2	24	229
Sthenelais limicola	21.91	30.55	I	II	1.5	-1	33	236
Sthenelais sp.	13.88	29.10	I	II	1.5	-1	27	100
Streblosoma bairdi	11.65	25.83	II	I	0	1	199	574
Streblosoma intestinale	13.04	32.06	I	I	0	0	418	2302
Strongylocentrotus droebachiensis	21.47	35.51	I	I	0	0	36	99
Stylatula elegans	16.08	21.35	III	n.a.			25	46
Syllidae	8.83	24.11	II	n.a.			120	299
Syllides longocirratus	21.06	34.53	I	II	1.5	-1	44	129
Syllidia armata	11.12	24.82	II	II	1.5	0	59	126
Syllis sp.	11.80	23.94	II	II	1.5	0	89	471
Syllis variegata	7.48	20.16	III	II	1.5	1	56	415
Synchelidium haplocheles	16.23	28.50	I	I	0	0	64	78
Tanaidacea	11.55	28.61	I	II	1.5	-1	498	1851
Tectibranchiata	10.93	17.85	IV	n.a.			49	147
Tellimya ferruginosa	8.25	25.70	II	II	1.5	0	318	996
Tellimya tenella	10.98	26.92	II	II	1.5	0	430	1303
Terebellidae	11.10	30.21	I	n.a.			256	489
Terebellides stroemii	7.63	25.86	II	II	1.5	0	2123	10600
Terebellinae	11.27	30.28	I	n.a.			107	242
Tharyx marioni	7.60	21.09	III	IV	4.5	-1	195	4797
Tharyx sp.	7.55	21.64	III	IV	4.5	-1	1285	29565
Thelepus cincinnatus	14.76	31.15	I	II	1.5	-1	47	100
Themisto abyssorum	12.85	22.42	III	n.a.			80	146
Thracia convexa	12.42	28.18	I	I	0	0	53	81
Thracia sp.	12.56	26.97	II	I	0	1	134	242
Thracia villosiuscula	18.91	27.25	II	I	0	1	48	153
Thyasira equalis	6.87	19.82	III	III	3	0	2377	58751
Thyasira flexuosa	6.29	21.33	III	III	3	0	952	15206
Thyasira gouldi	12.18	18.61	IV	I	0	3	53	516
Thyasira granulosa	10.63	15.40	IV	n.a.			33	2719
Thyasira obsoleta	11.58	29.40	I	I	0	0	830	3444
Thyasira sarsi	4.14	14.18	IV	III	3	1	1064	26911
Thyasira sp.	6.23	19.63	III	II	1.5	1	747	22773
Timoclea ovata	11.34	31.53	I	I	0	0	162	876
Tmetonyx cicada	15.53	36.22	I	I	0	0	68	147
Tomopteris (Johnstonella) helgolandica	14.92	23.60	II	n.a.			38	86
Trichobranchus glacialis	16.88	30.37	I	II	1.5	-1	38	95
Trichobranchus roseus	9.18	27.93	I	II	1.5	-1	679	2516
Trochochaeta multisetosa	4.97	17.18	IV	III	3	1	206	852
Tropidomya abbreviata	13.61	29.05	I	I	0	0	141	219
Tryphosites longipes	9.21	28.90	I	I	0	0	144	270
Turbellaria	15.04	28.49	I	II	1.5	-1	64	120
Turritella communis	16.20	27.19	II	II	1.5	0	41	98
Typosyllis cornuta	5.86	20.85	III	II	1.5	1	604	4401
Ubestemt	13.86	28.18	I	n.a.			162	281

TAXON NAME	ISI_{2012}	NSI	NSI EG	AMBI EG	AMBI VALUE	GROUP DIFF	COUNT	ABUN-DANCE
Vermiformis	8.40	26.09	II	n.a.			286	495
Virgularia mirabilis	14.37	26.64	II	I	0	1	76	117
Westwoodilla caecula	10.09	28.00	I	II	1.5	-1	489	921
Xenodice frauenfeldti	26.30	39.51	I	I	0	0	39	70
Yoldiella frigida	12.35	20.12	III	I	0	2	64	415
Yoldiella lenticula	11.96	20.88	III	I	0	2	119	1968
Yoldiella lucida	12.08	25.58	II	I	0	1	810	2964
Yoldiella nana	11.32	22.17	III	I	0	2	323	2646
Yoldiella philippiana	12.45	30.74	I	I	0	0	266	593
Yoldiella sp.	12.74	27.70	I	I	0	0	85	190
Zeppelina monostyla	9.82	14.57	IV	n.a.			27	607
Zoealarve	8.90	24.90	II	n.a.			105	132

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