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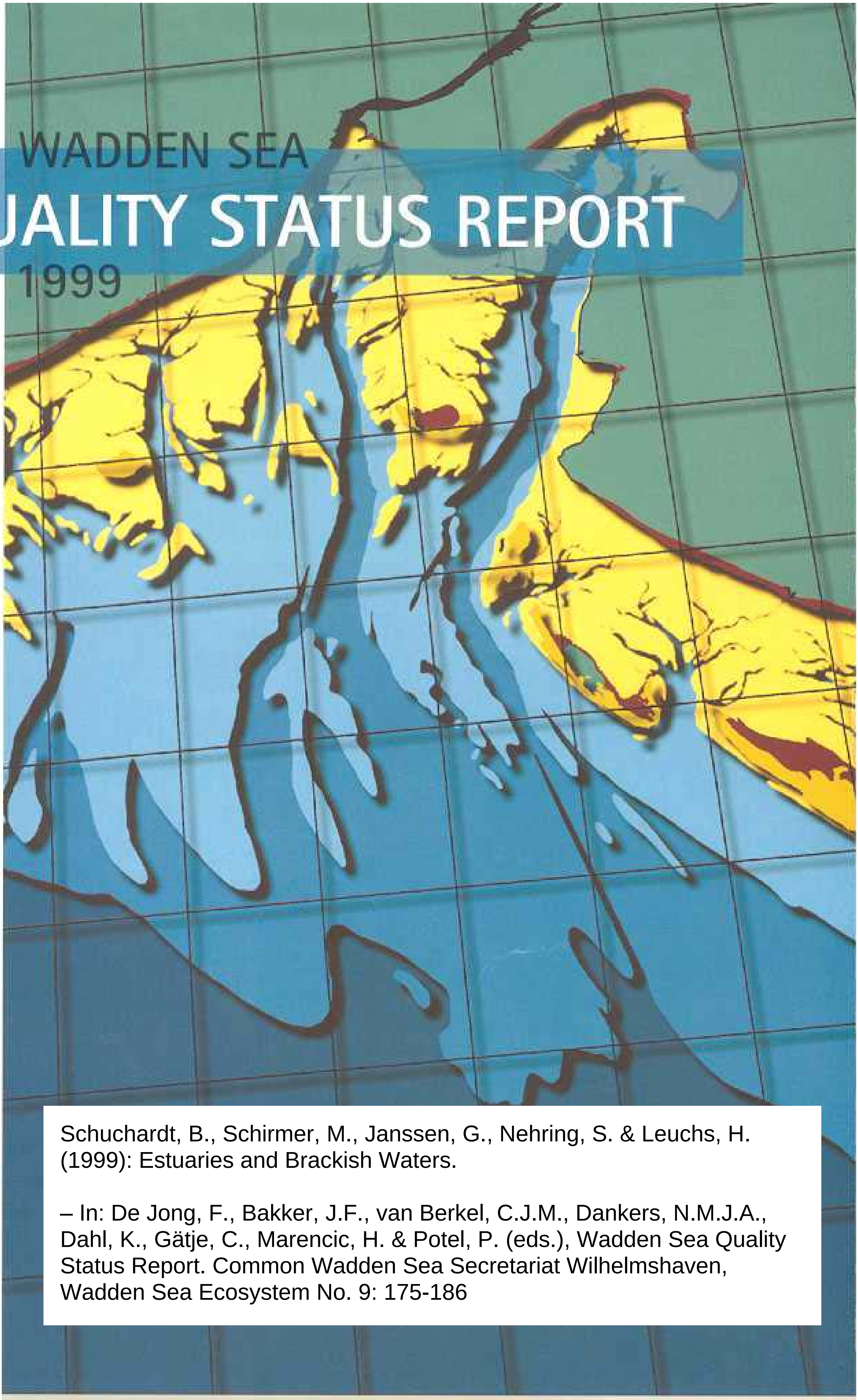

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5.15 Estuaries and Brackish Waters

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5.15.1 Introduction

Estuaries can be defined as tidally influenced transition zones between marine and riverine environments. According to the Leeuwarden Declaration, the estuaries in the Trilateral Cooperation Area are delimited on the landward side by the mean brackish water limit and on the seaward side by the average 10 PSU isohaline at high water in the winter situation. However, in the present review the tidally influenced freshwater reaches are included (according to the definition of Fairbridge, 1980), as they form an integral part of the estuarine habitat (Schuchardt *et al.,* 1993a). Laterally, all areas up to the main dike or, where absent, the spring high tide water line, are included.

According to the above definition, there are five estuaries in the Wadden Sea region: the Varde Å estuary in Denmark and the Eider, Elbe, Weser and Ems estuaries in Germany.

These estuaries are, on the one hand, of high relevance for the Wadden Sea ecosystem (input of nutrients and toxic substances, sediment dynamics, nursery and feeding area). On the other hand, the estuaries themselves are a specific habitat, characterized by strong variability and dynamics of key-factors such as salinity, tidal range, turbidity and others. From an ecological point of view, they are important, *e.g.* for the migration of a number of species and, additionally, they are inhabited by various brackish-water and, at least, estuary-endemic species, thus being of special importance for conservation purposes. However, in contrast to the Wadden Sea,the estuaries are strongly altered by human activities and only scat-

Figure 5.19. Estuaries in the Wadden Sea region.

tered areas are protected as nature reserves.

The data describing the ecological situation is heterogenous and a positive correlation between length of the estuary and the amount of available data exists. Systematic long-term monitoring data only exist for water quality and, partly, macrozoobenthos. For biological data, only scattered information is available, resulting mainly from research programs of universities/authorities and, very recently, data sets obtained in the framework of environmental impact assessments.

5.15.2 Brief characterization

The estuaries of the Varde Å, Eider, Elbe, Weser and Ems are mesotidal coastal plain estuaries debouching into the Wadden Sea (North Sea) (Figure 5.19).

Table 5.9. Compilation of main features, describing the estuaries of Varde Å, Eider, Elbe, Weser and Ems. Data from Schuchardt, 1995; Pedersen, pers. comm.

	Varde Å	Eider	Elbe	Weser	Ems
drainage area upstream of tidal weir ($km^2.10^3$)	1.08	2	135	38	13
mean river discharge (m^3/s)	13	23	725	323	125
mean tidal range at tidal weir (m)	1.3	2	2.4	4.1	2.8
length of the inner estuary (km)(definition see text)	17	21	120	70	50

Morphologically, the river mouth can be divided into two sections: a river-like inner part (including the tidal freshwater, the oligohaline and parts of the mesohaline reaches) between a tidal weir and the outer part. This outer part is characterized by a funnel-like morphology with very extended tidal flats, being part of the Wadden Sea. From this general structure, the Ems estuary differs due to the Dollart, a brackish bay, the Eider estuary, due to the construction of a storm-surge-barrier and the Varde Å, where mixing of river and sea water takes place normally in the Ho Bugt seaward of the narrow river (Duinker *et al.*, 1980). According to the definition given above, this paper deals mainly with the inner parts of the estuaries.

The estuaries vary considerably in size, length and river discharge (Table 5.9). Except for the Varde Å (Olesen, 1993) the adjacent lowlands in all estuaries are protected by dikes against flooding, either from the sea or from the river, and they are of great economic importance for shipping, agriculture and industrial purposes and have been altered by human activities.

5.15.3 Morphological modifications

Morphological alterations of rivers and estuaries have strongly affected virtually all estuaries under consideration except the Varde Å. The main reasons were coastal protection and land reclamation and adaptation to increasing ship numbers and sizes.

Deepening of the shipping routes

Since the beginning of the century, the estuaries of Elbe and Weser have been successively adjusted to the increase in the average size of the world merchant fleet to allow ocean liners to reach Hamburg and Bremen. In the Ems estuary, the driving forces are the port of Emden and the transport of newly built ships from the Papenburg shipyard to Emden. The adaptation of the estuaries of Elbe, Weser and Ems was accomplished by the excavation of a straight navigable channel to concentrate and accelerate the water masses. Concentration was increased by groynes and by the cutting and filling in of sidearms and ramifications. Shallows and gravel banks were often removed or elevated and connected to each other. The shipping channel was smoothened; roughness and energy-dissipation reduced and given a funnel-like shape, the narrow end leading into the upstream laying harbors (Schirmer, 1996; Kausch, 1996).

The changes are most extreme in the Weser estuary, especially when compared to the natural width of the estuary and the freshwater discharge. The Ems is similarly impacted; the Dollard much less than the Elbe estuary, where the shaping of the channel left much of the estuarine topography unchanged.

The stepwise deepening and canalization of the outer and inner estuaries of Elbe, Weser and Ems led to a marked increase in tidal amplitude. The correlation between tidal amplitude within an estuary and its morphology is fairly high and allows the use of this well-documented parameter as an indicator of the anthropogenic impact on the estuaries considered here. Another advantage of monitoring and evaluating tidal amplitudes lies in its importance as an ecologically relevant factor.

Figure 5.20 gives an impression of the changes in tidal range between 1880 and 1995. About 75%

of the increase in tidal amplitude results from a drop of the mean low water level, about 25% from a rise of mean high water (Harten, 1979). The increase in the Weser is extreme due to the excessive canalization of the estuary and a reflection of the tidal wave at the weir in Bremen-Hemelingen.

The increased current velocities transport increasing amounts of suspended solids into the side waters. This material is accreted there and causes a slow but steady rise of the bottom level. This happens below the low water line as well as on tidal flats, thus transforming shallow water areas into tidal flats.

The strong tidal currents, together with wave action from passing ships, tend to erode the banks and, thus, enforce bank protection measures, especially in the narrower estuaries of Weser and Ems. In the Weser estuary, *e.g.* about 60 % of the banks along the main channel between Bremen and Bremerhaven are protected, mainly by rock material (Schuchardt *et al.*, 1984).

Maintenance dredging is necessary in all of the canalized estuaries creating environmental impact during dredging and during dumping. It is least within the shipping channel of the Weser estuary compared to the Elbe and Ems as indicated in Table 5.10. The removed sediments from the channels of Elbe, Weser and Ems are either transported into the outer estuaries and dumped next to the shipping channel or dumped in the inner estuary in stretches which are over-deepened due to erosion. With respect to the material balance between estuaries and the Wadden Sea, the removal of sand (and silt) from the estuaries raises critical questions on the long-term consequences for the Wadden Sea sediment budget (Höpner, 1994).

Coastal protection and land reclamation

Another main factor for far-reaching modifications in all estuaries is coastal protection. Linear dikes along the estuarine banks have been built since the 11th and 12th century (Meier, 1996). Until the 19th century, Bremen and parts of Hamburg, however, were prone to flooding by high discharges of Weser and Elbe. Only after the dredging, did the storm surges from the North Sea become the greatest danger and dikes had to be reinforced. Many of these dikes still follow the old lines but land reclamation and shortening of dike length was a permanent issue: the Eider estuary lost about 12 km^2 of forelands in 1972 (Katinger Watt), the Elbe estuary lost about 140 km^2 between 1896 and 1982, the Weser lost about 32 km^2 between 1880 and 1955 and the Ems/Dollard-region has lost about 21 km^2 since 1922 (Schuchardt *et al.*, 1993b). Major land reclamation after 1975 is only found along the Elbe estuary (Haseldorfer Marsch 20 km^2, Asseler- und Krautsand 26 km^2 (ARGE Elbe, 1984).

The importance of dikes along the estuaries has been steadily growing because of

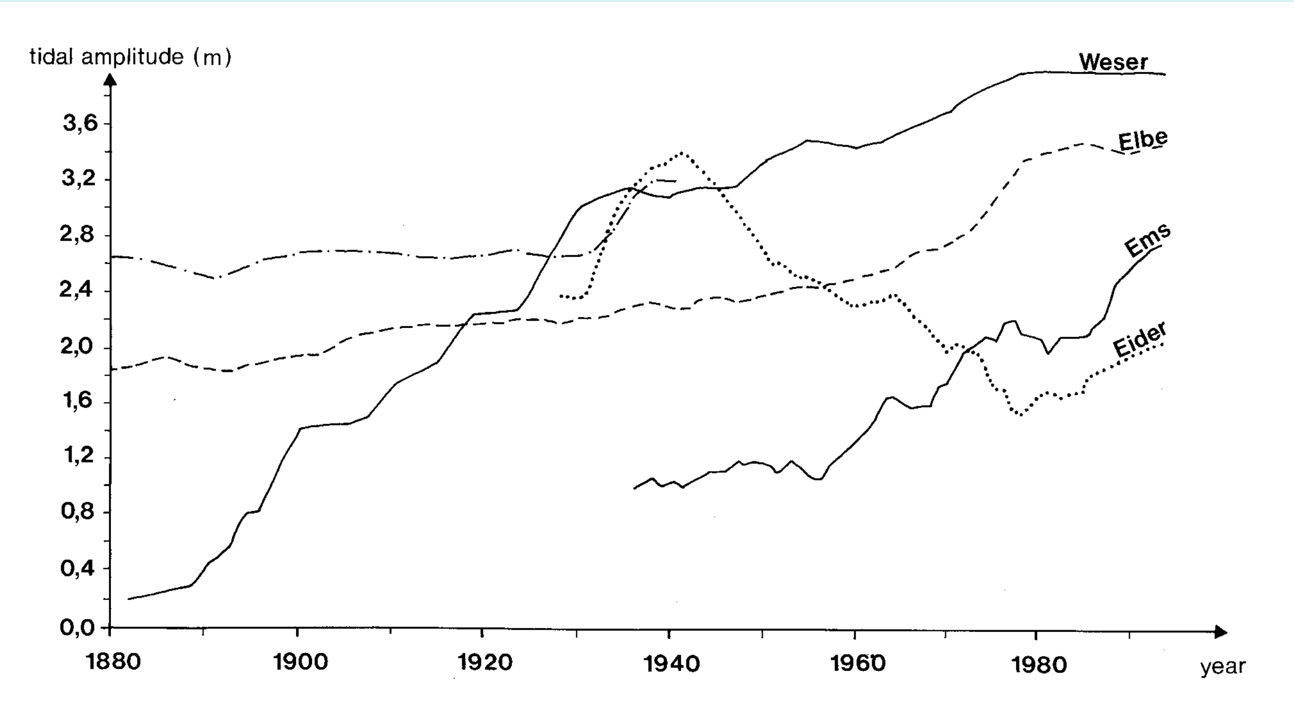

Figure 5.20. Changes in tidal range between 1880 and 1995 in the Eider (gauges Tönning and Friedrichstadt), Elbe (gauge Hamburg St. Pauli), Weser (gauge Bremen Oslebshausen) and Ems (gauge Herbrum) (5-year-running mean). According to Schuchardt, 1995.

Table 5.10. Mean annual volumes ($10^6 m^3/yr$) of maintenance dredging in the shipping channels of Elbe, Weser and Ems Estuaries between 1981 and 1992 (after Farke, 1994) and sediment accumulation in the harbors (according to Nasner, 1992).

	Elbe	Weser	Ems
av. volume in channel (min-max)	12.8 (9.5-16.5)	3.4 (1.3-7.9)	7.3 (0-10.5)
av. sedimentations in harbour area	2.4 (Cuxhaven+Brunsbüttel+Hamburg)	1.0 (Bremerhaven+Bremen)	0.6 (Emden)

i) the secular sea level rise;

ii) the enhancement of storm surges by dredging and channeling;

iii) the construction of storm surge barriers on the tributaries which reduced the flood basin dramatically and raised the flood level, *e.g.* in the Weser more than 0.5 m;

iv.) strong subsidence of the marshes due to soil mineralization and drainage.

Additional losses of interaction between river and marsh were caused by low summer dikes constructed to protect forelands in agricultural use. As a result of diking and channeling, the hydrological and sedimentary interaction between the estuaries and their marshes has been interrupted to a maximum degree. The hydrological interaction is highly controlled. Drainage and irrigation are accomplished by sluices and pumps, biological interaction is restricted (Garms, 1961).

The situation is somewhat different for the Eider estuary. In addition to diking, the morphology has changed strongly due to a reduction of the catchment area by the Kiel Canal by about 30% (1895) and the construction of a tidal barrage at Nordfeld (1936). The cross-section below Nordfeld shrunk to 5 - 10% of the initial width due to siltation. The construction of a storm-surge barrier at the mouth of the Eider (Vollerwiek) in 1973 and the diking of the Katinger Watt reduced the cross-section even more. Today, the incoming tidal flood is actively reduced to prevent further siltation (Fock and Ricklefs, 1996).

5.15.4 Estuarine habitats: changes in quantity and quality

The morphological and physical alterations of the estuaries had an immense impact on habitat structure and quality both in the marshes, the amphibious zone and in the aquatic environment.

The Forelands

Foreland areas between the mean spring tide high water line and the winter dikes are frequently flooded and are of special ecological importance. About two to three quarters of the forelands along the inner estuaries of Elbe, Weser and Ems were lost during the last century (Schuchardt *et al.*, 1993b). Many of the remaining marshes are protected by low summer dikes, which prevent much of the everyday interaction between river and marsh. This is being amplified by the lowering of the ground water table due to the lowering of the tidal low water and midwater levels in the estuaries of Elbe, Weser and Ems and by active drainage for agricultural use.

Tidal flats and shallow waters

The increase in tidal amplitude due to the deepening of the estuaries could have created more tidal flats and shallow water areas (with fewer than 2 m depth below tidal low water). However, the deposition of dredged sediments within the tidal area, the reclamation of land, the widening of the deep shipping channel and the protection of banks have altogether strongly reduced these areas. The losses are worst within the Weser estuary between Bremen and Bremerhaven and less pronounced in the Elbe (Schirmer, 1994).

5.15.5 Ecological structure: abiotic parameters

The estuarine habitat can be characterized as a very dynamic environment, governed by steep gradients of salinity and turbidity, the tidal rise and fall and resulting currents, long water residence time compared to the river, partly pronounced oxygen deficits, relatively high nutrient concentrations and, before diking, extended lowlands flooded both due to riverine peak discharge and during storm flood situations.

Salinity gradient

The freshwater-seawater interface is characterized by the mixing of sea and river water resulting in a steep, strongly variable salinity gradient. The position of the resulting brackish habitat varies with the tides and due to changes in riverine discharge. The gradient has been strongly altered in the Eider estuary due to a tidal weir and a storm surge barrier with some consequences for the brackish water community (Fock and Heydemann, 1995). In the Weser estuary, an upstream shift of the brackish water has been found (Grabemann *et al.*, 1983). Morphological changes due to canalization could not be clearly identified as main reasons, but must be assumed. This is similar to the situation in the Elbe estuary (Bergemann, 1995).

Turbidity zone

A zone of high turbidity associated with the upstream limit of the salinity gradient is typical for all estuaries under consideration (Wellershaus, 1981; Grabemann *et al.*, 1996). The downstream border of this reach may be set at a salinity of about 8 PSU. In this turbidity zone, phytoplankton production is restricted due to light limitation (Schuchardt and Schirmer, 1991). A relation between extensive dredging and dumping activities or estuarine canalization and increased turbidity has been discussed (Wellershaus, 1986).

Temperature

Water temperature as an ecological master factor is locally altered due to the input of cooling water (Müller *et al.*, 1990). Several large power plants are located along the inner estuaries of Elbe and Weser.

Tides

The tides are an essential feature of an estuary (aestus = tide). However, in the Wadden Sea estuaries, the tidal amplitude has been strongly changed due to canalization and other activities (Schuchardt, 1995). Especially in the tidal freshwater reaches, the habitat structure has been altered (Schirmer, 1994). The decrease of the mean low tide level has led to a nearly complete transformation of shallow areas to tidal flats in the inner Weser estuary over the last 100 years. In the adjacent lowlands, tidal influence has been reduced due to diking and water management (Heckman, 1984). Thus, the function of these areas for the estuary, like retention of suspended matter and nutrients, has been diminished (Heckman and Kausch, 1996).

Residence time

The water residence time within the estuary is an important feature preventing downstream loss of planktonic species and increasing oxygen demand due to C- and N-mineralization. It depends mainly on the relation between the river discharge and the estuarine water volume. The water volume has been increased in the estuaries of Elbe, Weser and Ems due to deepening and decreased in the Eider estuary as a result of siltation after construction of the tidal weir (Fock and Heydemann, 1995).

Oxygen

Slight oxygen deficits have been observed to be a typical estuarine feature associated with the accumulation of suspended particulate matter in the estuarine turbidity zone (Martin and Brun-Cottan, 1988). In the Eider estuary, oxygen deficits are only minor, indeed. However, in the Weser and Elbe estuaries, it had been strongly enhanced as a result of waste water input over the last decades. In the Elbe estuary, recently, a reduction of the summer oxygen deficits can be observed (Reincke, 1995). This is both a result of improving waste water treatment in Hamburg and a reduction of oxygen-consuming substances from upstream. Also, in the Weser estuary, oxygen deficits have been reduced since waste water treatment in Bremen has been improved (Schuchardt *et al.*, 1989). A significant deterioration has been observed in the Ems estuary in the last years probably due to excessive dredging activities, leading to an impoverishment of the estuarine biocoenosis (IBL, 1997).

Nutrients and pollutants

The nutrient concentrations in the river-dominated estuaries are clearly elevated compared to a pre-industrial situation, which has been estimated for the Elbe estuary (Flügge *et al.*, 1989). However, there exist some differences between the estuaries under consideration. This is detailed in Chapter 4.

For concentrations of heavy metals and trace organic compounds see Chapter 4.

5.15.6 Ecological structure: biota

The estuarine biocoenosis is substantially governed by physical factors such as tides (tidal range and currents), water depth and river discharge as well as by the salinity gradient. Suspended particulate matter dynamics, morphodynamics and sediment properties are also important. However, human uses have altered the ecological structure of all estuaries (Schuchardt *et al.*, 1993b, Höpner, 1995).

Phytoplankton

Phytoplankton biomass shows a steep gradient within the estuaries with a peak in the tidal freshwater reach and minimum values in the turbidity zone. Light limitation has been found to be of greater importance than salinity or nutrients. Biomass, upstream of the turbidity cloud, is mainly formed by the estuarine diatom *Actinocyclus normanii* during summer and autumn, whereas riverine species (*Asterionella, Synedra*) are dominating during spring (Schulz, 1961, Schuchardt and Schirmer, 1991).

Biomass in shallow side-arms has been found to be several-fold higher than in the deep main channel (ARGE Elbe, 1984), indicating the consequences of subsequent reduction of shallow areas due to deepening of the estuaries.

For the Weser estuary, some shifts of species composition in the last 50 years have been documented, mainly as a result of increasing salt-concentration from potassium-mining and due to nutrient increase (Haesloop and Schuchardt, 1995). However, recently, a shift in species composition has been observed in the Weser River as a result of a reduction of the anthropogenic salt burden (Bäthe and Preuß, 1994).

Microphytobenthos

Microphytobenthos in the eulittoral has been analyzed by Gätje (1992) for the Elbe estuary. It is dominated by widely distributed diatom species. Interactions with the phytoplankton via sedimentation and resuspension have been found to be of some importance (Kies *et al.*, 1992). Reduction of tidal areas due to the deepening for sea-going vessels and other use have reduced their habitat (Kies *et al.*, 1992). Of some importance are benthic (macro)-algae, mostly species of the genera *Vaucheria*, *Enteromorpha* and *Blidingia*.

Vegetation

Submersed macrophytes are nearly completely absent in all of the estuaries. In the oligohaline and mesohaline reaches, this is due to natural tidal amplitude, salinity and turbidity. In the limnic reaches, this is mainly a result of anthropogenic increase of the tidal range (Runge, 1981 for the Ems; Cordes, 1993 for the Weser). During mappings at the beginning of the century, species such as *Potamogeton pectinatus*, *P. lucens* and *Myriophyllum spicatum* were abundant.

As a result of diking, agricultural use of foreland and disposal of dredged material on land, small bodies of waters above the high tide water line have been reduced. In such waters, submersed macrophytes might be still abundant due to the absence of tidal rise and fall.

Eulittoral vegetation (mainly reeds) is still of importance in the estuaries (Kies *et al.*, 1992). Although strongly reduced, compared with the situation at the beginning of the century (*e.g.* Preisinger, 1991, Claus *et al.*, 1994), the typical vertical and longitudinal zoning of *Schoenoplectus tabernaemontani*, *Bolboschoenus maritimus* and *Phragmites australis* is still present (*e.g.* Kötter, 1961). In the Eider estuary, steepening and seaward displacement of the freshwater-seawater interface, resulting from several constructions (stormsurge-barrier, tidal weir), has led to strong sedimentation and subsequent downstream increase of reeds in the area of former extended salt marshes (Fock and Heydemann, 1995).

Foreland vegetation above MHW is characterized by agricultural use and the loss of formerly widely distributed vegetation communities and species (Cordes, 1993; Claus *et al.*, 1994). Endemic species such as *Oenanthe conioides* and *Dechampsia wibeliana* adapted to tidal influence have become rare (Heckmann and Kausch, 1996). Riparian forests, widely distributed on the riverbanks of the tidal freshwater reaches before the settling of man (Behre, 1985) are nearly completely lacking today.

Zooplankton

Zooplankton communities in the estuaries under consideration have been found to be similar (Kühl and Mann, 1981). The inner and middle estuarine reaches are dominated by the calanoid copepod *Eurytemora affinis* (Kausch and Peitsch, 1992; Haesloop and Schuchardt, 1995). During summer, the rotifers *Keratella* spp. and *Brachionus* spp. and some cladocera may be of some quantitative importance, especially in the innermost estuary. In the turbidity zone, the rotifers decrease strongly and biomass is dominated by *Eurytemora* during the year. Due to the invasion of some marine species (*e.g. Synchaeta*), there is no minimum in the species number found. In the water column, several mobile crustacea like *Crangon crangon*, *Palaemon longirostris*, *Gammarus* spp. and *Neomysis integer* have been found to be of quantitative importance (Fiedler, 1991).

Similar to the distribution of phytoplankton, abundance of zooplankton in areas with reduced current velocities like harbors open to the tide, can be several times higher (Schuchardt *et al.*, 1995).

Significant long-term changes in species composition have not been found for the inner Weser estuary (Haesloop and Schuchardt, 1995). However, reduction of shallow sidearms due to canalization caused strong habitat reduction.

Macrozoobenthos

Macrozoobenthos is relatively well documented for the four estuaries. In general, high densities and low diversity are typical for the brackish zone, whereas lower densities and increasing diversity are typical for the outer estuary. In the tidal freshwater reaches upstream, diversity is low. This is mainly due to the tides, as can be shown by comparing the situation upstream of the tidal weir

(Scholle and Schuchardt, 1997). However, motile benthic species (mostly crustacea) are of some importance (Haesloop, 1990; Arntz *et al.*, 1992).

In the Eider estuary, the salinity gradient has been strongly altered (see above) resulting in a reduction of the length of the brackish reach and a steepening of the salinity gradient. Marine species such as *Nereis diversicolor, Arenicola marina* and *Cerastoderma edule* have retreated downstream (Fock and Heydemann, 1995) and the number of genuine brackish species is low (Michaelis *et al.*, 1992). However, recent surveys (Fock, 1996) have documented the occurrence of further brackish water species (*Tubificoides heterochaetus, Paranais frici, P. botniensis*). Quantitatively, the low salinity region is characterized by *Marenzelleria* spp. *(Viridis/wireni* complex*), Heteromastus filiformis* and *Macoma balthica*.

Although the former situation of the macrozoobenthos in the Elbe estuary is well documented, recent published data are scattered. Stony embankments have been sampled by Gaumert and Spieker (1995) showing higher densities and diversity in the low salinity region (dominated by *Balanus improvisus*) than in the tidal freshwater reach (dominated by *Dreissena polymorpha* and *Gammarus zaddachi*). According to Nehring and Leuchs (1996), the low salinity region is characterized by *Marenzelleria* spp., *Boccardiella redeki* and *Neomysis integer*. Riedel-Lorje *et al.* (1995) and Krieg (1996) have described some upstream extension of brackish water species such as *Bathyporeia pilosa* and *Corophium volutator* and concluded that there has been an upstream movement of the brackish water zone, perhaps as a result of engineering works in the estuary. However, this item is still open to scientific discussion.

In the Weser estuary, the situation is well documented by the results of, *e.g.* Haesloop (1990), Kolbe (1995b) and Gosselck and Prena (1996). Due to elevated conductivity (resulting from potassium mining upstream) in the tidal freshwater reach, the benthic fauna is dominated by several brackish and marine crustaceans, most of them invading in large numbers from the natural brackish region in spring and summer. Among them, *Gammarus zaddachi, Corophium lacustre, Neomysis integer, Palaemon longirostris* and *Crangon crangon* are of particular importance (Haesloop and Schuchardt, 1995) as well as *Balanus improvisus* and *Marenzelleria* spp. (Nehring and Leuchs, 1996). In the natural brackish reach, further species such as *Balanus improvisus, G. salinus*, brackish oligochaetes like *Peloscolex heterochaetus* and *Tubifex costatus* as well as some polychaetes are of some importance as well as a number of marine species. Analyzing the existing data sets, a long-term data set compiled by Kolbe (1995b) is of special interest. Data on infauna from the natural brackish water zone near Bremerhaven over 20 years show that strong variability of species diversity and abundance is a typical feature of estuarine communities, making it very difficult to differentiate between natural dynamics and manmade changes (analyzing estuarine community data).

In the freshwater and the oligohaline reaches of the Ems estuary, species number, biomass and densities are lower than in the mesohaline reaches (IBL, 1994). Species most present in the tidal freshwater reach are *Limnodrilus hoffmeisteri* and other tubifids as well as *Gammarus zaddachi*. Species composition in the oligohaline reaches is similar, whereas in the mesohaline reach brackish species like *Marenzelleria* spp., *Tubifex costatus, Bathyporeia pilosa* and some marine species are important. However, there is some evidence that reduced habitat diversity and dredging have reduced the number of species (Dittmer, 1981; Rhode, 1982; IBL, 1994). Arntz *et al.* (1992) have described the quantitative importance of motile macrofauna species such as *Paramysis kervillei* and *Neomysis integer*. However, recently, a decline of diversity and abundance, probably due to dredging activities and anoxia, has become obvious (IBL, 1997).

Comparison of recent data with older ones from the beginning of the century, reveals a strong reduction of species number in the innermost Weser estuary, which is mainly the result of morphological changes, whereas in the middle reaches, changes are less significant (Haesloop and Schuchardt, 1995). It can be assumed that this is a general tendency in the estuaries under consideration (for the Elbe see BfG, 1994). However, due to the intrusion of a number of "new" species (neozoa), these losses have partly been compensated (see Nehring and Leuchs, 1999). These alien species seem to have become integrated into the food web without out-competing other species (in estuarine sediment dumping areas *Marenzelleria* spp. becomes one of the dominant forms; Leuchs *et al.*, 1996).

Fish

Fish is relatively well documented as well, due to its great commercial importance in historical times. This importance has been reduced strongly, both due to a decrease or extinction of some fish species of commercial interest and changes in the behavior of consumers (Schuchardt *et al.*, 1985; Möller, 1989). However, in general, the estuaries still sustain large fish stocks. The open boundaries to the marine as well as to the fluvial reaches and the high productivity are the most important prerequisites.

For the Eider estuary, only scattered data are available. According to Dehus (1987), euryhaline species (see Elbe section) are dominant in the upper estuary. There is some evidence that one main reason for the extinction of sturgeon (*Acipenser sturio*) was the construction of the tidal weir in 1936, isolating the adults from their upstream spawning grounds (Spratte, 1992). Due to the weir, the hydrographic situation upstream, in this former tidally influenced stretch, has been changed: rheophilic species such as lampern (*Lampetra fluviatilis)* have been reduced, whereas lenitic cyprinids are still abundant (Dehus,1987; Spratte, 1992). A strong decline of eel (*Anguilla anguilla*) catches has been explained as a result of the storm-surge barrier (Fock, 1998).

The situation in the Elbe estuary is very well documented. In the inner Elbe estuary (Tideelbe), 77 species have recently been recorded, of which 31 are freshwater species (6 of them are allochthonous), 11 can be classified as euryhaline (one of them allochthonous) and 34 of them are marine species (Thiel, 1995). Four species, formerly abundant, are extinct. These are *Vimba vimba, Silurus glanis, Alosa alosa* and *Acipenser sturio*. Some other species have been strongly reduced in numbers. Quantitatively, the euryhaline species smelt (*Osmerus eperlanus*), twaite shad (*Alosa fallax*), flounder (*Platichthys flesus*), stickleback (*Gasterosteus aculeatus*) and eel (*Anguilla anguilla*), the marine species herring (*Clupea harengus*) and the freshwater species ruffe (*Gymnocephalus cernua*) are the most important. Biomass in the shallow side-arms is about one third higher than in the main channel giving an impression of the consequences of the subsequent reduction of shallow areas in all of the estuaries (see above). Longitudinally, no differences in fish abundance have been found, whereas biomass is increasing seaward due to the appearance of marine species. For the Elbe estuary, some impact of oxygen deficits on the distribution of smelt and flounder has been found: they are avoiding areas with concentrations lower than 3 mg/l. Today, the oxygen deficits during summer are less, due to the improvement of water quality (Reincke, 1995). The concentrations of heavy metals and, especially chlorinated hydrocarbons in eels, are still elevated in the Elbe estuary, resulting mainly from the input via some tributaries of the middle reaches of the Elbe (Reincke, 1995). This prompted a ban on marketing Elbe eel for human consumption. However, a reduction of contamination in the future can be expected. The influence of the tidal weir at Geesthacht on fish is documented (Beckedorf and Schubert, 1995). Impact of the entrainment of cooling water is described by Köhler (1981).

According to the recent compilation by Schirmer (1991) and Scheffel and Schirmer (1997), the fish community in the Weser estuary seems to be very similar to that in the Elbe estuary. The same species are rare or extinct (in addition to those already mentioned for the Elbe, also *Coregonus oxyrhynchus* and *Lota lota*) and a similar spectrum of species is dominating (euryhaline species and some cyprinids). A characteristic species in the innermost estuary is the ide *(Leuciscus idus*). The main reasons for the extinction of species like *Acipenser sturio* and others are the same as for the Elbe estuary (Busch *et al.*, 1989).

For the Ems estuary, dominance of the same euryhaline species as in the Elbe and Weser is documented (Arntz *et al.*, 1992). However, occurrence of *Alosa alosa* is still possible and for *Coregonus oxyrhynchus* there exist records up to the seventies (Gaumert and Kämmereit, 1993). Recently, the fish fauna seems to have been declining strongly (IBL, 1997). Whether this is due to excessive dredging activities or anoxia during summer or other factors is still unclear.

For the Varde Å, data are not available. However, the restocking of *Coregonus oxyrhynchus* should be mentioned (see Section 5.10).

Summarizing the situation in the estuaries, it can be stated that they are still (and partly again) populated by a diverse fish community and that they are still of importance as a nursery ground for Wadden Sea species (*e.g.* flounder *Platichthys flesus*, see Kerstan, 1991). However, some alterations of the fish communities due to anthropogenic impact are obvious. Some species (especially diadromous species) have become extinct or rare, the main reasons being overfishing, construction of weirs, destruction of spawning grounds and pollution. Also, reduction of shallow areas seems to be an impact factor. Recently, some positive developments like increase of smelt in the Elbe estuary as a result of the improvement of water quality can be stated. However, the situation in the Ems estuary requires special attention. During recent years, there seems to be a sharp decrease of species diversity and abundance. Measures improving the ecological situation are necessary.

Special attention must be given to the strong decrease of eel catches in the North Sea and, especially, to the reduction of young eel invading the estuaries from the North Sea.

5.15.7 Ecological functions of the estuaries

The most important ecological functions of estuaries result both from their open boundaries to marine and limnic reaches and from their own specific properties.

Linkage and gateway

The linkage and gateway function of estuaries between marine and limnic environments is an essential feature in the life cycle of several fish and invertebrate species (*e.g. Salmo salar, Anguilla anguilla* as the most important). This function is diminished in all estuaries due to the construction of tidal weirs (*e.g.* Beckedorf and Schubert, 1995).

Filter

The filter function of estuaries for particulate and partly dissolved matter (due to the increase of water-residence-time, partial retardation of particulate matter in the turbidity cloud and of sediment on estuarine flats and marshes, degradation of organic material) is of importance for the input of substances to the Wadden Sea and the North Sea. However, this function has been strongly reduced due to manmade morphological changes (Kausch *et al.*, 1991; Heckman and Kausch, 1996).

Habitat

The importance of the habitat function of estuaries for the genuine brackish water species has increased after the nearly complete destruction of the former gradual transition area between marine and limnic reaches along the coast due to diking and water management (Wolff, 1991). However, due to physical (morphological and hydrological) alterations of the estuaries this function is restricted (Michaelis *et al.*, 1992).

Sediment supply

The sediment supply function of the estuaries seems to be of importance for the sediment balance in the Wadden Sea (*e.g.* Höpner, 1994). The input has been reduced due to the construction of dams, maintenance dredging with deposition on land and sand extraction. However, quantitative importance cannot be assumed yet.

The trophic dynamics of the estuaries under consideration is still only partly understood and the scientific discussion of the relative importance of organic detritus versus phytoplankton for estuarine consumers is open (see Day *et al.*, 1989). Little comparable data on the productivity of estuaries is available. For the primary production of plankton, microphytobenthos and macrophytes, some data from the Elbe estuary are shown in Table 5.11. The high biomass and production of macrophytes per m^2 is remarkable, whereas turnover (p/b-ratio) is highest for phytoplankton. Taking the entire areas available in the Elbe estuary into account, the contribution of phytoplankton is relatively small, whereas the contribution of macrophytes is highest. This means that the strong reduction of estuarine areas populated by macrophytes, as mentioned above, has had considerable negative consequences also for the estuarine productivity.

Phytoplankton production in the estuary has been influenced by the deepening for sea-going vessels. Deepening has changed the relation between the euphotic zone and non-euphotic zone. This can only partly be compensated by the heterotrophic activities of estuarine phytoplankton (Kies *et al.*, 1992). For planktonic primary production, shallow areas are, thus, of special importance as can be shown in the remaining side-arms in the Elbe estuary (Schuchardt and Schirmer, 1991). However, such shallow areas are nearly completely lacking in the canalized Weser estuary and have been reduced in the other estuaries.

5.15.8 Other brackish waters

Diking and land reclamation all along the coast of the Wadden Sea have eliminated the broad

	biomass	production (gC/m²)	p/b-ratio (gC/gC. d)	production (tC/yr)
phytoplankton	4.1	0.35	0.09	2,933
microphytobenthos	12.8	0.66	0.05	10,000
macrophytes	686.4	9.42	0.01	30,072

Table 5.11. Comparison of biomass and primary production for phytoplankton, microphytobenthos and macrophytes from the Elbe estuary in September 1987 per m^2 (Kies et al., 1992) and for the whole area of the Elbe estuary between km 650 and 715 (Kies and Neugebohrn, 1994).

natural transitional zone with creeks, swamps and marshes (Behre, 1985) where freshwater draining from land and seawater mixed and created a chain of brackish water habitats between the big open estuaries. Only a few habitats of this kind, like the mouth of the Godel creek on the island of Föhr (Figure 5.19)(see Stock *et al.,* 1996), have been left. The concentration of drainage systems into a few sluices, with a combination of gates and powerful pumps, created small, isolated brackish water environments with very unstable conditions. Little and/or irregular freshwater flow, depending on intermittent pumping, is the main reason for the very poor ecological quality of these biotopes as stated by Michaelis *et al.* (1992). They checked eight smaller outlets and found only half as many brackish-water species (≤ 7) as in the riverine estuaries (≤ 14) (see also Wolff, 1991). Most of these show hardly any salinity gradient but a sharp salinity break and have been termed fresh-salt-water changes by den Hartog (1964, 1967). About 25 of these are found in the Dutch Wadden Sea (de Boer and Wolff, 1996). Tidal creeks on the salt marshes of the Wadden Sea islands are considered to be another category of "mini-estuaries". Although only small amounts of freshwater run off through these creeks (al least 15 in the Dutch Wadden Sea), a brackish gradient in these creeks might be present. On two islands, dikes have been removed to restore estuarine gradients and further measures are planned.

The former estuary of the river IJssel in the Dutch Wadden Sea became a freshwater lake in 1932. The freshwater of the IJssel is now discharged through the sluices in the Afsluitdijk, creating estuarine conditions in the western Wadden Sea. In the Dutch Wadden Sea, there are about 11 such semi-open 'estuaries, forming real barriers for organisms, which use these transitions zones for migration between the fresh and the marine environment.

A different type of brackish water is found in several polders along the German coast. Whilst most of the enclosed waters turned into freshwaters, in four of them, brackish water prevails due to special water management. However, all suffer from eutrophication, algal blooms and oxygen deficits (Hagge, 1994; Nehring *et al.,* 1998).

Another type of brackish water is represented by the artificial Kiel Canal. It is, more or less, stagnant and salinity changes are weak. The natural stress of an estuary due to strong salinity changes is lacking and the number of brackish water species living there is high: from a survey in 1996, 38 macrozoobenthos species out of a total of 93 species have been classified as brackish species. It has been found that the canal is a habitat for several endangered species such as *Streblospio benedicti*, *Gammarus duebeni*, *Heterotanais oerstedi*, *Cyathura carinata* and *Embletonia pallida* (Leuchs *et al.,* 1999).

In the Dutch Wadden Sea, the restoration of salinity gradients in small sites has started. The management of the fresh water discharge in the Afsluitdijk has been adjusted to improve fish-migration into the IJsselmeer. However, knowledge on brackish-water habitats other than estuarine is scarce. Thus, in The Netherlands, a research program is being carried out on the possibilities of restoration of all kinds of aspects of estuarine (Ministerie van Verkeer and Waterstraat, 1996c).

5.15.9 Brief evaluation of the ecological situation of estuaries

Attempts to come to a qualitative/semi-quantitative evaluation of the ecological status of the estuaries under consideration have been made by Schuchardt *et al.* (1993b, Eider, Elbe Weser, Ems) and Höpner (1995, Elbe, Weser, Ems).

The attempt by Höpner (1995) included nine features or functions, presenting a wider spectrum of estuarine characteristics. However, they have not been quantified and the evaluation was primarily relative between the estuaries, taking, also, the still existing nature protection potential into account. The results are shown in Table 5.12.

Schuchardt *et al.* (1993b) have compared the status quo (about 1985) with a historical reference situation (about 1880) for the indicators morphology/cross-sections, loss of foreland, deficit of dissolved oxygen and heavy metal concentration within the sediments which are partly quantifiable. The results are shown in Table 5.13.

Compared to the Wadden Sea, the estuaries are heavily stressed both due to the input of chemicals and due to morphological deterioration. However, there exist considerable differences between the degree of deterioration of the estuaries under consideration.

Some years ago, it was obvious that the Ems estuary has received less human impact than the other estuaries (except the Varde Å). The Eider estuary has been altered very strongly by morphological and hydrological changes due to storm flood protection and agricultural use, whereas the water quality is better than in the other estuaries. The Elbe estuary has been changed both due to deepening for sea-going vessels and as a result of coastal protection. The water quality is worse than in the other estuaries. However, natural conservation potential is still very high. In the Weser estuary, deepening and canalization for shipping purposes is most significant and has altered the estuary greatly.

Taking the actual situation into account, this ranking must be changed considerably. The ecological status of the inner Ems estuary must be classified as heavily stressed regarding water quality, sediment budget, morphology and aquatic fauna, whereas the water quality parameters in the Elbe and Weser estuaries have been improved.

Data for the Varde Å are hardly available; thus, it cannot be evaluated in detail in the present paper. However, the Varde Å can be described as mostly natural in terms of hydrographic and morphological structure, although the marshes have also been strongly altered due to agricultural purposes.

Since some improvements of water quality have been achieved during the last years (especially in the Elbe estuary), the deterioration of the physical environment (morphology, hydrology) can now be regarded as the most severe impact on the ecological situation of all four German estuaries.

5.15.10 Current and future activities within the estuaries

Looking into the future, further improvement of water quality, especially in the Elbe estuary, can be expected. The situation in the Ems estuary is unclear. Concerning morphology, there are two tendencies existing, a further deterioration due to further deepening of the inner and outer estuaries and active habitat restoration (Gaumert, 1995; Schuchardt, 1997).

We will give a short summary of the most important or advanced schemes:

Ems estuary: irregular dredging of the inner estuary (Papenburg to Pogum) from 6.8 m to 7.3 m below high water for the transfer of ships from the Papenburg ship yard to Emden; extension of the Emden port; building of a storm-surge-barrier.

Weser estuary: Weser Tunnel at Dedesdorf; industrial district on the Luneplate; extension of Nordenham and Brake harbors; extension of the container terminal in Bremerhaven (CT IIIa and IV); filling of harbor basins in Bremen; canalizing and dredging of the river Hunte (km 0 - 21); deepening of the outer Weser (Bremerhaven to the open sea) from 12 to 14.7 m below sea chart zero;

Elbe estuary: deepening of the lower and outer Elbe (Hamburg - Cuxhaven) from 13.5 to 16 m below sea chart zero; raising of dikes and storm surge protection constructions, shortening of dike length; filling of harbor basins in Hamburg; transformation of marshes into dumpsites and harbor areas (Altenwerder).

All these activities will perpetuate and increase the adverse effects on the ecological system 'estuary'.

biotope-diversity	Elbe	>	Ems	>	Weser
water quality	Ems	>	Weser	>	Elbe
sediment quality	Ems	>	Weser	>	Elbe
side-arms	Elbe	>	Ems	>	Weser
filter potential	Elbe	>	Ems	>	Weser
importance for avifauna	Ems	>	Elbe	>	Weser
importance for fish	?		?		?
importance for nature protection	Ems	>	Elbe	>	Weser
quality for recreation	Elbe	>	Ems	>	Weser

Table 5.12. Evaluation of the ecological status of the estuaries relative to each other (Höpner, 1995). (Höpner had also included the Oder river mouth). The assessment of the status of the Ems should be updated for recent changes.

	Eider	Elbe	Weser	Ems
morphology / cross-sections	very strong	strong	very strong	moderate (*)
loss of foreland	no	very strong	strong	moderate
deficits of dissolved oxygen	small	very strong	strong	moderate (*)
heavy metals in sediments	moderate	very strong	very strong	strong

Table 5.13. Evaluation of the ecological status of the estuaries (about 1985) related to a historical reference situation (about 1880) (Schuchardt et al., 1993b). (*): must, on the basis of recent developments, be categorized as very strong.

5.15.11 Recommendations

- Existing ecological targets for estuaries (*e.g.* Leeuwarden) must be detailed, taking into account the individuality of each estuary.
- Monitoring of ecological long-term changes, other than water quality and macrozoobenthos in the estuaries, is necessary.
- The tidal freshwater reaches should be integrated into the Leeuwarden definition of an estuary.
- Active restoration of estuarine habitats (especially shallow areas and foreland) is necessary in all estuaries under consideration. Problems linked to the artificial increase of the tidal range have to be given special attention.
- Consequences of further impact due to further deepening, barriers and harbor extension should be evaluated very carefully, taking into account the historical deterioration of the estuaries and the uniqueness of each estuary.
- Further improvement of water quality is necessary, especially, for the Elbe and Ems estuaries.
- In contrast to the other estuaries, the ecological status of the Ems estuary has strongly deteriorated in recent years. An improvement of both, water quality and morphology, is necessary.
- Active restoration of smooth gradients of salinity and tidal amplitude in small creeks along the Wadden Sea coast and the estuaries to improve brackish water habitats is important.

Aagaard, T., Nielsen, N. and Nielsen, J., 1995. Skallingen - origin and evolution of a barrier spit. Skalling-Laboratoriet 35, pp. 85.

Admiraal, W., 1984. The ecology of estuarine sediment-inhabiting diatoms. In: Round, F. E. and Chapman, G. (Eds.), Progress in Phycological Research, 3. Biopress, Bristol, pp. 269-322.

Ærtebjerg, G., 1997. Black spots in the Danish Wadden Sea. In: Henke, S. (Ed.). Black spots in the Wadden Sea. Texte 3/97, Federal Environmental Agency, Berlin, pp. 19-20.

Agatz, M., 1998. Eutrophierungsfolgen im Wattenmeer: Veränderungen der benthischen Diatomeenflora durch Klärwasser im Königshafen von Sylt.- Diplom thesis, University of Bingen, 73 p.

Agatz, M., Asmus, R.M. and Deventer, B., 1999. Structural changes in the benthic diatom community along a eutrophication gradient on a tidal flat. Helgoland mar. Res. (in press).

Albrecht, A.S, 1998 Soft bottom versus hard rock: Community ecology of macroalgae on intertidal mussel beds in the Wadden Sea. J Exp Mar Biol Ecol 229, 85-109.

Andresen, H., Bakker, J.P., Brongers, M., Heydemann, B. and Irmler, U., 1990. Long-term changes of salt marsh communities by cattle grazing. Vegetatio 89, 137-148.

Aguilar, A. and Borrell, A., 1995. Pollution and harbour porpoises in the eastern North Atlantic. In: Bjørge, A. and Donovan, G.P. (Eds.). Biology of the Phocoenids. Rep. Int. Whal. Comm., Special Issue 16, 231 - 242.

ARGE Elbe, 1984. Gewässerökologische Studie. Arbeitsgemeinschaft der Länder zur Reinhaltung der Elbe (ARGE Elbe), Hamburg.

ARGE Elbe, 1990, Gewässergütebetricht 1985-1990, Teil III, Bericht über die PBSM-Belastungs der Elbe und ausgewählter Nebengewässer, Wassergütestelle Elbe, Hamburg, 1990.

ARGE Elbe, 1993 Wassergütedaten der Elbe von Schnackenburg bis zur See, Zahlentafel 1992, Wassergütestelle Elbe, Hamburg, 1993.

Armonies, W. and Reise, K., 1999. On the population development of the introduced razor clam *(Ensis americanus*) near the island of Sylt (North Sea). Helgoländer Meeresunters. 52 (3-4), 291-300.

Arntz, W., Schadwinkel, C., Günther, C.-P. and Meinken, H., 1992. Fischereibiologisch-fischereiwirtschaftliches Gutachten. Studie im Auftrag des Wasser- und Schiffahrtsamtes Emden (unpublished).

ASCOBANS, 1994. Agreement of the Conservation of Small Cetaceans of the Baltic and North Seas. Rep. First Meeting of Parties, Stockholm, 26-28 September 1994. ASCOBANS Secretariat, Cambridge, UK, pp. 44.

Asmus, H., 1987. Secondary production of an intertidal mussel bed community related to its storage and turnover compartments. Mar. Ecol. Progr. Ser. 39, 251-266.

Asmus, H. and Asmus, R.M., 1985. The importance of grazing food chain for energy flow and production in three intertidal sand bottom comunities of the northern Wadden Sea. Helgoländer Meeresunters. 39, 273-301.

Asmus, H. and Asmus, R.M., 1990. Trophic relationships in tidal flat areas: to what extent are tidal flats dependent on imported food? Neth. J. Sea Res. 27(1), 93-99.

Asmus, H., Lackschwitz, D., Asmus, R., Scheiffarth, G., Nehls, G. and Herrmann, J.-P., 1998a. Transporte im Nahrungsnetz eulittoraler Wattflächen der Sylt-Rømø Bucht. In: Gätje, C. and Reise, K. (Eds.). Ökosystem Wattenmeer: Austausch, Transport und Stoffwandlungsprozesse. Springer Verlag, Heidelberg, Berlin, pp. 393-420.

Asmus, R., Jensen, M.H., Murphy, D. and Doerffer, R., 1998b. Primärproduktion von Mikrophytobenthos, Phytoplankton und jährlicher Biomasseertrag des Makrophtobenthos im Sylt-Rømø Wattenmeer. In Gätje, C. and Reise, K. (Eds.). Ökosystem Wattenmeer: Austausch, Transport und Stoffwandlungsprozesse. Springer Verlag, Heidelberg, Berlin, pp. 367-392.

Asmus, R.M. and Asmus, H., 1991. Mussel beds: Limiting or promoting phytoplankton? J. Exp. Mar. Biol. Ecol. 148, 215-232.

Averbeck, C. and Voigt, L.H., 1992. Auswirkungen der kostenlosen Schiffsentsorgung gemäß MARPOL I + II, Ergebnisse der wissenschaftlichen Begleituntersuchung. Schiff & Hafen/Seewirtschaft, 11, 74-80.

Bakker, J.F., 1994. Schadstoffe in Mieschmuscheln. In: Lozán, J.L., Rachor, E., Reise, K., Westernhagen, H. v. and Lenz, W. (Eds.). Warnsignale aus dem Wattenmeer. Blackwell, Berlin, pp. 132-143.

Bakker, J.F., 1997. Black spots in the Dutch Wadden Sea. In: Henke, S. (Ed.). Black spots in the Wadden Sea. Texte 3/97, Federal Environmental Agency, Berlin. pp.17-19.

Bakker, J. and Smeenk, C., 1987. Time-series analysis of *Tursiops truncatus*, *Delphinus delphis* and *Lagenorhynchus albirostris* strandings on the Dutch coast. ECS Newsl. 1, 14-19.

Bakker, J. and Smeenk, C., 1990. Dolphins on the Dutch coast: an analysis of stranding records. In: Evans P.G.H., Aguilar, A. and Smeenk (Eds.). European Research on Cetaceans 4. Proc. Fourth Ann. Conf. European Cetacean Society. Palma de Mallorca, March 1990, 49-52.

Bakker, J.F., Jonge, V.N. de, Bartelds, W., Dijkhuizen, D. and Loos, C., 1994. The status of contaminants and nutrients in the Wadden Sea, a potential risk for birds? Pollution of the Wadden Sea over the past decennium. Ophelia 6, 99-116.

Bakker, J.F., Zande, T. van de and Smedes, F., 1996. Verontreinigingsgraad van en contaminantgehalte in sediment in de Waddenzee in 1993. Report RIKZ-96.027 ISSN 0927-3980, National Institute for Coastal and Marine Management, Rijkswaterstaat, The Netherlands.

Bakker, J.P., 1989. Nature management by grazing and cutting. Kluwer, Dordrecht, The Netherlands. pp. 400.

Bakker, J.P., 1993. Stategies for grazing management on salt marshes. Wadden Sea Newsletter 1993-1, 8-10.

Ballschmiter, K., 1999. The globe as a reaction vessel: environmental chemistry under global aspects. Key note presentation at the 9th Annual Meeting of SETAC-Europe, Leipzig, 25-29 May 1999.

Baptist, H.J.M., 1987. Waarnemingen van zeezoogdieren in de Nederlandse sector van de Noordzee. Lutra 30, 93-104.

Baptist, H.J.M., 1992. Witsnuitdolfijnen *Lagenorhynchus albirostris* in de Westerschelde. Sula 6, 59.

Baptist, H.J.M. and Wolf, P.A., 1993. Atlas van de vogels van het Nederlands continentaal plat. Rapport DGW-93.012. Ministerie van Verkeer en Waterstaat.

Baptist, H.J.M., Camphuysen, C.J. and Leopold, M.F., 1990. Sea Mammal sightings in The Netherlands. In: Evans, P.G.H., Aguilar, A. and Smeenk, C., (Eds.). European Research on Cetaceans 4. Proc. Fourth Ann. Conf. European Cetacean Society. Palma de Mallorca, March 1990, 31-33.

Baptist, H.J.M., Witte, R.H., Duiven, P. and Wolf, P.A., 1997. Aantallen Eidereenden *Somateria mollissima* in de Nederlandse kustwateren en de Waddenzee in de winters 1993-97. Limosa 70, 113-118.

Baretta, J. and Ruardij, P., 1988. Tidal Flat Estuaries. Ecological Studies, 71. Springer Verlag, Berlin. pp. 353.

Bastrop, R., Röhner, M., Sturmbauer, C. and Jürss, K., 1997. Where did *Marenzelleria* spp. (Polychaeta: Spionidae) in Europe come from? Aquat. Ecol. 31, 119-136.

Bäthe, J. and Preuß, K., 1994. Plankton und Benthos. Bericht zum DVWK-F+E-Vorhaben "Folgen der Reduktion der Salzbelastung in Werra und Weser für das Fließgewässer als Ökosystem". Niedersächsisches Landesamt für Ökologie, Hildesheim.

Bayne, B.L., 1965. Growth and delay of metamorphosis of the larvae of *Mytilus edulis* (L.). Ophelia 2, 1-47.

Beckedorf, R. and Schubert, H.-J., 1995. Funktionsüberprüfung der Fischaufstiegsanlagen an der Staustufe Geesthacht. Binnenfischerei in Niedersachsen 4. Niedersächsisches Landesamt für Ökologie, Hildesheim.

Becker, G. 1997. Hydrographic conditions on the coast of Lower Saxony in winter/spring 1996. In: Henke, S. (Ed.). Black spots in the Wadden Sea. Texte 3/97. Federal Environmental Agency, Berlin. pp. 23-26.

Becker, G. and Dooley, H., 1995. The 1989/91 High Salinity Anomaly in the North Sea and adjacent areas. Ocean Challenge 6(1), 52-57.

Becker, G. and Pauly, M., 1996. Sea surface temperature changes in the North Sea and their causes. ICES J. mar. Sci. 53, 887-898.

Becker, P.H., 1989. Seabirds as monitor organisms of contaminants along the German North Sea coast. Hegloländer Meeresunters. 43, 395-403

Becker. P.H., Koepff, C., Heidmann, W.A. and Büthe, A., 1991. Schadtstoffmonitoring mit Seevögeln. Forschungsbericht UBA-FB 91-081, Texte 2/92, Umweltbundesamt Berlin, pp. 259.

Becker, P.H., Thyen, S., Mickstein, S., Sommer, U. and Schmieder, K.R., 1998. Monitoring pollutants in coastal bird eggs in the Wadden Sea. Wadden Sea Ecosystem No. 8, Common Wadden Sea Secretariat, Wilhelmshaven, pp. 59-101.

Beek, F.A. van, Rijnsdorp, A.D. and Clerck, R. de, 1989. Monitoring juvenilestocks of flatfish in the Wadden Sea and the coastal areas of the southeastern North Sea. Helgoländer Meeresunters. 43, 461-477.

Beesen, A.H.G.C, Devilee, B.J.W.M. and Nijhuis, A., 1998. Vierde Nota Waterhuishouding, Regeringsbeslissing (Fourth Nota on Water Management, Gouvernmental Decision), Ministry of Transport, Public Works and Water Management, The Hague (NL), December 1998.

Behre, K.-E., 1985. Die ursprüngliche Vegetation in den deutschen Marschgebieten und deren Veränderung durch prähistorische Besiedelung und Meeresspiegelbewegungen. Verh. Ges. Ökol. 13, 85-96.

Beintema, A.J. and Müskens, G.D.J.M., 1993. Changes in migration pattern of the Common Snipe. In: Kalchreuter, H. (Ed.). Proceedings 2nd European Woodcock and Snipe workshop 1982. Fordingbridge, pp.146 – 160.

Benke, H. and Siebert, U., 1994. Zur Situation der Kleinwale im Wattenmeer und in der südöstlichen Nordsee. In: Lozán, J.L., Rachor, E., Reise, K., Westernhagen, H. v. and Lenz, W. (Eds.). Warnsignale aus dem Wattenmeer. Blackwell, Berlin, pp. 309-316.

Bennekom, A.J. van, Gieskes, W.W.C. and Tijssen, S. B., 1975. Eutrophication of Dutch coastal waters. Proc. R. Soc. Lond. B 189, 359-374.

Bergemann, M., 1995. Die Lage der oberen Brackwasserzone im Elbeästuar. DGM 39 (4/5), 134-137.

Berghahn, R. and Rösner, H.-U., 1992. A method to quantify feeding of seabirds on discard from the shrimp fishery in the North Sea. Neth. J. Sea Res. 28, 347-350.

Bernem, C. van, 1997. Final Discussion. In; Henke, S (Ed.). Black spots in the Wadden Sea. Texte 3/97. federal Environment Agency, Berlin. pp. 69-76.

Bester, K., 1996. Über Eintrag, Verbleib und Auswirkungen von stickstoff- und phosphorhaltigen Schadstoffen in der Nordsee, Verlag Shaker, Aachen, pp. 151.

Bester, K. and Faller, J.T., 1994. Persistente synthetische organische Schadstoffe in Wattenmeer. In: Lozán, J.L., Rachor, E., Reise, K., Westernhagen, H. v. and Lenz, W. (Eds.). Warnsignale aus dem Wattenmeer. Blackwell, Berlin, pp. 37-41.

Bester, K. and Hühnerfuss, H., 1993. Triazines in the Baltic and the North Sea. Mar. Poll. Bull. 26, 423-427; 26, 657-658.

Bester, K. and Hühnerfuss, H., 1996. Triazine herbicide concentrations in the German Wadden Sea. Chemosphere 32, 1919-1928.

Bester, K. and Hühnerfuss, H., 1997. Improvements of a combined size exclusion chromatography and solid phase extraction approach for the clean up of marine sediment samples for trace analysis of pesticides. Fresenius J. Anal. Chem., 358, 630-634.

Bester, K. and Hühnerfuss, H., 1998. Auswirkungen des Einsatzes von Triazinherbiziden auf die Nordsee (Effects of triazine herbicides use on the North Sea). Internal report. Expertgroup of quality objectives in the North Sea. Umweltbundesamt, Berlin.

Bester, K., Hühnerfuss, H., Brockmann, U. and Rick, H.J., 1995. Biological effect of triazine herbicide contamination on marine phytoplankton. Arch. Environ. Contam. Toxicol. 29, 277-283.

Bester, K., Hühnerfuss, H., Lange W. and Theobald. N., 1997. Results of non target screening of lipophilic organic pollutants in the German Bight I: Benzothiazoles. Sci. Total Environ. 207, 111-118.

Bester, K., Hühnerfuss, H., Lange, W., Rimkus, G.G. and Theobald, N., 1998a. Results of non target screening of lipophilic organic pollutants in the German Bight II: Polycyclic Musk Fragrances. Water Research 32, 1857-1863.

Bester, K., Biselli. S., Gatermann, R., Hühnerfuss, H., Lange, W. and Theobald, N., 1998b. Results of non target screening of lipophilic organic pollutants in the German Bight III: 2,5-Dichloroaniline. Chemosphere. 36, 1973-83.

Bester, K., Gatermann, R., Hühnerfuss, H., Lange, W. and Theobald, N., 1998c. Results of non-target screening of lipophilic organic pollutants in the German Bight IV: Identification and Quantification of Chloronitrobenzenes and Dichloronitrobenzenes. Environ. Poll. 102, 163-169.

Beukema, J.J., 1982. Annual variation in reproductive success and biomass of the major macrozoobenthic species living in a tidal flat area of the Wadden Sea. Neth. J. Sea Res. 16, 37-45.

Beukema, J.J., 1986. Eutrophication of the North Sea. In: Peet, G. (Ed.). Proceedings of the 2nd North Sea Seminar. Werkgroep Noordzee. Amsterdam, pp. 25-36.

Beukema, J.J., 1989. Long-term changes in macrozoobenthic abundance on the tidal flats of the western Dutch Wadden Sea. Helgoländer Meeresunters. 43, 405-415.

Beukema, J.J., 1990. Expected effects of changes in winter temperatures on benthic animals living in soft sediments in coastal North Sea areas. In: Beukema, J. J., Wolff, W.J. and Brouns, J.J.W.M., (Eds.). Expected effects of climate change on marine coastal ecosystems. Developments in Hydrobiol. 57, Kluwer Academic Publishers, Dordrecht, pp. 83-92.

Beukema, J.J., 1991. The abundance of shore crabs *Carcinus maenas* (L.) on a tidal flat in the Wadden Sea after cold and mild winters. J. Exp. Mar. Biol. Ecol. 153, 97-113.

Beukema, J.J., 1992a. Dynamics of juvenile shrimp *Crangon crangon* in a tidal-flat nursery of the Wadden Sea after cold and mild winters. Mar. Ecol. Prog. Ser. 83, 157-165.

Beukema, J.J., 1992b. Expected changes in the Wadden Sea benthos in a warmer world: Lessons from periods with mild winters. Neth. J. Sea Res. 30, 73-79.

Beukema, J.J., 1993. Increased mortality in alternative bivalve prey during a period when tidal flats of the Dutch Wadden Sea were devoid of mussels. Neth. J. Sea Res. 31(4), 395-406.

Beukema, J.J. and Cadèe, G.C., 1986. Zoobenthos responses to eutrophication of the Dutch Wadden Sea. Ophelia 26, 55-64.

Beukema, J.J. and Cadèe, G.C., 1997. Local differences in macrozoobenthic response to enhanced food supply caused by mild eutrophication in a Wadden Sea area: food is only locally a limiting factor. Limnol. Oceanogr. 42, 1424-1435.

Beukema, J.J. and Dekker, R., 1995. Dynamics and growth of a recent invader into European coastal waters: the American razor clam, *Ensis directus*. J. Mar. Biol. Ass. UK 75, 351-362.

Beukema, J.J. and Essink, K., 1986. Common patterns in the fluctuations of macrozoobenthos species living at different places on the tidal flats in the Wadden Sea. Hydrobiologia 142, 199-207.

Beukema, J.J., Dörjes, J. and Essink, K., 1988. Latitudinal differences in survival during a severe winter in macrozoobenthic species sensitive to low temperatures. Senckenbergiana marit. 20,19-30.

Beukema, J.J., Essink, K., Michaelis, H. and Zwarts, L., 1993. Year-to-year variability in the biomass of macrobenthic animals on tidal flats of the Wadden Sea: How predictable is this food source for birds? Neth. J. Sea Res. 31(4), 319-330.

Beukema, J.J., Essink, K. and Michaelis, H., 1996. The geographic scale of synchronized fluctuation patterns in zoobenthos populations as key to underlying factors: climatic or man-induced. ICES J. mar. Sci. 53, 964-971.

Beukema, J.J., Cadèe, G.C. and Dekker, R., 1998. How two large-scale "experiments" illustrate the importance of enrichment and fishery for the functioning of the Wadden Sea ecosystem. Proceedings 9th International Wadden Sea Symposium, November 1996, Norderney. Senckenbergiana marit. 29, 37-44.

Beukema, J.J., Honkoop, P.J.C. and Dekker, R., 1998. Recruitment in *Macoma balthica* after mild and cold winters and its possible control by egg production and shrimp predation. Hydrobiologia 375/376, 23-34.

Beusekom, J.E.E. van and Diel-Christiansen, S., 1996. Alterations of the North Sea plankton ecosystem due to changes in the regional climate, nutrient input and contaminant load: a hypothesis. In: Andersen, J., Karup, H. and Nielsen, U.B., (Eds.). Scientific Symposium on the North Sea Quality Status Report 1993, 18-21 April, 1994, Ebeltoft, Denmark. Ministry of Environment and Energy, Danish Environmental Protection Agency, Copenhagen, 64-73.

Beusekom, J.E.E. van, Brockmann, U.H., Hesse, K.-J., Hickel, W., Poremba, K. and Tillmann, U., 1998. Sediment - water interaction in the German Bight and adjacent Wadden Sea. TRANSWATT/KUSTOS Abschlussbericht 255-278.

Bezirksregierung Weser-Ems, 1997. Generalplan Küstenschutz für den Regierungsbezirk Weser-Ems. Bezirksregierung Weser-Ems, Oldenburg.

BfG, 1994. Historische Entwicklung der aquatischen Lebensgemeinschaft (Zoobenthos und Fischfauna) im deutschen Abschnitt der Elbe. Bericht der Bundesanstalt für Gewässerkunde Koblenz im Auftrag des Bundesministeriums für Umwelt, Naturschutz und Reaktorsicherheit, pp. 173.

Bijlsma, J.W.J., Breuer, R.E.H., Jansen, H.G., Posthuma, H., Roovaart, J.C. van den, Schooten, P. van and Voorhoeve, B., 1991. European coastal management. Universitaire Beroepsopleiding Milieukunde Report No. 1991/2, Leiden.

Boddeke, R. and Hagel, P., 1994. BEON studie naar de effecten van de teruglopende nutrientenbelasting van de Nederlandse kustzone. BEON Rapport, 94-17.

Boddeke, R., Daan, N., Posthuma, K.H., Veen J.F. de and Zijlstra, J.J., 1969. A census of juvenile demersal fish in the Dutch Wadden Sea, the Zeeland nursery ground, the Dutch coastal area and the open sea areas off the coasts of The Netherlands, Germany and the southern part of Denmark. Ann. biol. Copenhagen 26, 269-275.

Boer, K.D.E. and Wolf, W.J., 1996. Tussen zilt en zoet. Voorstudie naar de betekenis van estuariene gradienten in het Waddengebied. Rijksuniversiteit Groningen.

Boer, T.E. de, Arts, F., Beijersbergen, R.B. and Meininger, P.L., 1993. Actieplan Dwergstern. Actierapport 8, Vogelbescherming Nederland, Zeist.

Boer, J. de, Wester, P.G., Klamer, H.J.C., Lewis, W.W. and Boon, J.P., 1999. Do flame retardants threaten ocean life? Nature, 394, 28-29.

Brasseur, S.M.J.M. and Reijnders, P.J.H., 1997. The harbour seal in The Netherlands. IBN-DLO Texel, dept. Aquatic Ecology. Project 350 16 13. Directorate-General Rijkswaterstaat, pp. 40.

Breckling, P. and Neudecker, T., 1994. Monitoring the fish fauna in the Wadden Sea with stow nets (Part 1). A comparison of demersal and pelagic fish fauna in a deep tidal channel. Arch. Fish. Mar. Res. 42(1), 3-15.

Bree, P.J.H. van, Vedder, E.J. and Hart, L. 't, 1992. Over vondsten van ringelrobben *Phoca hispida* op de Nederlandse kust. Lutra 35, 90-97.

Bree, P.J.H. van, Vedder, E.J. and Hart, L. 't, 1994. Over zadelrobben *Phoca groenlandica* op de kust van continentaal West-Europa. Lutra 37, 97-105.

Bree, P.J.H. van and Smeenk, C., 1978. Strandingen van Cetacea op de Nederlandse kust in 1976 en 1977. Lutra 20, 13-18.

Bree, P.J.H. van and Smeenk, C., 1982. Strandingen van Cetacea op de Nederlandse kust in 1975, 1979 en 1980. Lutra 25, 19-29.

Breukel, R.M.A., Phernambucque, A.J.W., Wilting, A., Teunissen-Ordelman, H.G.K. and Geenen, J.P.W., 1996. Sporen in water, zes jaar speuren. (Traces in water, six years of probing). Report no. RIKZ 96.036, ISBN 903 69 504 30. Rijkswaterstaat.

Bruins, R.W.B., 1983. *Crassostrea gigas* (Thunberg, 1793) op Texel. Corr. Bl. Ned. Malc. Verenigung 215, 1436-1438.

Brunckhorst, H. and Rösner, H.-U., 1998. Das Vorkommen von Pfeifenten (*Anas penelope*) im schleswig-holsteinischen Wattenmeer. Corax 17, 81-96.

Brussaard, C.P.D., Riegman, R., Noorderloos, A.A.M., Cadèe, G.C., Witte, H., Kop, A.J., Nieuwland, G., Duyl, F.C. van and Bak, R.P.M., 1995. Effects of grazing, sedimentation, and phytoplankton cell lysis on the structure of a coastal pelagic food web. Mar. Ecol. Prog. Ser. 123, 259-271.

Buchwald, K.,1990. Nordsee: ein Lebensraum ohne Zukunft. Die Werkstatt, Göttingen, pp. 552.

Buhs, F. and Reise, K., 1997. Epibenthic fauna dredged from tidal channels in the Wadden Sea of Schleswig-Holstein: spatial patterns and a long-term decline. Helgoländer Meeresunters. 51, 343-359.

Bunje, J., 1990. Tourismus im Nationalpark Niedersächsisches Wattenmeer, Diplomarbeit Universität Göttingen, pp. 157.

Bunje, J., 1997. Salt marshes in the National Park "Niedersächsisches Wattenmeer". Status, Management, Aims ans Results. Wadden Sea newsletter 1997-1, 16-19

Busch, D., Schirmer, M., Schuchardt, B. and Ullrich, P., 1989. Historical changes of the River Weser. In: Petts, G.E., Roux, A. L. and Möller, H. (Eds.). Historical Change of Large Alluvial Rivers: Western Europe. J. Wiley & Sons, Chichester. pp. 297-321.

Cadée, G.C., 1984. Has input of organic matter into the western part of the Dutch Wadden Sea increased during the last decades? Neth. Inst. Sea Res. Publ. Ser. 10, 71-82.

Cadée, G.C., 1992a. Trends in Marsdiep phytoplankton. In: Dankers, N., Smit, C.J. and Scholl, M. (Eds.). Proceedings of the 7th international Wadden Sea Symposium, Ameland 1990. Present and future conservation of the Wadden Sea. Neth. Inst. Sea Res. Publ. Ser. 20, 143-149.

Cadée, G.C., 1992b. Variation in Marsdiep phytoplankton. ICES Mar. Sci. Symp. 195, 213-222.

Cadée G.C.,1996. Accumulation and sedimentation of *Phaeocystis globosa* in the Dutch Wadden Sea. J. Sea Res. 36, 321-327

Cadée G.C., Hegeman J., 1977. Distribution of primary production of the benthic microflora and accumulation of organic matter on a tidal flat area, Balgzand, Dutch Wadden Sea. Neth. J. Sea Res. 11, 24-41

Cadée, G.C. and Hegeman, J., 1991. Historical phytoplankton data of the Marsdiep. Hydrobiol. Bull. 24, 111-118.

Cadée, G.C. and Hegeman, J., 1993. Persisting high levels of primary production at declining phosphate concentrations in the Dutch coastal area (Marsdiep). Neth. J. Sea Res. 31(2), 147-152.

Cameron, P., Weichsel, T., Fick, A. and Watermann, B., 1998. TBT-Belastung der Küstensedimente in Nord- und Ostsee und ihre hormonellen Auswirkungen auf Meeresschnecken. (TBT load on coastal sediments of the North Sea and East Sea and their hormonal effects on sea snails). Umweltstiftung WWF – Germany, Bremen, pp. 24.

Camphuysen, C.J., 1989. Beached Bird Surveys in The Netherlands 1915-1988; Seabird mortality in the southern North Sea since the early days of oil pollution. Tech. Rep. Vogelbescherming 1, Werkgroep Noordzee, Amsterdam, pp. 322.

Camphuysen, C.J., 1994a. Terugkeer van Bruinvis en Tuimelaar in Nederlandse wateren? Sula 8, 271-274.

Camphuysen, C.J., 1994b. The harbour porpoise, *Phocoena phocoena*, in the southern North Sea, II: a come-back in Dutch coastal waters? Lutra 37, 54-61.

Camphuysen, C.J., 1995. Beached birds in The Netherlands as indicators of marine oil pollution. Sula 9 (special issue), 1-90.

Camphuysen, C.J., 1997. Oil pollution and oiled seabirds in The Netherlands, 1969-97: Signals of a cleaner Sea. Sula 11(2) (special issue), 41-156.

Camphuysen, C. J. and Franeker, J.A., (Eds.), 1991. Oil pollution, Beached Bird Surveys and Policy: towards a more effective approach to an old problem. Proceedings of the NZG/NSO Workshop on 19 April 1991 in Rijswijk, The Netherlands, Sula 5 (special issue), 1-52.

Camphuysen, C. J. and Franeker, J.A., 1992. The value of beached bird surveys in monitoring marine oil pollution. Technisch rapport Vogelbeschirmning 10 Nederland, Zeist, pp. 191.

Camphuysen, C.J. and Leopold, M.F., 1993. The harbour porpoise, *Phocoena phocoena*, in the southern North Sea, particularly the Dutch sector. Lutra 36, 1-24.

Camphuysen, C.J. and Leopold, M.F., 1994. Atlas of seabirds in the southern North Sea. IBN Research report 94/6, NIOZ Report 1994-8, Institute for Forestry and Nature Research, Netherlands Institute for Sea Research and Dutch Seabird Group, Texel, pp. 126.

Camphuysen, C.J. and Winter, C.J.N., 1995. Feeding fin whales, *Balaenoptera physalus*, in the North Sea. Lutra 38, 81-84.

Camphuysen, C.J., Ens, B.J., Heg, D., Hulscher, J.B., Meer, J. von der and Smit, C.J., 1996. Oystercatcher *Haematopus ostralegus* winter mortality in The Netherlands: The effect of severe weather and food supply. Ardea 84A, 469-492.

Carter, R.W.G., 1989. Coastal environments. Academic Press, London, pp. 617.

Chapman, V.J., 1976. Coastal vegetation. Pergamon Press, Frankfurt.

Claus, B., Neumann, P. and Schirmer, M., 1994. Rahmenkonzept zur Renaturierung der Unterweser und ihrer Marsch. Teil 1 und Teil 2. Gemeinsame Landesplanung Bremen/Niedersachsen 1/94 und 8/94.

Colijn, F. and Jonge, V.N. de, 1984. Primary production of microphytobenthos in the Ems-Dollard Estuary. Mar. Ecol. Prog. Ser. 14, 185-196.

Cordes, H., 1993. Die Entwicklung des Naturraumes Unterweser aus vegetationskundlicher Sicht. In: UVP- Förderverein (Ed.). Umweltvorsorge für ein Fluß- Ökosystem. Vertrieb für Bau- und Planungsliteratur, Dortmund. pp. 67-76.

Corten, A. and Kamp, G. van den, 1979. Abundance of herring larvae in the Dutch Wadden Sea as a possible indication of recruitment strength. ICES report C.M. 1979/ H: 26 Pelagic Fish Committee.

CPR Survey Team, 1992. Continuous plankton records: the North Sea in the 1980's. ICES Mar. Sci. Symp. 195, 243-248.

CWSS, 1994. Seventh Gonvernmental Wadden Sea Conference, Leeuwarden, 1994. Ministerial Declaration, Memorandum of Intent, Guinea Bissau – Wadden Sea, Assessment Report. Common Wadden Sea Secretariat, Wilhelmshaven, pp. 154.

CWSS, 1996. Black spots newsbulletin 1996-1. Common Wadden Sea Secretariat, Wilhelmshaven.

Daan, R., 1989. Factors controlling the summer development of copepod populations in the southern bight of the North Sea. Neth. J. Sea Res. 23, 305-322.

Dahl, K., Borchardt, T., Dankers, N. and Farke, H., 1994. Status, trends, regulations and ecological effects of the Wadden Sea Fishery. In: Frederiksen, M. and Dahl, K. (Eds.). Birds and their ecology in the Wadden Sea. Proceed. 8th Internat. Scient. Wadden Sea Symp., Esbjerg 1993. Ophelia, Suppl. 6, 87-97.

Dahlmann, G. and Nies, H., 1997. The role of the lipid surface film as a cause of the black spots. In: Henke, S. (Ed.). Black spots in the Wadden Sea. Texte 3/97. Federal Environmental Agency, Berlin, pp. 53-54.

Dahlmann, G., Timm, D., Averbeck, C., Camphuysen, C., Skov, H. and Durinck, J., 1994. Oiled Seabirds-Comparative Investigations on Oiled Seabirds and Oiled Beaches in The Netherlands, Denmark and Germany (1990-93). Mar. Poll. Bull. 28 (5), 305-310.

Dalfsen, J.A. and K. Essink, 1997. Risk analysis of coastal nourishment techniques. RIKZ Report 97.022. RIKZ, Haren.

Dame, R. and Dankers, N., 1988. Uptake and release of materials by a Wadden Sea mussel bed. J. Exp. Mar. Biol. Ecol. 118, 207-216.

Dame, R., Dankers, N., Prins, T., Jongsma, H. and Smaal, A., 1991. The influence of mussel beds on nutrients in the western Wadden Sea and Eastern Scheldt estuaries. Estuaries 14, 130-138.

Damm, U. and Neudecker, T., 1996. Abundance indices of plaice (*Pleuronectes platessa* L.) and sole (*Solea solea* L.) at the west coast of Schleswig-Holstein, North Sea. ICES Report C.M G:7, Demersal Fish Committee, pp. 12.

Danielsen, F., Skov, H., Durinck, J. , Christensen, K. M., 1990. Seks års overvågning af døde havfugle. Dansk orn. Foren. Tidskr. 84, 8-9.

Dankers, N., 1993. Integrated estuarine management - Obtaining a sustainable yield of bivalve resources while maintaining environmental quality. In: Dame, R. (Ed.). Bivalve Filter Feeders in Estuarine and Coastal Ecosystem Processes. NATO ASI Series Vol G 33, Springer Berlin-Heidelberg, pp. 479-511.

Dankers, N. and Koelemaij, K., 1989. Variations in the mussel population of the Dutch Wadden Sea in relation to monitoring. Helgoländer Meeresunters. 43, 529-535.

Dankers, N., Kühl, H. and Wolff, W.J., 1983. Invertebrates of the Wadden Sea. Balkema, Rotterdam, pp. 221.

Dankers, N., Dame, R. and Kersting, K., 1989. The oxygen consumption of mussel beds in the Dutch Wadden Sea. Scient. Mar. 53, 473-476.

Dankers, N., Meijboom, A. and Zegers, J., 1998. De ontwikkeling van mosselbanken in de Nederlandse Waddenzee. IBN-report (in press).

Dauer, D., Maybury, C.A. and Ewing, R.M., 1981. Feeding behaviour and general ecology of several polychaetes from the Chesapeake Bay. J. exp. mar. Biol. Ecol. 54, 21-38.

Davidson, N.C. and Piersma, T. (Eds.), 1992. The migration of knots. Wader Study Group Bull. 64. Special Issue.

Davidson, N.C. and Rothwell, P.I., 1993. Human disturbance to waterfowl on estuaries: conservation and coastal management implication of current knowledge. Wader Study Group Bull. 68, 97-105.

Day, J.W., Hall, C.A.S., Kemp, W.M. and Yanez-Arancibia, A., 1989. Estuarine Ecology. J. Wileys and Sons, New York, pp. 558.

Dehus, P., 1987. Bericht über die Befischung der Außeneider, der Untereider und der Mittleren Eider. Institut für Meereskunde Kiel, pp. 10, (unpublished).

Dekker, R., 1989. The macrozoobenthos of the subtidal western Dutch Wadden Sea. I. Biomass and species richness. Neth. J. Sea Res. 23, 57-68.

Delafontaine, M.T. and Flemming, B.W., 1997a. Episodic organic loading and mass mortality in marine sedimentary environments. In: Henke, S. (Ed.). Black spots in the Wadden Sea. Texte 3/97, Federal Environmental Agency, Berlin. pp.47-49.

Delafontaine, M.T. and Flemming, B.W., 1997b. The black tide of June 1996 in the German Wadden Sea revisited a year later. Symposium Aktuelle Probleme der Meeresumwelt. Dt. hydrogr. Z. Suppl.7, pp. 21-27.

Dethlefsen, V., Westernhagen, H. von and Cameron, P., 1996. Malformations in North Sea pelagic fish embryos during the period 1984-1995. ICES J. mar. Sci. 53, 1024-1035.

DGSM, 1993. Verkeersveiligheid op de Noordzee.

Dick, S., Brockmann, U.H., Beusekom, J. van, Fabiszisky, B., George, M., Hesse, K.-J., Mayer, B., Nitz, T., Pohlmann, T., Schaumann, K., Starke, A., Tillmann, U. and Weide, G., 1998. Exchange of matter and energy between the Wadden Sea and the coastal waters of the German Bight. Dt. hydrogr. Zeitschrift (in press).

Dickson, R.R., Kelly, P.M., Colebrook, J.M., Wooster, W.S. and Cushing, D.H., 1988. North winds and production in the eastern North Atlantic. J. Plankton Res. 10, 151-169.

Dieckmann, R., Osterthun, M. and Partenscky, H.W., 1988. A comparison between German and North American tidal inlets. Proc. 2 Ist. Coast. Enging. Conf. ASCE 3 199, 2681-269 1.

Dieren, J. W. van, 1934. Organogene Dünenbildung. Ph.D. thesis, Amsterdam, pp. 304.

Dijkema, K.S., 1987. Geography of salt marshes. Zeitschrift für Geomorphologie 31, 489-499.

Dijkema, K.S., 1990. Salt and brackish marshes around the Baltic Sea and adjacent parts of the North Sea: Their vegetation and management. Biological Conservation 51, 191-209.

Dijkema, K.S., 1991. Toekomstig beheer van kwelders op de eilanden en het vaste land. Waddenbulletin 91, 118-122.

Dijkema, K.S., 1994a. Küstenschutz am niederländischen Festland. Wattenmeer International 2, 11-12.

Dijkema, K.S., 1994b. Zeespiegelstijging en kwelderbeheer. Waddenbulletin 94, 104-107.

Dijkema, K.S., 1994c. Auswirkungen des Meeresspiegelanstieges auf die Salzwiesen. In: Lozán, J.L., Rachor, E., Reise, K., Westernhagen, H. v. and Lenz, W. (Eds.). Warnsignale aus dem Wattenmeer. Blackwell, Berlin, pp. 196-200.

Dijkema, K.S., 1994d. Expected developments of The Netherlands saltmarshes and seagrasses. In: Nugteren, J. van (Ed.). Brent geese in the Wadden Sea. The Dutch Society for the Preservation of the Wadden Sea, Harlingen, The Netherlands, pp. 157-167.

Dijkema, K.S., 1997. Impact prognosis for salt marshes from subsidence by gas extraction in the Wadden Sea. Journal of Coastal Research 13(4), 1294-1304.

Dijkema, K.S. and Heydemann, B., 1984. Western-European salt marshes - Wadden Sea and southwest Netherlands. In: Dijkema, K.S., Beeftink, W.G., Doody, J.P., Géhu, J.M., Heydemann, B. and Rivas Martinez, S. (Eds.). Salt marshes in Europe. Nature and Environment Series 30. Strasbourg, France, pp. 82-103.

Dijkema, K.S., Tienen, G. van and Beek, J.J. van, 1989. Habitats of The Netherlands, German and Danish Wadden Sea 1:100,000. Research Institute for Nature Management, Texel/Veth Foundation, Leiden, 24 maps.

Dijkema, K.S., Bergs, J. van den, Bossinade, J. and Kroese, T.A.G., 1995. Monitoring kwelderwerken in Groningen en Friesland. Evaluatie medio 1992-medio 1994. RWS Noord Nederland, DLO.

Dijkhuizen, D., Velde, J. van de and Frederiks, B., 1996. Emissies naar de Wadenzee; 1985-1994. National Institute for Coastal and Marine Management / RIKZ Report RIKZ-96.038, December 1996, pp. 74-75.

Dillingh, D. and Heinen, P.F., 1994. Zeespiegelstijging, getijverandering en deltaveiligheid. Nota RIKZ-94.026.

Dittmann, S., 1990. Mussel beds - amensalism or amelioration for intertidal fauna. Helgoländer Meeresunters. 44, 335-352.

Dittmer, J.-D., 1981. The distribution of subtidal macrobenthos in the estuaries of the rivers Ems and Weser. In: Dankers. N., Kühl, H. and Wolff, W.J. (Eds.). Invertebrates of the Wadden Sea. Balkema, Rotterdam, pp. 188-206.

Donovan, G.P. and Bjørge, A., 1995. Harbour porpoises in the North Atlantic: edited abstract from the Report of the IWC Scientific Committee, Dublin, 1995. In: Bjørge, A. and Donovan, G.P. (Eds.). Biology of the Phocoenids. Rep. Int. Whal. Commis., Special Issue 16, 3-25.

Dörjes, J., Michaelis, H. and Rhode, B., 1986. Long-term studies of macrozoobenthos in intertidal and shallow subtidal habitats near the island of Norderney (East Frisian coast, Germany). Hydrobiologia 142, 217-232.

Dronkers, J., 1984. Import of fine marine sediment in tidal basins. Neth. Inst. Sea Res. Publ. Ser. 10, 83-105.

Duiker, J.M.C., Nomden, E. and Smaal, A., 1998. De invloed van mechanische schelpdiervisserij op de sedimenthuishouding van de Waddenzee (The influence of mechanical mollusc fishery on sediments of the Wadden Sea). Instituut voor Marien en Atmosferisch Onderzoek, Rijksuniversiteit Utrecht. Rapport R 98-01.

Duin, W.E. van, Dijkema, K.S. and Zegers, J., 1997. Veranderingen in bodemhoogte (opslibbing, erosie en inkling) in de Paezemerlannen. IBN-Rapport 326, Wageningen, pp. 104.

Duinker, J.C., Hillebrand, M.T.J., Nolting, R.F., Wellershaus, S. and Kingo Jacobsen, N., 1980. The river Varde Å: Processes affecting the behaviour of metals and organochlorines during estuarine mixing. Neth. J. Sea Res. 14 (3/4), 237-267.

Ebbinge, B.S., 1985. Factors determining the population size of arctic-breeding geese, wintering in Western Europe. Ardea 73, 121-128.

Ebbinge, B.S., 1991. The impact of hunting on mortality rates and spatial distribution of geese wintering in the Western Palearctic. Ardea 79, 197-210.

Ebbinge, B.S., 1992. Regulation of numbers of Dark-bellied Brent Geese *Branta bernicla bernicla* on spring staging sites. Ardea 80, 203-228.

Ebbinge, B.S. and Spaans, B., 1995. The importance of body reserves acculumated in spring staging areas in the temperate zone for breeding in Dark-bellied Brent Geese *Branta b. bernicla* in the high Arctic. J. Avian Biol. 26, 105-113.

Ebenhöh, W. 1997. Black spots in the Wadden Sea. A mathematical model. In: Henke, S. (Ed.). Black spots in the Wadden Sea. Texte 3/97. Federal Environmental Agency, Berlin, pp. 55-59.

Eerden, M. R. van, Zijlstra, M., Roomen, M. van and Timmerman, A., 1996. The response of Anatidae to changes in agricutlural practice: Long-term shifts in the carrying capacity of wintering waterfowl. Gibier Faune Sauvage 13, 681-706.

Eigner, J., 1992. Fundamentals of dune protection in the Wadden Sea area of Schleswig-Holstein. In: Hilgerloh, G., (Ed.). Proceedings of the Third Trilateral Working Conference on Dune Management in the Wadden Sea Area. National Park Administration, Wilhelmshaven, pp. 21-26.

Ejbye-Ernst, M. and Thiil Nielsen, H., 1997. Laksefiskene og fiskeriet i Vadehavsomradet resume rapport fra Ribe Amt Sonderjyllands Amt og DanmarksFiskeri-undersøgelser. ISBN 87-7342-841-8.

Ejbye-Ernst, M., Larsen, L.K., Grøn, P.N., Møller, B. and Nielsen, M.B., 1988. Snæblen – en truet fiskeart. Sønderyllands amtsråd og Ribe amtsråd, pp. 31.

Elbrächter, M., 1994. Phytoplankton und toxische Algen. In: Lozán, J.L., Rachor, E., Reise, K., Westernhagen, H. v. and Lenz, W. (Eds.). Warnsignale aus dem Wattenmeer. Blackwell, Berlin, 81-86.

Elbrächter, M., 1997. Phytoplankton blooms in the North Sea. In: Henke, S. (Ed.). Black spots in the Wadden Sea. Texte 3/97. Federal Environmental Agency, Berlin, pp. 50-52.

Elbrächter, M. and Schnepf, E., 1996. *Gymnodinium chlorophorum*, a new, green, bloom-forming dinoflagellate (Gymnodiniales, Dinophyceae) with a vestigal prasinophyte endosymbiont. Phycologia 35, 381-393.

Ens, B.J., Wintermans, G.J.M. and Smit, C.J., 1993. Verspreiding van overwinterende wadvogels in de Nederlandse Waddenzee. Limosa 66, 137-144

Ens, B.J., Merck, T., Smit, C.J. and Bunskoeke, E.J., 1996. Functional and numerical response of oystercatcher *Haematopus ostralegus* on shellfish populations. Ardea 84A, 441-452.

EON. 1988. Ecosysteemmodel van de westelijke Waddenzee. NIOZ rapport 1,1-88.

Eppinga, J., 1997. HCB gehalten in Scholekstereieren in de Eems-Dollard. (HCB contents of oystercatcher eggs in the Ems-Dollard). Report RIKZ/OS-97.608x.

Erchinger, H.F., 1992. Conservation of barrier dunes for coast protection. In: Hilgerloh, G., (Ed). Proceedings of the Third Trilateral Working Conference on Dune Management in the Wadden Sea Area. National Park Administration, Wilhelmshaven, pp. 44-52.

Erchinger, H.F., 1995. Intaktes Deichvorland für Küstenschutz unverzichtbar. Wasser und Boden 47, 48-53.

Erchinger, H.F., Coldewey, H-G. and Meyer, C., 1996. Interdisziplinäre Erforschung des Deichvorlandes im Forschungsvorhaben "Erosionsfestigkeit von Hellern". Die Küste 58, 1-45.

Esbjerg Declaration, 1991. Sixth Gonvernmental Wadden Sea Conference, Esbjerg, 1991. Ministerial Declaration, Seals Conservation and Management Plan, Memorandum of Intent, Assessment Report. Common Wadden Sea Secretariat, Wilhelmshaven, pp. 152.

Essink, K., 1985. On the occurrence of the American jack-knife clam *Ensis directus* (Conrad, 1843) (Bivalvia, Cultellidae) in the Dutch Wadden Sea. Basteria 50, 73-80.

Essink, K. and Dalfsen, J. van, 1998. The Riacon project. WSNL 1998-1, 13-15

Essink, K. and Kleef, H.L., 1988. *Marenzelleria viridis* (Verrill, 1873) (Polychaeta: Spionidae. a new record from the Ems estuary (The Netherlands/Federal Republic of Germany). Zoologische Bijdragen (Leiden) No. 38, 1-13.

Essink, K. and Kleef, H.L., 1993. Distribution and life cycle of the North American spionid polychaete *Marenzelleria viridis* (Verrill, 1873) in the Ems estuary. Neth. J. Aquat. Ecol. 27, 237-246.

Essink, K., Eppinga, J. and Dekker, R., 1998a. Long-term changes (1977-1994) in intertidal macrozoobenthos of the Dollard (Ems estuary) and effects of introduction of the North American spionid polychaete *Marenzelleria* cf. *wireni*. Senckenbergiana marit. 28, 211-225.

Essink, K., Beukema, J.J., Madsen, P.B., Michaelis, H. and Vedel. G.R., 1998b. Long-term development of biomass of intertidal macrozoobenthos in different parts of the Wadden Sea. Governed by nutrient loads?. Proceedings 9th International Wadden Sea Symposium, November 1996, Norderney. Senckenbergiana marit. 29, 25-36.

Fairbridge, R. W., 1980. The estuary: its definition and geodynamic cycle. In: Olausson, E. and Cato, I. (Eds.). Chemistry and Biogeochemistry of Estuaries. J. Wiley & Sons, Chichester, 1-35.

Farke, H., 1994. Eingriffe durch Baggerarbeiten. In: Lozán, J.L., Rachor, E., Reise, K., Westernhagen, H. v. and Lenz, W. (Eds.). Warnsignale aus dem Wattenmeer. Blackwell, Berlin, pp. 60-64.

Farke, H., 1997. Typology of Black spots. In: Henke, S. (Ed.). Black Spots in the Wadden Sea - Causes, Effects, Ecological Implications. Texte 3/97, Federal Environmental Agency, Berlin, pp. 3-4.

Ferk, U., 1995. Folgen eines beschleunigten Meeresspiegelanstiegs für die Wattgebiete der niedersächsichen Nordseeküste. Die Küste 57, 135-156.

Fiedler, M., 1991. Die Bedeutung von Makrozoobenthos und Zooplankton der Unterelbe als Fischnahrung. Ber. Inst. Meeresk. Kiel 204, pp. 226.

Fleet, D.M., Frikke, J., Südbeck, P. and Vogel, R.L., 1994. Breeding Birds in the Wadden Sea 1991. Wadden Sea Ecosystem No. 1. Common Wadden Sea Secretariat, Wilhelmshaven, pp. 108.

Fleet D. M., Gaus. S., Hartwig. E., Potel. P. and Schulze-Dieckhoff. M., 1995. Ölopfer in der Deutschen Bucht im Zeitraum 1. Oktober 1992 bis 31. Dezember 1994. Seevögel Bd.16, 87-92.

Flemming, B.W. and Davis, R.A., 1994. Holocene Evolution, Morphodynamics and Sedimentology of the Spiekeroog Barrier Island System. Senckenbergiana marit. 24, Vol 1/6, 117-155.

Flemming, B. and Delafontaine, M.T., 1994. Biodeposition in a juvenile mussel bed of the east frisian Wadden Sea (southem North Sea). Neth. J. Aquatic Ecol. 28, 289-297.

Flemming, B. and Nyandwi, N., 1994. Land reclamation as a cause of fine-grained sediment depletion in backbarrier tidal flats (southem North Sea). Neth. J. Aquatic Ecol. 28, 299-307.

Flemming, B. and Ziegler, K., 1995. High-resolution grain size distribution pattems and textural trends in the backbarrier environment of Spiekeroog Island (Southem North Sea). Senckenbergiana marit. 26, 1-24.

Flügge, G., Gaumert, T. and Bergmann, M., 1989. Gewässergütekriterien und Bewirtschaftungsmodelle für die Tideelbe. Studie der Wassergütestelle Elbe im Auftrag des Umweltbundesamtes Berlin, pp. 247.

Fock, H., 1996. Lebensgemeinschaften im Eu-, Supra- und Epilitoral des schleswig-holsteinischen Wattenmeeres und der Eider und Elbe und die analytische Modellierung der Struktur und Dynamik der Lebensgemeinschaften und der Regulation durch biotische Parameter und Umweltparameter. Berichte, Forsch. u. Technologiezentrum Westküste d. Univ. Kiel, Nr. 13, pp. 336.

Fock, H., 1998. Die Eider – ökologische Folgen des Sperrwerkbaus. In: Umweltatlas Wattenmeer. Band 1. Nordfriesisches und Dithmarscher Wattenmeer. Landesamt für den Nationalpark Schleswig-Holsteinisches Wattenmeer, Umweltbundesamt. Ulmer Verlag, Stuttgart, pp. 142-143.

Fock, H. and Heydemann, B., 1995. Vom Meer abgesperrte Flußsysteme - die Eider. In: Lützenkirchen, M. (Ed.). Wasser zwischen Land und Meer - Flußmündungen unter Druck. WWF Tagungsbericht 10, 263-277.

Fock, H. and Ricklefs, K., 1996. Die Eider - Veränderungen seit dem Mittelalter. In: Lozán, J. and Kausch, H. (Eds.). Warnsignale aus Flüssen und Ästuaren, Parey, Berlin, pp. 39-43.

Fonds, M., 1978. The seasonal distribution of some fish species in the western Dutch Wadden Sea. In: Dankers, N., Wolff, W.J. and Zijlstra, J.J. (Eds.), 1978. Fishes and fisheries of the Wadden Sea. Report 5 of the final report of the section ‚Fishes and fisheries' of the Wadden Sea Working Group. Stichting Veth tot Steun aan Waddenonderzoek, Leiden, pp. 42-77. Also published in: Wolff, W.J. (Ed.), 1983. Ecology of the Wadden Sea, Vol. 2. Balkema, Rotterdam, pp. 42-77.

Forschungsstelle Küste, 1999. Überwachung der niedersächsischen Küstengewässer. Routineuntersuchungen 1997. Berichte der Forschungsstelle Küste 1999-3, 45-50.

Frank, D., 1998. Wassersport im Niedersächsischen Wattenmeer – Entwicklung, aktuelle Situation, Trends. Schriftenreihe Nationalpark Niedersächsisches Wattenmeer (in press).

Franke, S., Hildebrandt, S., Schwarzbauer, J., Link, M. and Francke, W., 1995. Organic compounds as contaminants of the Elbe river and its tributaries part II, GC-MS screening for contaminants of the Elbe water. Fresenius J. Anal. Chem., 353, 39-49.

Franke, S., Hildebrandt, S., Francke, W., Bester, K., Hühnerfuss, H. and Gatermann, R., 1998. Chlorinated Bis(propyl)ethers and chlorinated Bis(ethyl)formals in the German Bight of the North Sea. Mar. Poll. Bull., 36, 546-551.

Fransz, H.G., 1983a. List of the zooplankton species of the Wadden Sea In: Dankers, N., Kühl, H. and Wolff, W.J. (Eds.). Invertebrates of the Wadden Sea. Balkema, Rotterdam, pp. 12- 23.

Fransz, H.G., 1983b. Quantitative data on the plankton of the Wadden Sea proper. In: Dankers, N., Kühl, H. and Wolff, W.J. (Eds.). Invertebrates of the Wadden Sea. Balkema, Rotterdam, pp. 125- 133.

Fransz, H.G. and Gieskes, W.W.C., 1984. The unbalance of phytoplankton and copepods in the North Sea. Rapp. P. v. Reun. Cons. Int. Explor. Mer 183, 218-225.

Fransz, H.G., Gonzalez, S.R., Cadée, G.C. and Hansen, F.C., 1992. Long-term change of *Temora longicornis* (Copepoda, calanoida) abundance in a Dutch tidal inlet (Marsdiep) in relation to eutrophication. Neth. J. Sea Res. 30, 23 – 32.

Freitag, T., 1997. Microbial processes within black spots.In: Henke, S. (Ed.). Black spots in the Wadden Sea. Texte 3/97. Federal Environmental Agency, Berlin, pp. 4-8.

Führböter, A., 1989. Changes on the tidal water levels at the German North Sea coast. Helgoländer Meeresunters. 43, 325-332.

Führböter, A., Kotzbauer, U., Manzenrieder, H. and Schulze, M., 1992. Festigkeit von Hellern: Hydromechanik und Hydraulik, Bericht Nr. 732. Leichtweiss-Institut für Wasserbau, Technische Universität Braunschweig.

Ganter, B., 1994. Site tenacity and mobility of staging barnacle geese. Ardea 82, 231-240.

Garms, R., 1961. Biozönotische Untersuchungen an Entwässerungsgräben in Flußmarschen des Elbe-Ästuars. Arch. Hydrobiol./Suppl. Elbe-Ästuar 26 (3/4), 344-462.

Garthe, S., 1996. Distribution and abundance of North Sea seabirds and their feeding ecology in relation to fisheries and hydrography. Ph.D. thesis, University of Kiel.

Gätje, C., 1992. Artenzusammensetzung, Biomasse und Primärproduktion des Mikrophytobenthos des Elbe-Ästuars. Ph.D. thesis, University of Hamburg, pp. 210.

Gatermann, R., Hühnerfuss, H., Rimkus, G., Wolf, M. and Franke, S., 1995. The distribution of nitrobenzene and other nitroaromatic compounds in the North Sea. Mar. Poll. Bull., 30, 221-227.

Gatermann, R., Bester, K., Franke, S. and Hühnerfuss, H., 1996. The distribution of O,O,O-Trimethylthiophosphate and O,O,S-Trimethyldithiophosphate in the North Sea. Chemosphere 32, 1907-1918.

Gaumert, T., 1995. Maßnahmen zur Verbesserung des aquatischen Lebensraumes der Elbe. ARGE Elbe, Hamburg, pp. 103.

Gaumert, T. and Kämmereit, M., 1993. Süßwasserfische in Niedersachsen. Niedersächsisches Landesamt für Ökologie Hildesheim.

Gaumert, T. and Spieker, J., 1995. Makrozoobenthon der Elbe. ARGE Elbe, Hamburg, pp. 49.

George, M.R., 1996. Occurrence of meroplanktonic larvae, copepod nauplii and other mesozooplankton during winter months in the German Wadden Sea. ICES Report CM/L:14.

GESAMP, 1987. Land/sea boundary flux of contaminants: contributions from rivers. Report of the studygroup GESAMP (Joint group of experts on the scientific aspects of marine pollution).

Gieskes, W.W.C., 1973. De massale planktonsterfte op de kust bij Callantsoog juli 1972. Waddenbulletin 8(1), 36-37.

Gilbertson, M., Elliot, J.E. and Peakall, D.B., 1987. Seabirds as indicators of marine pollution. In: Diamond, A.W. and Filion, F.L., (Eds.). The value of birds. ICBP Technical Publication 6, 231-248.

Gosselck, F. and Prena, J., 1996. Zusammenstellung und problemorientierte Auswertung der bis 1994 im Sublitoral der Außenweser durchgeführten Benthosuntersuchungen. Studie im Auftrag des Hansestadt Bremischen Amtes Bremerhaven, Brodersdorf bei Rostock, pp. 61 (unpublished).

Grabemann, I., Krause, G. and Siedler, G., 1983. Langzeitige Änderungen des Salzgehaltes der Unterweser. Dt. Hydrogr. Z. 36, 61-77.

Grabemann, I., Kappenberg, J. and Krause, G., 1996. Comparison of the dynamics of the turbidity maxima in two coastal plain estuaries. Arch. Hydrobiol. Spec. Issues Advanc. Limnol. 47, 195-205.

Greve, W., 1994. The 1989 German Bight invasion of *Muggiaea atlantica*. ICES J.mar. Sci. 51, 355-358.

Grootjans, A. P., Hartog, P. S., Fresco, L. F. M and Esselink, H. , 1991. Succession and fluctuation in a wet dune slack in relation to hydrological changes. J. Veg. Sci., 2, 545-554.

Grünwälder, K.W., 1979. Erholung auf dem Wasser – Die gegenwärtige Situation des Sportbootverkehrs im Küstenraum zwischen Ems und Weser. Schriftenreihe des Fremdenverkehrsverbandes Nordsee-Niedersachsen-Bremen e.V., Heft 47, pp. 47.

Gussinklo, H.J., 1993. Bodemdaling in de Waddenzee door gaswinning. In: Lindeboom, H.J. (Ed.). Openbare discussiedag "Bodemdaling Waddenzee". NIOZ rapport 1993-14. NIOZ, Texel, pp. 21-26.

Haeslopp, U., 1990. Beurteilung der zu erwartenden Auswirkungen einer Reduzierung der anthropogenen Weserversalzung auf die aquatische Biozönose der Unterweser. Ph.D. thesis, University of Bremen, pp. 220.

Haeslopp, U. and Schuchardt, B., 1995. Plankton und Makrozoobenthon der gezeitenbeeinflußten Unterweser. In: Gerken, B. and Schirmer, M. (Eds.). Die Weser. G. Fischer-Verlag, Stuttgart, pp. 159-174.

Hagge, A., 1994. Ökologische Rolle der Brackwasserseen, Speicherbecken und Ersatzwatten. In: Lozán, J.L., Rachor, E., Reise, K., Westernhagen, H. v. and Lenz, W. (Eds.). Warnsignale aus dem Wattenmeer. Blackwell, Berlin, pp. 205-211.

Hagmeier, A., 1941. Die intensive Nutzung des nordfriesischen Wattenmeeres durch Austern- und Muschelkultur. Z. Fisch. 39, 105-165.

Hagmeier, A. and Kändler, R., 1927. Neue Untersuchungen im nordfriesischen Wattenmeer und auf den fiskalischen Austernbänken. Wiss. Meeresunters. (Abt. Helgoland) 16, 1-90.

Hälterlein, B., 1996. Brutvogel-Bestände im Schleswig-Holsteinischen Wattenmeer. Abschlußbericht Ökosystemforschung Schleswig-Holsteinisches Wattenmeer, Teilprojekt A 2.7.

Ham, N.F. van der, Platteeuw, M. and Camphuysen, C.J., 1992. Tuimelaar, *Tursiops truncatus*, bij Camperduin. Sula 6, 106-108.

Hammond, P.S., Benke, H., Berggren, P., Borchers, D.L., Buckland, S.T., Collet, A., Heide-Jørgensen, M.P., Heimlich-Boran, S., Hiby, A.R., Leopold, M.F. and Øien, N., 1995. Distribution and abundance of the harbour porpoise and other small cetaceans in the North Sea and adjacent waters. Life 92-2/UK/027, final report, Sea Mammal Research Unit, National Environment Research Council, Cambridge.

Hammond, P.S., Benke, H., Berggren, P., Collet, A., Heide-Jørgensen, M.P., Heimlich-Boran, S., Leopold, M.F. and Øien, N., 1996. How many porpoises are there in the North Sea - and how many is enough?. Brochure Life 92-2/UK/027, Sea Mammal Research Unit, National Environment Research Council, Cambridge.

Hansen, F.C, Reckermann, M., Klein Breteler, W.C.M. and Riegman, R., 1993. *Phaeocystis* blooming enhanced by copepod predation on protozoa: Evidence from incubation experiments. Mar. Ecol. Prog. Ser. 102, 51-57.

Hanslik, M. and Rahmel, J., 1995. Der Jahresgang blütenbildender und toxischer Algen an der niedersächsischen Küste seit 1982. Dt. hydrograph. Z. Suppl. 5, 221-235.

Hanslik, M., Rahmel, J., Bätje, M., Knieriemen, S., Schneider, G. and Dick, S., 1994. Der Jahresgang blütenbildender und toxischer Algen an der niedersächsischen Küste seit 1982. NLÖ, FSK.

Harten, H., 1979. Ausbaumaßnahmen in Tideästuarien der deutschen Nordseeküste und die Auswirkungen auf das Tidegeschehen. Die Küste 34, 150-158.

Hartog, C. den, 1964. Typologie des Brackwassers. Helgoländer Wissenschaft. Meeresunters. 10, 377-390.

Hartog, C. den, 1967. Brackish water as an environment for algae. Blumea XV, 31-43.

Hartog, C. den and Polderman, P.J.G., 1975. Changes in the seagrass populations of the Dutch Wadden Sea. Aquat. Bot. 1, 141-147.

Haß, P., 1992. Tourism and protection of dunes on the islands Sylt and Amrum. In: Hilgerloh, G., (Ed). Proceedings of the Third Trilateral Working Conference on Dune Management in the Wadden Sea Area. National Park Administration, Wilhelmshaven, pp. 62-70.

Heckmann, C.W., 1984. Effects of dike construction on the wetland ecosystem along the freshwater section of the Elbe estuary. Arch. Hydrobiol./Suppl. 61(4), 397-508.

Heckmann, C.W. and Kausch, H., 1996. Veränderungen und Gefährdungen der Flußmarschen. In: J. Lozán and Kausch, H. (Eds.). Warnsignale aus Flüssen und Ästuaren. Parey Buchverlag Berlin, pp. 280-285.

Heessen, H.J.L., 1996. Time-series data for a selection of forty fish species caught during the International Bottom Trawl Survey. ICES J. mar. Sci. 53(6), 1079-1084.

Heide-Jørgensen, M.-P., Teilmann, J., Benke, H. and Wulf, J., 1993. Abundance and distribution of harbour porpoises (*Phocoena phocoena*) in selected areas of the western Baltic and the North Sea. Helgoländer Meeresunters. 47, 335-346.

Heinis, F., Akkerman, I., Essink, K., Colijn, F. and Latuhihin, M.J., 1995. Biologische monitoring zoute rijkswateren. Rapport RIKZ-95.059.

Helder, W. and Vries, R.T.P de, 1983. Estuarine nitrite maxima and nitrfying bacteria (Ems-Dollart estuary). Neth. J. Sea Res. 17(1), 1-18.

Herlyn, M. and Michaelis, H., 1993. Bestandsaufname und Populationsbiologie von *Mytilus edulis* L.: Methoden der quantitativen Erfassung von Miesmuschel-vorkommen. Niedersächs. Landesamt f. Ökologie Forschungsstelle Küste, Norderney, pp. 32.

Herlyn, M. and Michaelis, H., 1996. Untersuchungen zur Entwicklung von Miesmuschelbänken der niedersächsischen Watten, unter Berücksichtigung der Mies-muschelfischerei. Forschungsstelle Küste, Norderney, Forschungsbericht 108-02-085/21, pp. 91.

Herlyn, M. and Millat, G., 1997. Erfassung und Dokumentation des Miesmuschelbestandes der niedersächsischen Watten. Unveröffentl. Zwischenbericht National-parkverwaltung, Wilhelmshaven, pp. 22.

Herlyn, M., Millat, G. and Michaelis, H., 1999. Einfluß der Besatzmuschelentnahme auf die Entwicklung eulitoraler Neuansiedlungen von *Mytilus edulis* im nieder-sächsischen Bereich des Wattenmeeres. Ber. Forschungsstelle Küste, Norderney, Bd. 42 (in press).

Hesse, K.-J., Gerdes, D. and Schaumann, K., 1989. A winter study of plankton distribution across a coastal salinity front in the German Bight. Meeresforsch. 32, 177-191.

Hesse, K.-J., Hentschke, U. and Brockmann, U., 1992. A synoptic study of nutrient and phytoplankton characteristics in the German Wadden Sea with respect to coastal eutrophication. In: Colombo, G. (Ed.). Marine eutrophication and population dynamics, 25th European Marine Biology Symposium 1990, Olsen & Olsen, Fredensborg, Denmark, 45-53.

Hesse, K.-J., Tillmann, U. and Brockmann, U., 1995. Nutrient-phytoplankton relations in the German Wadden Sea. ICES Report C.M. 19951T, 8.

Hesse, K.-J., Dick, S., Hickel, W., Schaumann, K. and Brockmann, U., 1996. TRANSWATT- Transport, Transfer und Transformation von Biomasse-Elementen in Watt-gewässern. 2. Zwischenbericht, pp. 208.

Hickel, W., 1997. Eutrophication of the German Bight during the past three decades. In: Henke, S. (Ed.). Black spots in the Wadden Sea. Texte 3/97. Federal Environmental Agency, Berlin, pp. 30-33.

Hickel, W., Eickhoff, M. and H. Spindler, 1995. Langzeit-Untersuchungen von Nährstoffen und Phytoplankton in der Deutschen Bucht. Dt. hydrogr. Z. Suppl. 5, 197-211.

Hickel, W., Eickhoff, M., Spindler, H., Berg, J., Raabe, T. and Müller, R., 1996. Evaluation of long-term measurements of nutrients and phytoplankton in the German Bight. Final Report, Federal Environmental Agency, Berlin.

Higler, B., Dankers, N., Smaal, A. and Jonge, V.N. de, 1998. Evaluatie van de ecologische effecten van het reguleren van schelpdiervisserij in Waddenzee en Delta op bodemorganismen en vogels. Appendix 5, pp. 17, In: Dijk, J.J. van and Heling, R. (Eds.). Structuurnota Zee- en Kustvisserij, Evaluatie van de maatregelen in de kustvisserij gedurende de erste fase (1993-1997).

Hilgerloh, G., Herlyn M. and Michaelis, H., 1997. The influence of predation by herring gulls *Larus argentatus* and oystercatchers *Haematopus ostralegus* on a newly established mussel *Mytilus edulis* bed in autumn and winter. Helgoländer Meeresunters. 51, 173-189.

Hoek, C. van den, Admiraal, W., Colijn, F. and Jonge, V.N. de, 1979. The role of algae and seagrass in the ecosystem of the Wadden Sea: a review. In: Wolff, W.J. (Ed.). Flora and vegetation of the wadden sea. Balkema, Rotterdam: 9-118.

Hofstede, J.L.A., 1991. Sea level rise in the inner German Bight (Germany) since AD 600 and its implications upon tidal flats geomorphology. In: Brückner, H. and Radtke, U. (Eds.). From the North Sea to the Indian Ocean. Franz Steiner Verlag, Stuttgart, pp. 11-27.

Hofstede, J.L.A., 1994. Meeresspiegelanstieg und Auswirkungen im Bereich des Wattenmeeeres. In: Lozán, J.L., Rachor, E., Reise, K., Westernhagen, H. v. and Lenz, W. (Eds.). Warnsignale aus dem Wattenmeer. Blackwell, Berlin, pp. 17-23.

Hofstede, J.L.A., 1997. Process-response analysis for the North Frisian supratidal sands (Germany). J. Coastal Res. 13, 1-7.

Hofstede, J.L. and Schirmacher, R., 1996. Vorlandmanagement in Schleswig-Holstein. Die Küste 58, 61-73.

Honkoop, P.J.C. and Meer, J. van der, 1998. Experimentally induced effects of water temperature and immersion time on reproductive output of bivalves in the Wadden Sea. J. exp. mar. Biol. Ecol. 220, 227-246.

Höpner, T., 1994. Auswirkungen der Ästuarvertiefung in der Emsmündung. In: Lozán, J.L., Rachor, E., Reise, K., Westernhagen, H. v. and Lenz, W. (Eds.). Warnsignale aus dem Wattenmeer. Blackwell, Berlin, pp. 171-175.

Höpner, T., 1995. Ökologischer Zustand der Flußmündungen an Nord- und Ostsee - ein Überblick. In: Lützenkirchen, M. (Ed.). Wasser zwischen Land und Meer - Flußmündungen unter Druck. WWF Tagungsbericht 10, pp. 33-49.

Höpner, T., 1997. Final Discussion. In: Henke, S. (Ed.). Black spots in the Wadden Sea. Texte 3/97. Federal Environmental Agency, Berlin, pp. 69-76.

Höpner, T. and Michaelis, H., 1994. Sogenannte 'Schwarze Flecken' - ein Eutrophierungssymptom des Wattenmeeres. In: Lozán, J.L., Rachor, E., Reise, K., Westernhagen, H. v. and Lenz, W. (Eds.). Warnsignale aus dem Wattenmeer. Blackwell, Berlin, pp. 153-159.

Hoppema, J.M.J., 1991. The oxygen budget of the western Dutch Wadden Sea, The Netherlands. Estuarine, Coastal and Shelf Science 32, 483-502.

Hötker, H., 1994. Wadden Sea birds and embankments - Can artificial wetlands compensate for losses due to land claims? Ophelia Suppl. 6, 279-295.

Hötker, H. and Kölsch, G., 1993. Die Vogelwelt des Beltringharder Kooges. Corax 15, Sonderheft, 1-145.

Houghton, J.J., Meiro Filho, L.G., Callander, B.A., Harris, N., Kattenberg, A. and Maskell, K. (Eds.), 1996. Climate Change 1995: The Science of Climate Change. Contribution of Working Group I to the Second Assessment Report of the Intergovernmental Panel on Climate Change., Cambridge University Press, Cambridge, pp. 584.

Hummel, H., Amiard-Triquet, C., Bachelet, G., Desprez, M., Marchand, J., Sylvand, B., Amiard, J.C., Rybarczyk, H., Bogaards, R.H., Sinke, J., Wit, Y. de and Wolf, L. de, 1996. Sensitivity to stress of the estuarine bivalve *Macoma balthica* from areas between The Netherlands and its southern limits (Gironde). Neth. J. Sea Res. 35(4), 315-321.

Hurrell, J.W., 1995. Decadal trends in the North Atlantic Oscillation: regional temperatures and precipitation. Science 269, 676-679.

IBL, 1994. UVS zur bedarfsweisen Anpassung des Emsfahrwassers von km 0,00 - km 40,45 für das 7,30 m tiefgehende Bemessungsschiff. Studie im Auftrag des Wasser- und Schiffahrtsamtes Emden, des Landkreises Emsland und der Stadt Papenburg, Oldenburg (unpublished).

IBL, 1997. UVS zum Antrag auf Planfeststellung für die Errichtung eines Emssperrwerks zwischen Gandersum und Nendorp bei Strom-km 32,2. Studie im Auftrag der Bezirksregierung Weser-Ems - Projektteam "Bau eines Emssperrwerks", Oldenburg (unpublished).

ICES, 1996. Report of the Working Group on *Crangon* fisheries and lifehistory. ICES Report, C.M. K:4, pp. 38.

IHK, 1988. Statistisches Handbuch 1988. 10. Jahrgang. Industrie- und Handelskammer für Ostfriesland und Papenburg, Emden, pp. 168.

IHK, 1997. Statistisches Handbuch 1997. Die wirtschaftliche Entwicklung. 19. Jahrgang. Industrie- und Handelskammer für Ostfriesland und Papenburg, Emden, pp. 169.

IPCC, 1995. Climate Change 1995, the science of climate changes. Cambridge Univ. Press, Cambridge, pp. 572.

IVM, 1998. Organotin pollution levels in sediments from the Dutch Wadden Sea. Institute for Environmental Studies, Free University of Amsterdam, commisioned by Greenpeace Netherlands.

Jacobs, R.P.W.M., 1980. Effects of the 'Amoco Cadiz' oil spill on the seagrass community at Roscoff with special reference to the benthic infauna. Mar. Ecol. Prog. Ser. 2, 207-212.

Jak, R.G. and Michelsen, B.F., 1996. Algenbegrazing: een nadere analyse van de invloed van toxicanten op het ontstaan van eutrofieringsproblemen. BEON Rapport 96-4.
Jak, R.G., Ceulemans, M., Scholten, M.C.Th. and Straalen, N.M. van, 1998. Effects of tributyltin on a coastal North Sea plankton community in enclosures. Environ. Toxicol. Chem. 17, 1840–847.

Jepsen, P.U., 1993. Hunting in the Wadden Sea -The Development of Hunting for Subsistence to Hunting as a Sport Activity. Wadden Sea Newsletter 1993-1, 15-18.

Joint Seal Project, 1995. Joint Research, Conservation and management project on harbour seals *Phoca vitulina* in the Wadden Sea, 1989 - 1994. Final Report on the Joint Management Plan for the Wadden Sea Population. Common Wadden Sea Secretariat, Wilhelmshaven, pp. 77 (internal report).

Jones, L., 1998. Ecological functioning and integrity of marine ecosystems - *Sabellaria spinulosa* reefs. OSPAR Commission, IMPACT 98 6 6-E, Annex 5, pp. 6.

Jong, D.J. de and Jonge, V.N. de, 1989. Zeegras *Zostera marina* L., *Zostera noltii* Hornem. Een ecologisch profiel en het voorkomen in Nederland. Report GWAO-89-1003. Rijkswaterstaat, Tidal Division. Den Haag, 1-34.

Jong, D.J. de and Jonge, V. N. de, 1995. Dynamics and distribution of microphytobenthic chlorophyll-a in the Western Scheldt estuary (SW Netherlands). Hydrobiologia 311, 21-30.

Jong, F. de, Bakker, J.F., Dahl, K., Dankers, N., Farke, H., Jäppelt, W., Kossmagk-Stephan, K. and Madsen, P.B., 1993. Quality status report of the North Sea, Sub region 10, The Wadden Sea. Common Wadden Sea Secretariat, Wilhelmshaven, pp. 107.

Jong, P.W. de, 1996. Monitoring Watersport op de Waddenzee 1995. Opzet en resultaten. Provincie Friesland.

Jonge, V.N. de, 1990. Response of the Dutch Wadden Sea ecosystem to phosphorus discharges from the river Rhine. Hydrobiologia 195, 49-62.

Jonge, V. N. de, 1992. Physical processes and dynamics of microphytobenthos in the Ems estuary (The Netherlands). Ph.D. thesis, University of Groningen, pp. 176.

Jonge, V.N. de and Essink, K., 1991. Long-term changes in nutrient loads and primary and secondary producers in the Dutch Wadden Sea. In: Elliott, M. and Ducrotoy, J.-P. (Eds.). Estuaries and coasts: spatial and temporal intercomparisons. ECSA 19 Symposium, Caen, France. Olsen & Olsen, Fredensborg, pp. 307-316.

Jonge, V.N. de and Jong, D.J. de, 1992. Role of tide, light and fisheries in the decline of *Zostera marina* L. in the Dutch wadden sea. NIOZ Pub. Ser. 20, 161-176.

Jonge, V.N. de and Postma, H., 1974. Phosphorus compounds in the Dutch Wadden Sea. Neth. J. Sea Res. 8, 139-153.

Jonge, V.N. de, Essink, K. and Boddeke, R., 1993. The Dutch Wadden Sea: a changed ecosystem. Hydrobiologia 265, 45-71.

Jonge, V.N. de, Bakker, J.F. and Stralen, M. van, 1995. Recente ontwikkelingen met betrekking tot de eutrofieringsproblematiek in de westelijke Waddenzee. Rapport RIKZ-95.010, (in English).

Jonge, V.N. de, Bergs, J. van den and Jong, D. J. de, 1997. Zeegras in de Waddenzee, een toekomstperspectief. Rapport RIKZ 97.016.

Kamermans, P., Hemminga, M. and Jong, D.J. de, 1999. Significance of salinity and silicon levels for growth of a formerly estuarine eelgrass (*Zostera marina*) population (Lake Grevelingen, The Netherlands). Mar. Biol. 133, 527-539.

Kamps, L.F., 1962. Mud distribution and land reclamation in the eastern wadden shallows. Rijkswaterstaat comm. 4, Den Haag, pp. 73.

Kastler, T. and Michaelis, H., 1997. Der Rückgang der Seegrasbestände im Niedersächsischen Wattenmeer. Ber. Forsch.-Stelle Küste Norderney 41, 119-139.

Kattenberg, A., Giorgi, F., Grassl, H., Meehl, G.A., Mitchell, J.F.B., Stouffer, R.J., Tokioka, T., Weaver, A.J. and Wigley, T.M.L., 1996. Climate Models - projections of future climate. In: Houghton, J.J., Meiro Filho, L.G., Callander, B.A., Harris, N., Kattenberg, A. and Maskell, K., (Eds.). Climate Change 1995, the science of climatic changes. Cambridge Univ. Press, Cambridge, pp. 258-357.

Kausch, H., 1996. Die Elbe - ein immer wieder veränderter Fluß. In: Lozán, J. and Kausch, H. (Eds.). Warnsignale aus Flüssen und Ästuaren. Parey, Berlin, pp. 43-52.

Kausch, H. and Peitsch, A., 1992. Das Zooplankton und seine Verteilung im Elbe-Ästuar. In: Kausch, H. (Ed.). Die Unterelbe - Natürlicher Zustand und Veränderung durch den Menschen. Berichte aus dem Zentrum für Meeres- und Klimaforschung der Universität Hamburg 19, 137-168.

Kausch, H., Breckling, P., Flügge, G., Gaumert, T., Kies, L., Nöthlich, M., Schirmer, M. and Weigel, H.-P., 1991. Tidegewässer. In: Hamm, A. (Ed.). Studie über Wirkungen und Qualitätsziele von Nährstoffen in Fließgewässern. Academia Verlag, St. Augustine, pp. 565-638.

Kempf, N., Lamp, J. and Prokosch, P. (Eds.), 1987. Salzwiesen: Geformt von Küstenschutz, Landwirtschaft oder Natur? Tagesbericht 1 der Umweltsstiftung WWF-Deutschland.

Kempf, N., Fleet, D.M., Rösner, H.U. and Prokosch, P., 1989. Brut- und Rastvogelzählungen im Schleswig-Holsteinischen Wattenmeer 1987/88. Nationalparkamt Tönning.

Kerstan, M., 1991. The importance of rivers as nursery grounds for 0- and 1-group flounder (*Plathichtys flesus* L.) in comparison to the Wadden Sea. Neth. J. Sea Res. 27 (3/4), 353-366.

Kiehl, K. and Stock, M., 1994. Natur- oder Kulturlandschaft? Wattenmeersalzwiesen zwischen den Ansprüchen von Naturschutz, Küstenschutz und Landwirtschaft. In: Lozán, J.L., Rachor, E., Reise, K., Westernhagen, H. v. and Lenz, W. (Eds.). Warnsignale aus dem Wattenmeer. Blackwell, Berlin, pp. 190-196.

Kiehl, K., Eischeid, I., Gettner, S. and Walter, J., 1996. Impact of different sheep grazing intensities on saltmarsh vegetation in northern Germany. J. Veg. Sci. 7, 99-106.

Kiehl, K., Esselink, P. and Bakker, J.P., 1997. Nutrient limitation and plant-species composition in temperate salt marshes. Oecologia 111, 325-330.

Kies, L. and Neugebohrn, L., 1994. Primärproduktion von Algen und Makrophyten im Elbe-Ästuar. Bericht des Teilprojektes B2 im Tätigkeitsbericht 1992-1994 des SFB 327 "Wechselwirkungen zwischen abiotischen und biotischen Prozessen in der Tide-Elbe, Universität Hamburg, pp. 329-411.

Kies, L., Neugebohrn, L. Braker, H., Fast, T., Gätje, C. and Seelig, A., 1992. Primärproduzenten und Primärproduktion im Elbe-Ästuar. In: Kausch, H. (Ed.). Die Unterelbe - Natürlicher Zustand und Veränderung durch den Menschen. Berichte aus dem Zentrum für Meeres- und Klimaforschung der Universität Hamburg 19, pp. 137-168.

Kinze, C.C., 1990. The harbour porpoise (*Phocoena phocoena*) - Stock identification and migrating patterns in Danish and adjacent waters. Ph.D. thesis, University of Copenhagen, pp. 39.

Kinze, C.C., 1995. Danish whale records 1575 - 1991 (Mammalia, cetacea). Review of whale species stranded, directly or incidentally caught along the Danish coasts. Steenstrupia 21, 155-196.

Kleef, H.L., 1993. Tuimelaars *Tursiops truncatus* in de Dollard. Lutra 36, 94-96.

Klug, H. and Klug, A., 1994. Tourismus als Belastungsfaktor an der Küste. In: Lozán, J.L., Rachor, E., Reise, K., Westernhagen, H. v. and Lenz, W. (Eds.). Warnsignale aus dem Wattenmeer. Blackwell, Berlin, pp. 66-74.

Knauth, H.-D., Gandraß J. and Sturm, R., 1993. Vorkommen und Verhalten organischer und anorganischer Mikroverunreinigungen in der mittleren und unteren Elbe; Berichte 8/93, Umweltbundesamt, Erich Schmitt Verlag, Berlin.

Knoke, V. and Stock, M., 1998. Menschliche Aktivitäten im Schleswig-Holsteinischen Wattenmeer und deren Auswirkungen auf Vögel. Texte 77/97. 2 Volumes, Umweltbundesamt Berlin, pp. 661.

Kock, K.-H. and Benke, H., 1996. On the by-catch of harbour porpoise (*Phocoena phocoena*) in German fisheries in the Baltic and the North Sea. Arch. Fish. Mar. Res. 44, 95-114.

Köhler, A., 1981. Fluktuationen der Fischfauna im Elbe-Ästuar als Indikator für ein gestörtes Ökosystem. Helgoländer Meeresunters. 34, 263-285.

Kötter, F., 1961. Die Pflanzengesellschaften im Tidegebiet der Unterelbe. Arch. Hydrobiol. Suppl. 26, 106-185.

Kolbe, K., 1995a. Zum Auftreten "schwarzer Flecken", oberflächlich anstehender reduzierter Sedimente im ostriesischen Wattenmeer. Ber. Forschungsstelle Küste 40, pp. 7-21.

Kolbe, K., 1995b: Sedimente und Makrozoobenthos der Wesermündung. Dienstbericht Forschungsstelle Küste 22/1995. Niedersächsisches Landesamt für Ökologie Norderney, pp. 22.

Kolbe, K., Kaminski, E., Michaelis, H., Obert, B. and Rahmel, J., 1995. Macroalgal mass development in the Wadden Sea: first experiences with a monitoring system. Helgoländer Meeresunters. 49, 519-528.

Koopmann, C., Faller, J., Bernem, K.-H. van, Prange, A. and Müller, A., 1993. Schadstofkartierung in Sedimenten des deutschen Wattenmeeres Juni 1989-Juni 1992. GKSS 88.156.

Kremer, H. and Maywald, A., 1991. Der Schweinswal in Nord- und Ostsee. Umweltstiftung WWF-Deutschland, Frankfurt am Main, pp. 92.

Kremer, H., Koch, L., Schneider, O., Adloff, B. and Fischer, W., 1990. Surprisingly high numbers of harbour porpoises *Phocoena phocoena* close to the Isle of Sylt. In: Evans, P.G.H., Aguilar, A. and Smeenk, C. (Eds.). European Research on Cetaceans 4. Proc. Fourth Ann. Conf. European Cetacean Soc., Palma de Mallorca, March 1990, pp. 62-63.

Kremer, H., Koch, L., Adloff, B., Baschek B., Schneider, O. and Fischer, W., 1994. Results from a pilot study of harbour porpoises, *Phocoena phocoena* at the North Sea coast of Schleswig-Holstein, FRG. Arch. Fish. Mar. Res. 42, 35-45.

Krieg, H.-J., 1996. Investigations on the occurrence and distribution of benthic fauna along a transect in the transition zone between fresh and brackish water on both sides of Lühesand at km 648,5 in the Lower Elbe. Arch. Hydrobiol. Suppl. 110 (2/3), 283-309.

Kristensen, P.S., 1994. Blåmuslingebestanden i det danske Vadehav og Blåmuslingefiskeri (1991-1993). DFH-rapport nr 476. pp. 56

Kristensen, P.S., 1995. Blåmuslingebestanden i det danske Vadehav august 1995. DFU-rapport 1-96, pp. 19.

Kristensen, P.S., 1996a. Biomass, density and growth of *Spisula solida* in the Danish part of the North Saea, south of Horns Reef. ICES Report C.M. 1996/K, Shellfish committee, pp. 27.

Kristensen, P.S., 1996b. Thirty years of blue mussel (*Mytilus edulis*) stock, and mussel beds in the Danish Wadden Sea. Memo Dan. Inst. Fish. Res., pp. 15.

Kristensen, P.S., 1997. Blåmuslingebestanden i det danske Vadehav august 1996. DFU-rapport nr 36-97, pp. 27.

Kristensen, P.S. and Wellendorph, V., 1995. Fishery of brown shrimps (*Crangon crangon*) in the Danish Wadden Sea (1963-1993). ICES Report, Shellfish Committee/ K:45, pp. 11.

Kröncke, I., 1996. Impacts of biodeposition on macrofaunal communities in intertidal sandflats. In:. Dworschak, P.C, Stachowittsch, M. and Ott, J.A. (Eds.). Influence of organisms on their environment. The role of episodic events. Proc. 29th EMBS Vienna. P.S.Z.N.I, Marine Ecology 17, 159-74.

Kröncke, I., Zeiss, B. and Dahms, S., 1997. Macrofauna Langzeitreihe im Inselvorfeld von Norderney. Abschlußbericht Umwelbundesamt Nr. 98-021.

Kröncke, I., Dippner, J.W., Heyen, H. and Zeiss, B., 1998. Long-term changes in macrofaunal communities off Norderney (East Frisia, Germany) in relation to climate variability. Mar. Ecol. Prog. Ser. 167, 25-36.

Kühl, H. and Mann, H., 1981. Main characteristics of the environment and zooplankton of Eider, Elbe, Weser and Ems. In: Dankers, N., Kühl, H. and Wolff, W.J. (Eds.). Invertebrates of the Wadden Sea. Marine Zoology 4, pp. 143-145.

Künitzer, A., Duineveld, G.C.A., Basford, D., Dewarumez, J.M., Dörjes, J., Eleftheriou, A., Heip, C., Herman, P.M.J., Kingston, P., Niermann, U., Rumohr, H. and P Wilde, A.W.J. de, 1992. The benthic infauna of the North Sea. Species distribution and assemblages. ICES J. mar. Sci. 49, 127-143.

Laane, R.W.P.M. (Ed.), 1992. Background concentrations of natural compounds in rivers, sea water, atmosphere and mussels. Tidal Waters Division, Report DGW-92.033, October 1992.

Lamb, P.J. and Peppler, R.A., 1987. North Atlantic Oscillation: concept and an application. Bull. Am. Meteorol. Soc. 68, 1218-1225.

Laursen, K. and Frikke, J., 1987. Foreløbig undersøgelse af ederfugle i relationtil fiskeri af blåmuslinger i Vadehavet. Rapport 11 Vildtbiologisk Station.

Laursen, K. and Frikke, J., 1997. Optælling fra fly af rastende vandfugle og menneskelige aktiviteter 1991-95. Vadehavet. Danmarks Miljøundersøgelser, Arbejdsrapport fra DMU 32.

Laursen, K., Frikke, J. and Salvig. J., 1997. Vandfugle i relation til menneskelig aktivitet i Vadehavet 1980-1995 med en vurdering af reservatbestemmelser. Danmarks Miljøundersøgelser. Faglig rapport fra DMU, nr 187, pp. 73.

Leendertse, P.C., 1991. Kwelderontwikkeling in relatie tot de waterkwaliteit van de Waddenzee.Vakgroep Oecologie en Oecotoxicologie, Vrije Universiteit, Amsterdam, pp. 97.

Leeuwen, P.I. van, Rijnsdorp, A.D. and Vingerhoed, B., 1994a. Variations in abundance and distribution of demersal fish species in the coastal zone of the Southeastern North Sea between 1980 and 1993. ICES paper C.M. 1994/G:10, Demersal Fish Committee, pp. 19.

Leeuwen, A. van, Postma, T.A.C., Leopold, M.F. and Bergman, M.J.N., 1994b. De ecologie van de kustzone van Ameland tot Borkum. NIOZ Rapport 1994-4.

Leopold, M.F., 1993. *Spisula*'s, zeeëenden en kokkelvissers: een nieuw milieuprobleem op de Noordzee. Sula 7, 24-28.

Leopold, M.F., 1994. Walvisachtigen in de zuidelijke Noordzee: twee survey methoden vergeleken. Sula 8, 207-225.

Leopold, M.F., 1996a. Record aantallen Bruinvissen *Phocoena phocoena* en Roodkeelduikers *Gavia stellata*. Sula 10, 105-107.

Leopold, M.F., 1996b. Zeehonden ,on the rocks'. Sula 10, 100-101.

Leopold, M.F. and Platteeuw, M., 1987. Talrijk voorkomen van Jan van Genten *Sula bassana* bij Texel in de herfst: reactie op lokale voedselsituatie. Limosa 60, 105-110.

Leopold, M.F. and Dankers, N.M.J.A., 1997. Natuur in de zoute wateren. IKC Natuurbeheer, Wageningen. Achtergrondrapport 2-C Natuurverkenningen 1997.

Leopold, M.F., Maas, F.-J. and Hin, H., 1986. Elfsteden winter 1986: slachting onder de wadvogels met name de Toppereend. Skor 5, 70-78, 5(4), 90-96.

Leopold, M.F., Baptist, H.J.M., Wolf, P.A. and Offringa, H., 1995. De Zwarte Zeeëend *Melanitta nigra* in Nederland. Limosa 68, 49-64.

Leopold, M.F., Werf, B. van der, Ries, E.H. and Reijnders, P.J.H., 1997. The importance of the North Sea for winter dispersal of harbour seals *Phoca vitulina* from the Wadden Sea. Biol. Conserv. 81 (1-2), pp. 97-102.

Leuchs, H., Nehring, S. and Fock, H., 1999. Das Makrozoobenthos des Nord-Ostsee-Kanals, Bestandsaufnahme in 1996. Bundesanstalt für Gewässerkunde, Koblenz. Bericht BfG - 1121 (in press).

Leuchs, H., Nehring, S., Hagendorff, R., Kröncke, I. and Stecher, J., 1996. Dauerklappstelle Brunsbüttel - Auswirkungen auf das Makrozoobenthos. Mitteilungen der Bundesanstalt für Gewässerkunde, Koblenz 11, 53-59.

Liebezeit, G., 1997. Seasonal variation in nutrient concentrations in the channel Otzumer Balje, Spiekeroog Island. In: Henke, S. (Ed.). Black spots in the Wadden Sea. Texte 3/97. Federal Environmental Agency, Berlin, pp. 41-43.

Lindley, J.A., Roskell, J., Warner, A.J., Halliday, N.C., Hunt, H.G.J. and Jonas, T.D., 1990. Doliolids in the German Bight in 1989: Evidence for exceptional inflow into the North Sea. J. Mar. Biol. Ass. U.K. 70, 679-682.

Linke, O., 1937. Der Verfall der Wangerooger Austernbänke. Abh. Nat. Ver. Bremen 30, 238-241.

Linke, O., 1951. Neue Beobachtungen über Sandkorallen-Riffe in der Nordsee. Natur und Volk, 81, 77-84.

Linke, O., 1954. Die Bedeutung der Miesmuscheln für die Landgewinnung im Wattenmeer. Natur und Volk 84, 253-261.

Lloyd, C., Tasker, M.L. and Patridge, K., 1991. The status of seabirds in Britain and Ireland. T. and A.D. Poyser. London, U.K., pp. 322.

LNV, 1992. Vissen naar evenwicht. Structuurnota Zee- en kustvisserij. Beleidsvoornemen. Ministerie van Landbouw, Natuurbeheer en Visserij, Directie Visserijen, Den Haag, pp. 97.

Louters, T. and Gerritsen, F., 1994. The Riddle of the Sands. A Tidal System's answer to a rising sea level. Report RIKZ-94.040. RIKZ, Den Haag, pp. 69.

Lozán, J.L., 1994. Über die ökologische und wirtschaftliche Bedeutung der Nordseegarnele im Wattenmeer mit Bemerkungen über andere Krebsarten. In: Lozán, J.L., Rachor, E., Reise, K., Westernhagen, H. v. and Lenz, W. (Eds.). Warnsignale aus dem Wattenmeer. Blackwell, Berlin, pp. 117-122.

Lozán, J.L., Breckling, P., Fonds, M., Krog, C., Veer, H.W. van de and Witte, J.I.J., 1994. Über die Bedeutung des Wattenmeeres für die Fischfauna und deren regionale Veränderung. In: Lozán, J.L., Rachor, E., Reise, K., Westernhagen, H. v. and Lenz, W. (Eds.). Warnsignale aus dem Wattenmeer. Blackwell, Berlin, pp. 226-234.

Madsen, J., 1994. Impacts of disturbance on migratory waterfowl. Ibis 137, 867-874.

Madsen, J. and Fox, A.D., 1995. Impacts of hunting disturbance on waterbirds - a review. Wildl. Biol. 1, 193-207.

Manuels, M.W. and Postma, H., 1974. Measurement of ATP and organic carbon in suspended matter of the Dutch Wadden Sea. Neth. J. Sea Res. 8(2-3), 292-311.

Manzenrieder, H. and Schulze, M., 1997. Erosion stability of dike foreshores. Wadden Sea Newsletter 1997-1, 25-29.

Marencic, H., Bakker, J.F., Farke, H., Gätje, C., Jong, F. de, Kellerman, A., Laursen, K., Pedersen, T.F. and Vlas, J. de, 1996. The Trilateral Monitoring and Assessment Program (TMAP). Expert Workshops 1995/1996. Wadden Sea Ecosystem No. 6, Common Wadden Sea Secretariat, Wilhelmshaven, pp. 205.

Marlen, B. van, Redant, F., Polet, H., Radcliffe, C., Revill, A., Kristensen, P.S., Hansen, K.E., Kuhlmann, H.J., Riemann, S., Neudecker, T. and Brabant, J.C., 1998. Research into Crangon Fisheries Unerring Effect (RESCUE). EU Study 94/044. Report C054/97, pp. 151.

Marquenie, J.M. and Gussinklo, H.J., 1998. Integrale Bodemdalingsstudie Waddenzee. Samenvatting. NAM, Assen.

Martens, P., 1992. Inorganic phytoplankton nutrients in the Wadden Sea areas off Schleswig-Holstein. II. Dissolved ortho-phosphate and reactive silicate with comments on the zooplankton. Helgoländer Meeresunters. 46, 103-115.

Martin, J. M. and Brun-Cottan, J. C., 1988. Estuaries. In: Salomons, W., Bayne, B.L., Duursma, E.K., Förstner, U. (Eds.). Pollution of the North Sea. Springer-Verlag, Berlin, pp. 88-99.

Meier, D., 1996. Besiedlungsgeschichte in den Flußmündungsgebieten am Beispiel der Eider und Elbe. In: Lozán, J. and Kausch, H. (Eds.). Warnsignale aus Flüssen und Ästuaren. Parey, Berlin, pp. 19-23.

Meininger, P.L. and Bekhuis, J.F., 1990. De Zwartkopmeeuw *Larus melanocephalus* als broedvogel in Nederland en Europa. Limosa 63, 121-134.

Meire, P.M., 1996. Distribution of Oystercatchers *Haematopus ostralegus* over a tidal flat in relation to their main prey species, cockles *Cerastoderma edule* and mussels *Mytilus edulis*: did it change after a substantial habitat loss? Ardea 84A, 525-538.

MELFF/MNU, 1995. Vorlandmanagement in Schleswig-Holstein. Endbericht. MELFF, Kiel.

Melter, J., Südbeck, P., Fleet, D.M., Rasmussen, L.M. and Vogel, R.L., 1997. Changes in Breeding Bird Numbers on Census Areas in the Wadden Sea 1990 until 1994. Wadden Sea Ecosystem No. 4, Common Wadden Sea Secretariat, Wilhelmshaven, pp. 7-93.

Meltofte, H., Blew, J., Frikke, J., Rösner, H.-U. and Smit, C.J., 1994. Numbers and distribution of waterbirds in the Wadden Sea. Results and evaluation of 36 simultaneous counts in the Dutch-German-Danish Wadden Sea 1980-1991. IWRB Publ. 34 / Wader Study Group Bull. 74, Special Issue. Common Wadden Sea Secretariat, Wilhelmshaven, pp. 192.

Meyer, H. and Reinke, H.-D., 1996. Veränderungen in der biozönotischen Struktur der Wirbellosenfauna von Salzwiesen durch unterschiedliche Beweidungsintensität mit Schafen. Faun.-Ökol. Mittlg. 7, 109-151.

Meyer, H., Fock, H., Haase, A., Reinke, H.D. and Tulowitzki, I., 1995. Structure of the invertebrate fauna in salt marshes of the Wadden Sea coast of Schleswig-Holstein influenced by sheep-grazing. Helgoländer Meeresunters. 49, 563-589.

Meyer, K.O., 1994. Küstenfunde - Wale und Delphine aus der Deutschen Bucht. Drosera 1, 1-6.

Michaelis, H., 1977. Untersuchungen über das Sterben wirbelloser Wattentiere seit dem Sommer 1976. Unpublished Report Forschungsstelle f. Insel- und Küstens-chutz, Norderney.

Michealis, H., 1987. Bestandsaufnahme des eulitoralen Benthos im Jadebusen in Verbindung mit einer Luftbild-Analyse. Jber. Forsch.-Stelle Küste Norderney 38, 13-97.

Michaelis, H., 1997. History and distribution of black spots in the east Frisian Wadden Sea. In: Henke, S. (Ed.). Black spots in the Wadden Sea. Texte 3/97. Federal Environmental Agency, Berlin, pp. 13-17.

Michaelis, H. and Reise, K., 1994. Langfristige Veränderungen des Zoobenthos im Wattenmeer. In: Lozán, J.L., Rachor, E., Reise, K., Westernhagen, H. v. and Lenz, W. (Eds.). Warnsignale aus dem Wattenmeer. Blackwell, Berlin, pp. 106-117.

Michaelis, H., Ohba, T. and Tüxen, R., 1971. Die *Zostera* Gesellschaften der niedersächsischen Watten. Jber. Forschungsstelle f. Insel- und Küstenschutz, Norderney 21, 87-100.

Michaelis, H., Fock, H., Grotjahn, M. and Post, D., 1992. The status of the intertidal zoobenthic brackish-water species in estuaries of the German Bight. Neth. J. Sea Res. 30, 201-207.

Michaelis, H., Obert, B., Schultenkötter, I. and Böcker, L., 1995. Die Miesmuschelbestände der Niedersächsischen Watten (1989-1991). Ber. Forschungsstelle Küste Norderney 40, 55-71.

Millat, G., 1996. Entwicklung eines methodisch-inhaltlichen Konzeptes zum Einsatz von Fernerkundungsdaten für ein Umweltmonitoring im niedersächsischen Wattenmeer. Schriftenreihe der Nationalparkverwaltung Niedersächsisches Wattenmeer, Wilhelmshaven, Band 1, pp. 125.

Ministerie van Verkeer en Waterstaat, 1988. Beehrsplan Burgerluchtvaart, Annex 1.

Ministerie van Verkeer en Waterstaat, 1996a. Kustbalans 1995 – de tweede kustnota. Ministerie von Verkeer en Waterstaat, Den Haag, pp. 47.

Ministerie van Verkeer en Waterstaat, 1996b. Beheersplan Waddenzee 1996-2001. Sectornotities Natuur- en Kustbeheer, Milieubeheer, Verkeer en Vervoer, Civiele Werken, Recreatie, Visserij, Militaire Activiteiten. Sociaal Economische Aspecten. Vervangende mogelijkheden voor zandwinning. Rijkswaterstaat, Directie Noord-Nederland, Leeuwarden, pp. 273.

Ministerie van Verkeer en Waterstaat, 1996c. Gevoel voor zout, werken aan de grens tussen zoete en zoute watersystemen. Brochure Integraal Waterbeheer nr. 8. Ministerie van Verkeer en Waterstaat.

Ministerie van Verkeer en Waterstaat, Rijkswaterstaat Noord-Nederland 1996c. Beheersplan Waddenzee 1996-2001. Deel 1 – 2, Rijkswaterstaat, Directie Noord-Nederland, Leeuwarden.

Ministeries van Economische Zaken, Landbouw, Natuurbeheer en Visserij, Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer en Verkeer en Waterstaat, 1997. Proefboringen in de Noordzeekustzone en de Waddenzee. Nadere onderbouwing voor besluitvorming. pp. 50.

Ministry of Economic Affairs, 1997. Oil and gas in The Netherlands, exploration and production 1996.

MinVenW, 1998. Vierde Nota Waterhuishouding. Regeringsbeslissing. (Fourth Note on Water Management. Gouvernmental decision). Ministerie van Verkeer en Waterstaat, December 1998. ANDO bv, The Hague.

Misdorp, R., Staeyert, F., Hallie, F. and Ronde, J. de, 1990. Climate change, sea level rise and morphological developments in the Dutch Wadden Sea, a marine wetland. J. J. Beukema, J.J, Wolff, W.J. and Brouns, J.J.W.M. (Eds.). Expected effects of climatic change on marine coastal ecosystems. Kluwer Acad. Publ., Netherlands, pp. 123-131.

Möbius, K., 1877. Die Auster und die Austernwirthschaft. Wiegandt, Hempel Parey, Berlin, 1-126.

Möller, H., 1989. Changes in fish stocks and fisheries: the Lower Elbe River. In: Petts, G. E., Roux, A. L. and Möller, H. (Eds.). Historical Change of Large Alluvial Rivers: Western Europe. J. Wiley & Sons, Chichester, 203-220.

Moloney, C.L., Botsford, L.W. and Largier, J.L., 1994. Development, survival and timing of metamorphosis of planktonic larvae in a variable environment: the Dungeness crab as an example. Mar. Ecol. Prog. Ser. 113, 61-79.

Montagna, P. A., 1995. Rates of metazoan meiofaunal microbivory: a review. Vie Milieu 45 (1), 1-9.

Monval, J.-Y. and Pirot, J.-Y. (Eds.), 1989. Results of the IWRB International Waterfowl Census 1997 - 1986. IWRB special Publ. 8, Slimbridge.

Mühlenhardt-Siegel, U., Dörjes, J. and Cosel, R. von, 1983. Die amerikanische Schwertmuschel *Ensis directus* (Conrad) in der Deutschen Bucht. II. Populationsdynamik. Senckenbergiana marit. 15, 93-110.

Müller, A., Grodd, M. and Weigel, P., 1990. Lower Weser monitoring and modelling. In: Michaelis, W. (Ed.). Estuarine water quality management. Coastal and estuarine studies 36, Springer-Verlag, New York, pp. 285-294.

Munksgaard, C, 1989. Undersøegelse af blåmuslingebestanden i det danske vadehav. Miljøeministeriet, Skov og Naturstyrelsen.

Nachtigall, K. H., 1991. Hydrogeologisches Gutachten des Geologischen Landesamtes Schleswig-Holstein zur Süßwassergewinnung für die Mineralwasserherstellung in Rantum/Sylt. Unpublished Report, pp. 12.

Nanninga, H.J., 1997. Invloed van stikstof en fosfor op de visstand in de Noordzee. Rijksuniversiteit Groningen, Vakgroep Mariene Biologie.

Nasner, H., 1992. Sedimentation in Tidehäfen. Die Küste 53, 127-169.

Nehls, G.,1994. Untersuchungen zu Bestand und Verbreitung von Eiderente, Trauerente und Brantente im Nationalpark Schleswig-Holsteinisches Wattenmeer. Bericht an das Landesamt für den Nationalpark Schleswig-Holsteinisches Wattenmeer.

Nehls, G. and Thiel, M., 1993. Large scale distribution patterns of the mussel *Mytilus edulis* in the Wadden Sea of Schleswig Holstein: do storms structure the ecosystem? Neth. J. Sea Res. 31, 181-187.

Nehls, G., Herzler, I. and Scheiffarth, G., 1997. Stable mussel *Mytilus edulis* beds in the Wadden Sea - They're just for the birds. Helgoländer Meeresunters. 51, 361-372.

Nehring, S., 1998. 'Natural' processes in the Wadden Sea - challenging the concept of 'an intact ecosystem'. Ocean Challenge 8 (1), 27-29.

Nehring, S. and Leuchs, H., 1996. BfG-Ästuarmonitoring in Ems, Jade, Weser, Elbe - Makrozoobenthos 1995. Bericht BfG - 1040. Bundesanstalt für Gewässerkunde, Koblenz.

Nehring, S. and Leuchs, H., 1998. Das BfG-Ästuarmonitoring in Ems, Jade, Weser, Elbe - Makrozoobenthos-Pilotstudie. In: Deutsche Gesellschaft für Limnologie (Ed.). Tagungsbericht 1997 Frankfurt/M. Eigenverlag der DGL, Krefeld, pp. 976-980.

Nehring, s. and leuchs, H., 1999. Introduced macrozoobenthic species at the German North Sea coast. A review. Wadden Sea Newsletter 1999-1, 10-13.

Nehring, S., Hesse, K.-J. and Tillmann, U., 1995. The German Wadden Sea: A problem area for nuisance blooms? In: Lassus, P. et al. (Eds.). Harmful marine algal blooms: Proccedings of the Sixth International Conference on Toxic Marine Phytoplankton, October 1993. Lavoisier, Intercept Ltd, Paris, New York, Andover, pp. 199-204.

Nehring, S., Riedl-Lorjé, J. C. and Hesse, K.J., 1998. Welchen Einfluß haben Speicherkoogbecken auf die Planktonentwicklung im Wattenmeer? In: Umweltatlas Wattenmeer. Band 1. Nordfriesisches und Dithmarscher Wattenmeer. Landesamt für den Nationalpark Schleswig-Holsteinisches Wattenmeer, Umweltbundesamt. Ulmer Verlag, Stuttgart, pp. 82-83.

Neudecker, T., 1990. The history of the former German oyster fishery and mariculture: 400 years of crown law on oysters (4.2.1587). Dt. hydrogr. Z., Erg.-H. Bd. 22, 518-525.

Neudecker, T. and Damm, U., 1996. Abundance indices of brown shrimp (*Crangon crangon* L.) at the west coast of Schleswig-Holstein, North Sea. ICES C.M. K:8, Shellfish Committee, pp. 18.

Niedersächsischer Landtag, 1996. Antwort auf eine Große Anfrage. 10 Jahre Nationalpark Niedersächsisches Wattenmeer. Niedersächsischer Landtag - 13. Wahlperiode. Drucksache 13/1943.

Niehoff, B. and Fischer, U., 1996. Epibiosen anthropogener Hartsubstrate an ausgesuchten Standorten im niedersächsischen Teil des Wattenmeeres. Ein Vergleich mit früheren Erhebungen. Internal Report Forschungsstelle Küste, Norderney.

Nienhuis, P. H., 1993. Nutrient cycling and foodwebs in Dutch estuaries. Hydrobiologia 265, 15-44.

Nilsson, P., Jönsson, B., Lindström Swanberg, I. and Sundbäck, K., 1991. Response of a marine shallow-water sediment system to an increased load of inorganic nutrients. Mar. Ecol. Prog. Ser. 71, 275-290.

Nordheim, H. von, Norden Anderson, O. and Thissen, J. (Eds.), 1996. Red List of Biotopes, Flora and Fauna of the Trilateral Wadden Sea Area, 1995. Helgoländer Meeresunters. 50, Suppl., also: Schriftenreihe für Landschaftspflege und Naturschutz Heft 47. Bundesamt für Naturschutz, Bonn-Bad Godesberg 1996, pp. 136.

Nordseebäderverband Schleswig-Holstein e. V., 1998. Meer-Wert. Wirtschaftfaktor Tourismus - Bestandsaufnahme und Perspektiven für die Westküste Schleswig-Holstein.

Northridge, S., Tasker, M. and Webb, A., 1996. White-beaked *Lagenorhynchus albirostris* and Atlantic white-sided dolphin *L. acutus* distributions in northwest European and U.S. North Atlantic waters. IWC, SC/48/SM44, pp. 6.

Obert, B. and Michaelis, H., 1991. History and ecology of the musselbeds (*Mytilus edulis* L.) in the catchment area of a Wadden Sea tidal inlet. In: Elliot, M and Ducrotoy, J.P. (Eds.). Estuaries and coasts. Spatial and Temporal Intercomparisons. Olsen & Olsen, pp. 185-194.

Olesen, H.J., 1993. Fallbeispiel Varde Å. Wattenmeer International 1/93, 10.

Oost, A.P., 1995 Dynamics and sedimentary development of the Dutch Wadden Sea with emphasis on the Frisian Inlet. Ph.D. thesis, University of Utrecht, Geologica Ultraiectina 126, pp. 455.

Oost, A.P. and Boer, P.L. de, 1994. Sedimentology and development of barrier islands, ebb-tidal deltas, inlets and backbarrier areas of the Dutch Wadden Sea. Senckenbergiana marit. 24, 65-115.

Oost, A.P., Ens, B.J., Brinkman, A.G., Dijkema, K.S., Eysink, W.D., Beukema, J.J., Gussinklo, H.J., Verboom, B.M.J. and Verburgh, J.J., 1998. Integrale Bodemdalingstudie Waddenzee. NAM, Assen.

OSPAR, 1997. Annex 5: Agreed Background/Reference concentrations for contaminants in sea water, biota and sediment. Annex 6: Agreed ecotoxicological assessment criteria for trace metals, PCBs, PAHs, TBT and some organochlorine pesticides. Joint meeting of the Oslo and Paris commissions, Brussels, 2-5 September 1997.

Osiek, E.R. and Hustings, F., 1994. Rode Lijst van bedreigde en kwetsbare vogelsoorten in Nederland. Techn. Rapport Vogelbescherming Nederland 12, Vogelbescherming Nederland, Zeist.

Ovesen, H.C. (Ed.), 1990. Proceedings of the Second Trilateral Working Conference on Salt marsh Management in the International Wadden Sea Area, Rømø, 1989. National Forest and Nature Agency, Denmark, pp. 203.

Pachur, H.-J., Ricking, M., Sommerfeldt, B., Varlemann, R., Bakker, J.F. and Smedes, F., 1995. Geoaccumulation of environmental contaminants in sediments of the lower Ems river in the framework of the European project "Chemical Time Bombs". Report no. 107 01 016/17 of the Federal Environmental Agency (UBA), Berlin.

Peletier, H., 1992. Measurements of biomass, pigments and photosynthesis of *Ulva* sp. in the Western Wadden Sea in 1988-91. Rijkswaterstaat, National Institute for Coastal and Marine Management (RIKZ). Report DGW-92.005 (in Dutch).

Peletier, H., 1996. Long-term changes in intertidal estuarine diatom assemblages related to reduced input of organic waster. Mar. Ecol. Prog. Ser. 137, 265-271.

Peletier, H., Gieskes, W.W.C. and Buma, A.G.J., 1996. Ultraviolet-B radiation resistance of benthic diatoms isolated from tidal flats in the Dutch Wadden Sea. Mar. Ecol. Prog. Ser. 135, 163-168.

Petersen, J., 1999. Die Dünentalvegetation der Wattenmeer-Inseln in der südlichen Nordsee. Eine pflanzensoziologische und ökologische Vergleichsuntersuchung unter Berücksichtigung von Nutzung und Naturschutz. Diss. Univ. Hannover. pp. 203.

Phil, N.J. and Kristensen, P.S, 1998. Blåmuslingebestanden i det danske Vadehav efteråret 1997. DFU Rapport nr. 49-98, pp. 19.

Philippart, M., 1989. Uitwisseling Noordzee-Waddenzee: tijdschalen in de Waddenzee. (Water exchange North Sea - Wadden Sea: time scales in the Wadden Sea) NIOZ/IMO report V89-1.

Philippart, C.J.M., 1994. Eutrophication as a possible cause of decline in the seagrass *Zostera noltii* of the Dutch Wadden Sea. Ph.D. thesis, Landbouwuniversiteit, Wageningen, 1-157.

Philippart, C.J.M. and Dijkema, K.S., 1995. Wax and wane of *Zostera noltii* Hornem. in the Dutch Wadden Sea. Aquat. Bot. 49, 255-268.

Piersma, T., 1986. Breeding Waders in Europe. Wader Study Group Bulletin No. 48, Supplement.

Piersma, T. and Koolhaas, A., 1997. Shorebirds, shelfish(eries) and sediments around Griend, Western Wadden Sea, 1988-96. NIOZ-Rapport 1997-7, pp. 118.

Piersma, T., Beintema, A.J., Davidson, N.C., Munster, O.A.G. and Pienkowski, M.W., 1987. Wader migration systems in the East Atlantic. Wader Study Group Bull. 49, Suppl. / IWRB Special Publ. 7, 35-56.

Pirot, J.-Y., Laursen, K., Madsen, J. and Monval, J.-Y., 1989. Population estimates of swans, geese, ducks and Eurasian Coot (*Fulica atra*) in the Western Palearctic and Sahelian Africa. IWRB Special Publication No. 9, 14-23.

Poot, M., Rasmussen, L.M., Roomen, M.v., Rösner, H.-U. and Südbeck, P., 1996. Migratory Waterbirds in the Wadden Sea 1993/94. Wadden Sea Ecosystem No. 5, Common Wadden Sea Secretariat, Wilhelmshaven, pp. 79.

Post K. and Kompangje E.J.O., 1995. Late Pleistocene White Whales *Delphinapterus leucas* from the Dutch coastal waters. Lutra 38, 67-76.

Postma, H., 1983. Hydrography of the Wadden Sea movements and properties of water and particulate matter. In: Wolff, W. J. (Ed.). Ecology of the Wadden Sea. Vol. 1, Part 2, Balkema, Rotterdam, pp. 1-75.

Postma, H., 1984. Introduction to the symposium on organic matter in the Wadden Sea. Neth. Inst. Sea Res. Publ. Ser. 10, 13-22.

Potel, P., Südbeck, P. and Hälterlein, B., 1998. Wie kommen wir zu einem verbesserten Schutz der Strandvögel im Wattenmeer? Seevögel Band 19, Sonderheft, 1, (Dt. See- und Küstenvogelkoll.), pp. 75-80.

Pott, R., 1995. Farbatlas Nordseeküste und Nordseeinseln. Ulmer, Stuttgart, pp. 228.

Prawitt, O., 1995. Untersuchungen zur Bestimmung der Fangkraft und des Fischereiaufwandes von Krabbenkuttern. Diplomarbeit, Universität Kiel.

Preisinger, H., 1991. Strukturanalyse und Zeigerwert der Auen- und Ufervegetation im Hamburger Hafen- und Hafenrandgebiet. Diss. Bot. 174, Verlag J. Cramer, Berlin, pp. 296.

Prins, T.C. and Smaal, A.C., 1990. Benthic-pelagic coupling: The release of inorganic nutrients by an intertidal bed of *Mytilus edulis* In: Barnes, M. and Gibson, R.M. (Eds.). Trophic relationships in the marine environment. Proc. 24th European Marine Biological Symposium, Aberdeen Univ. Press, pp. 89-103.

Prokosch, P., 1984. Population, Jahresrhythmus und traditionelle Nahrungsplatzbindung der Dunkelbauchigen Ringelgans (*Branta b. bernicla*) im Nordfriesischen Wattenmeer. Ökol. Vögel 6, 1-99.

Pulfrich, A., 1997. Seasonal variation in the occurrence of planktic bivalve larvae in the Schleswig-Holstein Wadden Sea. Helgoländer Meeresunters. 51, 23-39.

Raabe, E. W., 1964. Auswirkungen der Aufforstungen Amrums auf die Wasserbilanz. Die Heimat 71, 1-8.

Raaphorst, W. van, Jonge. V.N. de, Dijkhuizen, D. and Frederiks, B., 1999. Hind casting of nitrogen and phosphorus reference concentrations in the western Dutch Wadden Sea from emissions of the river Rhine and concentrations in the southern North Sea. Neth. J. Sea Res., (in prep).

Rademaker, M., Reckermann, M., Tillmann, U., Tillmann, A., Colijn, F., Zevenboom, W. and Houpt, P., 1998. *Fibrocapsa japonica* and *Heterosigma akashiwo*: new observations. Harmful Algae News 17, 8-10.

Rahmel, J., Bätje, M., Jakobs, R. and Michaelis, H., 1997. Die Entwicklung der Nährstoffkonzentrationen im ostfriesischen Wattenmeer. Dienstbericht Forschungsstelle Küste 4/1997, pp. 15.

Rahmstorf, S., 1999. Shifting seas in the greenhouse? Nature 399, 523-524.

Ranwell, D.S., 1972. Ecology of salt marshes and sand dunes. Chapman and Hall, London, pp. 258.

Rat von Sachverständigen für Umweltfragen, 1980. Umweltprobleme der Nordsee. Kohlhammer, Stuttgart, pp. 503.

Redfield, A.C., Ketchum, B.H. and Richards, F.A., 1963. The influence of organisms on composition of seawater. In: Hill, M.R., (Ed.). The Sea. Vol. 2, Wiley Interscience, New York, pp. 26-77.

Reents, S., 1995. Vergelijking van het kunstmatige afwateringssysteem in de kwelderwerken met natuurlijke kreeksystemen. Studentenverslag, RWS, Directie Noord-Nederland en IBN-DLO, Texel, pp. 79 (also in German).

Reijnders, P.J.H., 1978. Recruitment in the harbour seal (*Phoca vitulina*) population in the Dutch Wadden Sea. Neth. J. Sea. Res. 12, 164-179.

Reijnders, P.J.H., 1992. Retrospective population analysis and related future management perspectives for the harbour seal *Phoca vitulina* in the Wadden Sea. In: Beukema, J.J. (Ed.). Proc. Seventh Int. Wadden Sea Symp., Ameland 1990. Neth. Inst. Sea Res. Publ. Ser. 20, 193-197.

Reijnders, P.J.H., 1996. Developments of grey and harbour seal populations in the international Wadden Sea: reorientation on management and related research. Wadden Sea Newsletter 1996-2, 12-16.

Reijnders, P.J.H. and Ruiter-Dijkman, E.M. de, 1995. Toxicological and epidemiological significance of pollutants in marine mammals. In: Blix, A.S., Walløe, L. and Ulltang, Ø. (Eds.). Whales, seals, fish and man. Elsevier Science B.V. Amsterdam, pp. 575-587.

Reijnders, P.J.H., Dijk, J van and Kuiper, D., 1995. Recolonization of the Dutch Wadden Sea by the grey seal *Halichoerus grypus*. Biol. Conserv. 71, 231-235.

Reijnders, P.J.H., Ries, E.H. and Brasseur, S.M.J.M., 1996b. On the status of harbour seals in the Wadden Sea in 1995. Wadden Sea Newsletter 1996-1, 31-32.

Reijnders, P.J.H., Leopold, M.F., Camphuysen, C.J., Heessen, H.J.L. and Kastelein, R.A., 1996b. The Status of the harbour porpoise *Phocoena phocoena* in Dutch waters and the state of related research in The Netherlands: an overview. Rep. Int. Whale Comm. 46, 607-611.

Reijnders, P.J.H., Ries, E. H., Tougaard, S., Nørgaard, N., Heidemann, G., Schwarz, J., Vareschi, E. and Traut, I.M., 1997: Population development of the harbour seal, *Phoca vitulina*, in the Wadden Sea after the virus epizootic. Neth. J. Sea Res. 38, 161-168.

Reincke, H., 1995. Wie hat sich die Gewässerqualität im Elbeeinzugsgebiet verändert? In: Umweltbehörde Hamburg (Ed.). Situation der Elbe 5 Jahre nach der Wende. Hamburg, pp. 7-23.

Reineking, B., 1997. Verölte Seevögel im Spülsaum-Hinweise auf Ölverschmutzungen durch den Seeverkehr. Symposium Aktuelle Probleme der Meeresumwelt. Dt. hydrogr. Z. Suppl. 7, 113-123.

Reinke, H.-D. and Irmler, U., 1994. Die Spinnenfauna (Araneae) Schleswig-Holsteins am Boden und in der bodennahen Vegetation. Faun. Ökol. Mittl. Suppl. 17, 1-148.

Reise, K., 1982. Long-term changes in the macrobenthic invertebrate fauna of the Wadden Sea: are polychaetes about to take over? Neth. J. Sea Res. 16, 29-36.

Reise, K., 1993. Die verschwommene Zukunft der Nordseewatten. In: Schellnhuber, H.-J. and Sterr, H. (Eds.). Klimaänderung und Küste. Springer-Verlag, Heidelberg, pp. 223-229.

Reise, K., 1994a. Changing life under the tides of the Wadden Sea during the 20th century. Ophelia Suppl. 6, 117-125.

Reise, K., 1994b. Das Schlickgras *Spartina anglica*: die Invasion einer neuen Art In: Lozán, J.L., Rachor, E., Reise, K., Westernhagen, H. v. and Lenz, W. (Eds.). Warnsignale aus dem Wattenmeer. Blackwell, Berlin, pp. 211-214.

Reise, K., 1995a. Vorkommen von Grünalgen und Seegras im Nationalpark Schleswig-Holsteinisches Wattenmeer. Forschungsbericht im Auftrag des Landesamtes für den Nationalpark Schleswig-Holsteinisches Wattenmeer, Tönning. Biolog. Anstalt Helgoland, List/Sylt, pp. 16.

Reise, K., 1995b. Predictive ecosystem research in the Wadden Sea. Helgoländer Meeresunters. 49, 495-505.

Reise, K., 1996. Das Ökosystem Wattenmeer im Wandel. Geogr. Rdschau 48, 442-449.

Reise, K., 1997. Vorkommen von Grünalgen und Seegras im Nationalpark Schleswig-Holsteinisches Wattenmeer. Forschungsbericht im Auftrag des Landesamtes für den Nationalpark Schleswig-Holsteinisches Wattenmeer, Tönning. Biolog. Anstalt Helgoland, List/Sylt, pp. 14.

Reise, K. 1998a. Vorkommen von Grünalgen und Seegras im Nationalpark Schleswig-Holsteinisches Wattenmeer. Forschungsbericht im Auftrag des Landesamtes für den Nationalpark Schleswig-Holsteinisches Wattenmeer, Tönning. Biolog. Anstalt Helgoland, List/Sylt, pp. 13.

Reise, K., 1998b. Pacific oysters invade mussel beds in the European Wadden Sea. Senckenbergiana marit. 28, 167-175.

Reise, K. and Siebert, I., 1994. Mass occurrence of green algae in the German Wadden Sea. Dt. hydrogr. Z. Suppl. 1, 171-180.

Reise, K., Herre, E. and Sturm, M., 1989. Historical changes in the benthos of the Wadden Sea around the island of Sylt in the North Sea. In: Reise, K., Armonies, W. and Scherer, B. (Eds.). Monitoring the Wadden Sea. Helgoländer Meeresunters. 43 (3-4), 417-433.

Reise, K., Herre, E. and Sturm, M., 1994b. Biomass and abundance of macrofauna in intertidal sediments of Königshafen in the northern Wadden Sea. Helgoländer Meeresunters. 48, 201-215.

Reise, K., Kolbe, K. and Jonge, V. de, 1994b. Makroalgen und Seegrasbestände im Wattenmeer. In: Lozán, J.L., Rachor, E., Reise, K., Westernhagen, H. v. and Lenz, W. (Eds.). Warnsignale aus dem Wattenmeer. Blackwell Wissenschaftsverlag, Berlin, pp. 90-100.

Revill, A., Pascoe, S., Redcliffe, C., Riemann, S., Redant, F., Polet, H., Damm, U., Neudecker, T., Kristensen, P.S. and Jensen, D., 1999. The economic and biological consequences of discarding in the European Crangon fisheries (ECODISC). EU (DG XIV A: 3) project 97/SE/025, pp. 117.

Rhode, B., 1982. Die Bodenfauna der Watten in der Emsmündung von Papenburg bis Emden. Jber. Forsch.-Stelle Küste Norderney 32, 99-118.

Richardson, W.J., Greene, C.R., Malme, C.I. and Thomson, D.H., 1995. Marine mammals and noise. Academic Press, London, pp. 576.

Ridderinkhof, H., 1990. Residual currents and mixing in the Wadden Sea. Ph.D. thesis, University of Utrecht (IMO), pp. 91.

Riedel-Lorjé, J. C., Kohla, U. and Vaessen, B., 1995. Das Vordringen ausgewählter Bodentiere im Elbe-Ästuar als Indikation für eine Verlagerung der oberen Brackwasserzone. DGM 39 (4/5), 137-145.

Riegman, R., Noordeloos, A.A.M. and Cadée, G.C., 1992. *Phaeocystis* blooms and eutrophication of the continental coastal zones of the North Sea. Mar. Biol. 112, 479-484.

Riesen, W. and Reise, K., 1982. Macrobenthos of the subtidal Wadden Sea: revisited after 55 years. Helgoländer Meeresunters. 35, 409-423.

Roff, J.C., Middlebrook, K. and Evans, F., 1988. Long-term variability in North Sea zooplankton off the Northumberland coast: Productivity of small copepods and analysis of trophic interactions. J. Mar. Biol. Ass. U.K. 68, 143-164.

Roomen, M.W.J. van and Madsen, J. (Eds.), 1992. Waterfowl and agriculture: Review and future perspective of the crop damage conflict in Europe. IWRB Special Publ. 21.

Rose, P.M. and Scott, D.A., 1994. Waterfowl population estimates. IWRB Publ. 29.

Roskam, R.T., 1970. De verontreiniging van de zee. Chemisch Weekblad, 4 September 1970.

Rösner, H.-U., 1990. Sind Zugmuster und Rastplatzansiedlung des Alpenstrandläufers (*Calidris alpina alpina*) abhängig vom Alter? J. Orn. 131, 121-139.

Rösner, H.-U., 1994. Population indices for migratory birds in the Schleswig-Holstein Wadden Sea from 1987 to 1993. Ophelia Supp. 6, 171-186.

Rösner, H.-U., 1997. Strategien von Zug und Rast des Alpenstrandläufers (*Calidris alpina*) im Wattenmeer und auf dem Ostatlantischen Zugweg. Ph.D. thesis, Univ. Frankfurt/M, Shaker Verlag, Aachen.

Rösner, H.-U. and Stock, M., 1994. Numbers, recent changes, seasonal development and spatial distribution of dark-bellied brent geese in Schleswig-Holstein. In: Nugteren, J. van (Ed.). Proc. Int. Workshop "Brent Geese in the Wadden Sea", Leeuwarden, pp. 69-85.

Rösner, H.-U., Roomen, M.v., Südbeck, P. and Rasmussen, L.M., 1994. Migratory Waterbirds in the Wadden Sea 1992/93. Wadden Sea Ecosystem No. 2, Common Wadden Sea Secretariat, Wilhelmshaven, pp. 72.

Rösner, H.-U., Blew, J., Frikke, J., Meltofte, H. and Smit, C.J., 1995. Anzahl und Verteilung von Wasservögeln im Wattenmeer. Natur und Landschaft 70, 412-419.

Roy, P.S. and Cowell, P.J., 1995. Chaotic coastal behaviour under conditions of slowly rising sea level. In: IGCP Project 367, Rapid coastal Changes. Second Annual Meeting, Abstr. Vol., pp. 101-102.

Rudfeld, L., 1990. 25 års beskyttelse af Vadehavet, Miljøministriet, Skov- og Naturstyrelsen.

Runge, F., 1981. Die Pflanzengesellschaften der Ems. Decheniana 134 (70), 71-86.

Rus, J.S., Bonnema, F.D., Brorens, B. and Kok, A., 1997. Integraal waterbeheer Vlieland: werken aan eilandeigen oplossingen.

Ruth, M., 1994. Untersuchungen zur Biologie und Fischerei von Miesmuscheln im Nationalpark „Schleswig - Holsteinisches Wattenmeer". Inst. f. Meeresforschung, Univ. Kiel, pp. 327.

Sam R. and Smit, J., 1996. Wad monitoren? Een onderzoek naar de afstemming tussen beleid m.b.t. de Waddenzee en de monitoringsactiviteiten. RWS werkdocument RIKZ/AB-96.602.

Schaub, B.E.M. and Gieskes, W.W.C., 1991. Eutrophication of the North Sea: the relation between Rhine river discharge and chlorophyll-a concentration in Dutch coastal waters. In: Elliott, M. and Ducrotoy, J.-P. (Eds.). Estuaries and coasts: spatial and temporal intercomparisons. ECSA 19 Symposium, Caen, France. Olsen & Olsen, Fredensborg, pp. 85-90.

Scheffel, H.-J. and Schirmer, M., 1997. Die Fischgesellschaften im Bereich der Tideweser. Bremer Beiträge zu Naturkunde und Naturschutz 3, 25-36.

Scheibel, W. and Weidel, H., 1988. Zum Vorkommen von Kegelrobben (*Halichoerus grypus* Fabricius, 1791, Phocidae, Pinnipedia) in Schleswig-Holstein. Zool. Anz. 220, 65-70.

Scheppingen, Y. van and Groenewold, A., 1990. De ruimtelijke verspreiding van het benthos in de zuidelijke Noordzee. De Noord-Nederlandse kustzone overzicht 1988-1989. Milzon-benthos Rapport Nr. 90-03.

Schirmer, M., 1991. Die Verbreitung der Fische im Land Bremen. Abh. Naturw. Verein Bremen 41/3, 405-465.

Schirmer, M., 1994. Ökologische Konsequenzen des Ausbaus der Ästuare von Elbe und Weser. In: Lozán, J.L., Rachor, E., Reise, K., Westernhagen, H. v. and Lenz, W. (Eds.). Warnsignale aus dem Wattenmeer. Blackwell, Berlin, pp. 164-171.

Schirmer, M., 1995. Eindeichung, Trockenlegung, Korrektion, Anpassung: Die Abwicklung der Unterweser und ihrer Marsch. In: Gerken, B. and Schirmer, M. (Eds.). Die Weser. Limnologie aktuell. Bd. 6, Fischer, Stuttgart, pp. 35-53.

Schirmer, M., 1996. Die Weser - eine Zustandsbeschreibung. In: Lozán, J. and Kausch, H. (Eds.). Warnsignale aus Flüssen und Ästuaren. Parey, Berlin, pp. 75-82.

Schmidt, R.C. and Hussel, B., 1994. Tourists and locals, seals and porpoises - friendly interaction and mutual endangering, examples from the German island Sylt, North Sea. In: Evans, P.G.H. (Ed.). European Research on Cetaceans - 8: 36. Proc. 8th Ann. Conf. ECS, Montpellier, March 1994.

Schmidt, H., 1995. Deutscher Wetterdienst, Hamburg (unpublished).

Schmidt, H. and Storch, H. von, 1993. German Bight storms analysed. Nature, Vol. 365, 791.

Scholle, J. and Schuchardt, B., 1997. Übersicht über die Benthon-Taxozönosen im limnischen Abschnitt der Unterweser und in ihren Zuflüssen. Bremer Beiträge für Naturkunde und Naturschutz 3, 7-24.

Scholten, M.C.T., Jak, R.G. and Foekema, E.M., 1994. Ecological control of algal densities. TNO-MW-R94/280a.

Scholten, M.C.T., Jak, R.G., Pavoni, B., Sfriso, A., Philippart, C.J.M., Dankers, N., Heij, H. de and Helder, W., 1995. BEST Benthic Eutrophication Studies - Synthesis Report. TNO-MEP R94/049, pp. 60.

Schories, D. and Reise, K., 1993. Germination and anchorage of *Enteromorpha* spp. in sediments of the Wadden Sea. Helgoländer Meeresunters. 47, 275-285.

Schories, D., 1995. Populationsökologie und Massenentwicklung von *Enteromorpha* spp. (Chlorophyta) im Sylter Wattenmeer. Berichte aus dem Institut für Meereskunde an der Christian-Albrechts-Universität Kiel, Nr. 271, pp. 145.

Schories, D., Albrecht, A. and Lotze, H., 1997. Historical changes and inventory of macroalgae from Königshafen Bay in the northern Wadden Sea. Helgoländer Meeresunters. 5, 321-341.

Schuchardt, B., 1995. Die Veränderung des Tidehubs in den inneren Ästuaren von Eider, Elbe, Weser und Ems. Ein Indikator für die ökologische Verformung der Gewässer. Naturschutz und Landschaftsplanung 27 (6), 211-217.

Schuchardt, B., 1997. Auenrevitalisierung an der Unterweser bei stark anthropogen verändertem Tidehub: Leitbilder und Umsetzungsmöglichkeiten. Bremer Beiträge für Naturkunde und Naturschutz 3, 53-62.

Schuchardt, B. and Schirmer, M., 1991. Phytoplankton maxima in two coastal plain estuaries. Est. Coast. Shelf Sci. 32, 187-206.

Schuchardt, B., Beckmann, M., Knust, R. and Schirmer, M., 1984. Eulitorale Uferstrukturen an der Unterweser. Drosera 84 (2), 83-90.

Schuchardt, B., Busch, D., Schirmer, M. and Schröder, K., 1985. Die aus langfristig geführten Fischereistatistiken rekonstruierbaren Bestandsänderungen der Fischfauna: Ein Indikator für Störungen des Ökosystems. Natur und Landschaft 60 (11), 441-444.

Schuchardt, B., Müller, M. and Schirmer, M., 1989. Veränderungen im Sauerstoff-Haushalt der Unterweser nach der Reduzierung kommunaler und industrieller Einleitungen. DGM 33 (3/4), 98-103.

Schuchardt, B., Haeslopp, U. and Schirmer, M., 1993a. The tidal freshwater reach of the Weser Estuary: riverine or estuarine? Neth. J. Aquatic Ecol. 27 (2-4), 215-226.

Schuchardt, B., Schirmer, M. and Jathe, B., 1993b. Vergleichende Bewertung des ökologischen Zustands der tidebeeinflußten Flußunterläufe Norddeutschlands. Jb. Natursch. Landschaftspfl. 48, 137-152.

Schuchardt, B., Rieger, E.-M. and Schirmer, M., 1995. Untersuchungen zur ökologischen Bedeutung der tideoffenen Bremer Seehäfen: abiotische Parameter und Plankton. DGM 39 (1), 6-10.

Schulz, H., 1961. Qualitative und quantitative Planktonuntersuchungen im Elbe Ästuar. Arch. Hydrobiol. Suppl. 26 (1/2), 5-105.

Schulz, R. and Stock, M., 1991. Kentish plovers and tourists - Conflicts in a highly sensitive but unprotected area in the Wadden Sea National Park of Schleswig-Holstein. Wadden Sea Newsletter 1991-1, 20-24.

Schuster, O., 1952. Die Vareler Rinne im Jadebusen. Abh. Senckenberg. Naturf. Ges. 486, 1-38.

Schwarz, J. and Heidemann, G., 1994. Zum Status der Bestände der Seehund- und Kegelrobbenpopulationen im Wattenmeer. In: Lozán, J.L., Rachor, E., Reise, K., Westernhagen, H. v. and Lenz, W. (Eds.). Warnsignale aus dem Wattenmeer. Blackwell, Berlin, pp. 296 - 303.

Schwarzschild, A.C., Macintyre, W.G., Moore, K.A. and Libelo, E.L., 1994. *Zostera marina* L. growth response to atrazine in root-rhizome and whole plant exposure experiments. J. Exp. Mar. Biol. Ecol. 183, 77-89.

Seed, R. and Suchanek, T.H., 1992. Populationa and community ecology of *Mytilus:* In: Gosling, E.M. (Ed.). The mussel *Mytilus:* Ecology, physiology, genetics and culture. Elsevier Press, Amsterdam, pp. 87-169.

Short, F.T., Muehlstein, L.K. and Porter, D., 1987. Eelgrass wasting disease: cause and reoccurrence of a marine epidemic. Biol. Bull. 173, 557-562.

Siebert, U., 1995. Analyse des Quecksilbergehaltes in Organen von Kleinwalen aus deutschen Gewässern der Nord- und Ostsee und seine möglichen Beziehungen zu Erkrankungs- und Todesursachen. Ph.D. thesis, University Giessen, pp. 130.

Siebert, U., Nannen, M., Reckermann, M., Wünschmann, A., Baumgärtner, W., Rademaker, M. and Colijn, F. Can *Fibrocapsa* kill seals? (in press).

Sival, F. P., 1997. Dune soil acidification threatening rare plant species. PhD Thesis, Univ. Groningen. pp. 150.

Sivebaek, F., Jensen, A.R. and Clausager Rasmussen, P., 1997. Laksefiskene og fiskeriet i Vadehavsomradet. Supplerende rapport, DFU rapport nr-40b-97, ISBN 87-88047-42-3.

Skov, H., Durinck, J., Leopold, M.F. and Offringa, H., 1994. Habitats at sea: "Action preparatory to the establishment of a protected areas network in the southeastern North Sea and the southern Baltic". EU DG XI ACE contract no. 445-45, Final Report, NIOZ Report, Texel.

Skov, H., Durinck, J., Leopold, M.F. and Tasker, M.L., 1995. Important bird areas in the North Sea, including the Channel and the Kattegat. BirdLife International, Cambridge, pp. 156.

Skov, H., Christensen, K.D. and Durinck, J., 1996. Trends in Marine Oil Pollution in Denmark 1984-1995. An analysis of Beached Bird Surveys. Danish Environmental Protection Agency, Working Report No. 75, pp. 62.

Skov, H., Durinck, J., Leopold, M.F. and Offringa, H., 1999. Habitats at sea: Action preparatory to the establishment of a protected areas network in the southeastern North Sea and the southern Baltic. Unpublished EU report.

Smedes, F., 1997. Zand, slib en zeven. Standaardisering van contaminantgehaltes in mariene sedimenten. National Institute for Coastal and Marine Management / RIKZ Report RIKZ-96.043.

Smedes, F., Groen, K., Riesenkamp, W. and Bakker, J.F., 1996. Vergelijking van homogenosatie technieken. (Deelrapport 2 van HCBMON-project "Monitoring hexachloorbenzeen in het Zeehavenkanaal van Delfzijl"), National Institute for Coastal and Marine Management, Report RIKZ/IT-97.607.

Smeenk, C., 1986. Strandingen van cetacea op de Nederlandse kust in 1981, 1982 en 1983. Lutra 29, 268-281.

Smeenk, C., 1989. Strandingen van cetacea op do Nederlandse kust in 1984, 1985 en 1986. Lutra 32,164-180.

Smeenk, C., 1995. Strandingen van cetacea op do Nederlandse kust in 1990, 1991 en 1992. Lutra 38, 90-104.

Smeenk, C., 1992. Strandingen van cetacea op de Nederlandse kust in 1987, 1988 en 1989. Lutra 35, 55-66.

Smeenk, C. and Addink, M.J., 1990. „Massastranding" op de Nederlandse kust: Witsnuitdolfijnen in storm en branding. Zoogdier 1, 5-9.

Smit, C.J. and Piersma, T., 1989. Numbers, mid-winter distribution and migration of wader populations using the East Atlantic Flyway. IWRB Special Publ. 9, 24-63.

Smit, C.J. and Zegers, P.M., 1994. Shorebird counts in the Dutch Wadden Sea, 1980-91: a comparison with the 1965-77 period. Ophelia Suppl. 6, 163-170.

Sommer, U., Schmieder, K.R. and Becker, P.H., 1997. Untersuchung von Seevogeleiern auf chlorierte Pestizide, PCBs und Quecksilber. Bioforum, 20(2), 68-72.

Sonntag, R.P., Benke, H., Siebert, U. and Lick, R., 1996. Investigation of the North Sea off Schleswig-Holstein (FRG) for breeding ground of harbour porpoises (*Phocoena phocoena*). Report SC/48/SM26, Scientific Committee of the IWC.

Sonntag, R.P., Benke, H., Hiby, A.R., Lick, R. and Adelung, D., 1997. Breeding ground of harbour porpoises (*Phocoena phocoena*) in the North Sea off Schleswig-Holstein, Germany, unpublished.

Spiegel, F., 1997. Die Tidebecken des schleswig-holsteinischen Wattenmeeres: Morphologische Strukturen und Anpassungsbedarf bei weiter steigendem Meeresspiegel. FTZ-Büsum 14, pp. 255.

Spratte, S., 1992. Daten zur limnischen Fischfauna im Eidergebiet. Ministerium für Ernährung, Landwirtschaft, Forsten und Fischerei des Landes Schleswig-Holstein und Landessportfischerverband Schleswig-Holstein, Kiel, pp. 137.

Stachel, B. and Lüchow, R., 1996. Entwicklung der Metallgehalte in Sedimenten der Tideelbe, 1979-1994. Arbeitsgemeinschaft für die Reinhaltung der Elbe (ARGE Elbe).

Stade Declaration, 1997. Ministerial Declaration of the Eighth Trilateral Governmental Conference on the Protection of the Wadden Sea. Stade, 1997 (English version). Common Wadden Sea Secretariat, Wilhelmshaven, pp. 100.

Statistisches Bundesamt (Ed.), 1987, 1997. Verkehr, Fachserie 8, Reihe 6. Luftverkehr. Metzler-Poeschel, Stuttgart.

Stede, M., 1994. Zur Todesursache bei Walen der niedersächsischen Nordseeküste. Drosera 1, 7-19.

Steffen, D., 1996. Pflanzenschutzmittel und Nitromoschusverbindungen in ausgewählten niedersächsischen Fließgewässern. In: Niedersächsisches Landesamt für Ökologie (Ed.).Oberirdische Gewässer. Hildesheim.

Sterr, H., 1995. Klimawandel und mögliche Auswirkungen auf die deutsche Nordseeküste. In: SDN (Ed.). Klimaänderung und Küste. SDN-Kolloquium 1995. Schriftenreihe der Schutzgemeinschaft Deutsche Nordseeküste e.V., Heft 1, Varel, pp. 9-30.

Stienen, E.W.M. and Brenninkmeijer, A., 1992. Ecologisch profiel van de visdief (*Sterna hirundo*). RIN-rapport 92/18. DLO-instituut voor Bos- en Natuuronderzoek.

Stock, M., 1993. Salt marshes in Schleswig-Holstein: from a green towards a natural succession. Wadden Sea Newsletter 1993-1, 11-14.

Stock, M., 1994. Auswirkungen von Störreizen auf Ethologie und Ökologie von Vögeln im Wattenmeer. Ph.D. thesis., Univ. Osnabrück, Shaker Verlag, Aachen.

Stock, M., 1997. Salt marsh management in the National Park Schleswig-Holsteinisches Wattenmeer. Wadden Sea Newsletter 1997-1, 11-15.

Stock, M. and F. Hofeditz, 1997. Grenzen der Kompensation: Energiebudgets von Ringelgänsen (*Branta b. bernicla*) - die Wirkung von Störreizen. J. Orn. 138, 387-411.

Stock, M., Hofeditz, F., Mock, K. and Pohl, B., 1995. Einflüsse von Flugbetrieb und Freizeitaktivitäten auf Verhalten und Raumnutzung von Ringelgänsen (*Branta bernicla bernicla*) im Wattenmeer. Corax 16, 63-83.

Stock, M., Schrey, E., Kellermann, A., Gätje, C., Eskildsen, K., Feige, M., Fischer, G., Hartmann, F., Knoke, V., Möller, A., Ruth, M., Thiessen, A. and Vorberg, R., 1996: Ökosystemforschung Wattenmeer Synthesebericht: Grundlagen für einen Nationalparkplan. Schriftenreihe des Nationalparks Schleswig-Holsteinisches Wattenmeer, Heft 8, pp. 784.

Stock, M., Kiehl, K. and Reinke, H.D., 1997. Salt marsh protection in the Schleswig-Holstein Wadden Sea area. Texte 84/97. Umwelbundesamt, Berlin.

Stone, C.J., Webb, A., Barton, C., Ratcliffe, N., Reed, T.C., Tasker, M.L., Camphuysen, C.J. and Pienkowski, M.W., 1995. An atlas of seabird distribution in north-west European waters. Joint Nature Conservation Committee, Peterborough, pp. 326.

Storch, H. von, Guddal, J., Iden, K.A., Jónsson, T., Perlwitz, J., Reistad, M., Ronde, J. de, Schmidt, H. and Zorita, E., 1993. Changing statistics of storms in the North Atlantic? MPI-Report, No 116.

Stralen, M.R. van, 1995. De groei en aanvoer van gekweekte mosselen(*Mytilus edulis*) na 1952 en de ontwikkeling van het kokkelbestand(*Cerastoderme edule*) in relatie tot het voedselaanbod, eutrofiëring enandere milieufactoren in de Waddenzee. RIVO Rapport 95.016, pp. 27.

Stralen, M.R. van, 1998. De ontwikkeling van het mosselbestand in de Waddenzee en Oosterschelde na 1992. RIVO-rapport C.006.98, pp. 31.

Sundbäck, K. and Granéli, W., 1988. Influence of microphytobenthos on the nutrient flux between sediment and water: a laboratory study. Mar. Ecol. Prog. Ser. 43, 63-69.

Swart, R.L. de, Ross, P.S., Vedder, E.J., Timmerman, H.H., Heisterkamp, S.H., Loveren, H. van, Vos, J.G., Reijnders, P.J.H. and Osterhaus, A.D.M.E., 1994. Impairment of immune function in harbour seals (*Phoca vitulina*) feeding on fish from polluted waters. Ambio 23, 155-159.

Swart, J.A.A., Reijnders, P.J.H. and Delden W. van, 1996. Absence of genetic variation in harbour seals (*Phoca vitulina*) in the Dutch Wadden Sea and the British Wash. Conservation Biology 10, 289-293.

Swennen, C., Leopold, F.M. and Stock, M., 1985. Notes on growth and behaviour of the American razor clam *Ensis directus* in the Wadden Sea, and the predation on it by birds. Helgoländer Meeresunters. 39, 255-261.

Tamminga, M., 1997. Monitoring Watersport op de Waddenzee. Resultaten 1996. Provincie Friesland.

Temming, A. and Temming, B., 1992. Economic overfishing and increase offishing effort in the North Sea brown shrimp fishery. ICES Report C.M. K:37, Shellfish Committee, pp. 29.

Temming, A., Damm, U. and Neudecker, T., 1993. Trends in the size composition of commercial catches of brown shrimp (*Crangon crangon* L.) along the German coast. ICES Report C.M. K:53, Shellfish Committee, pp. 14.

Theede, H., 1981. Frostschutz bei Meerestieren. Unterricht Biologie 58, 43.

Theobald, N., Gaul, H., and Ziebarth, U., 1996. Verteilung von organischen Schadstoffen in der Nordsee und angrenzenden Seegebieten. Dt. hydrogr. Z. 6, 81-93.

Theobald, N., Lange, W., Gählert, W. and Remmer, F., 1995. Mass spectrometric investigations of water extracts of the river Elbe for the determination of potential inputs of pollutants into the North Sea. Fresenius J. Anal. Chem. 353, 50-56.

Thiel, R., 1995. Die Fischfauna der Tideelbe - historische Entwicklung, gegenwärtiger Zustand, fischereiliche Perspektive. In: Umweltbehörde Hamburg (Ed.). Situation der Elbe 5 Jahre nach der Wende. pp. 64-71.

Thiele, B., Günther, K. and Schwuger, M. J., 1997. Alkylphenol Ethoxylates:Trace analysis and environmental behavior. Chemical Reviews 97, 3247-3272.

Thiil Nielsen, H., Jensen, A.R., Sivebaek, F., Clausager Rasmussen, P., Dieperink, C., and Ejbye-Ernst, M., 1997. Laksefiskene og fiskeriet i Vadehavsomradet.Teknisk rappport, DFU. rapport nr.40-97, ISBN 87-88047-38-5.

Tiews, K. and Wienbeck, H., 1990. Grundlagenmaterial zu „35-Jahres-Trend (1954-1988) der Häufigkeit von 25 Fisch- und Krebstierbeständen an der deutschen Nordseeküste." Veröff. des Instituts für Küsten- und Binnenfischerei Hamburg, No. 103, pp. 64.

Tiews, K., 1990. 35-Jahres-Trend (1954-1988) der Häufigkeit von 25 Fisch-und Krebstierbeständen an der deutschen Nordseeküste. Arch. Fisch. Wiss. 40, 1/2, 39-48.

Tillmann, U., Mayer-Brinkmann, A. and Egge, B., 1996. Phytoplanktonentwicklung an der Terminstation Büsum-Mole. FTZ-Jahresbericht 1995, 17-19.

Todd, C.D. and Doyle, R.W., 1981. Reproductive strategies of marine benthic invertebrates: a settlement-timing hypothesis. Mar. Ecol. Prog. Ser. 4, 75-83.

Töppe, A., 1993. Longtime cycles in mean tidal levels. Proceedings Int. Workshop Workshop "SEACHANGE ´93": 135-143. BfG, IHP/OHP-Sekretariat, Koblenz.

Tougaard, S., Clausen, B., Jepsen, P. U., Heidemann, G., Schwarz, J., Reijnders, P., Boer, M. den and Vareschi, E., 1994. Statement on Seal Rehabilitation and Release, based on scientific experiences and knowledge. Unpublished.

Trilateral Wadden Sea Plan, 1997. In: Ministerial Declaration of the Eighth Trilateral Governmental Conference on the Protection of the Wadden Sea, Stade, 1997, Annex 1 (English version). Common Wadden Sea Secretariat, Wilhelmshaven, pp. 13-83.

Tubbs, C.R., Tubbs, J.M. and Kirby, J.S., 1992. Dunlin *Calidris alpina alpina* in the Solent, southern England. Biol. Conserv. 60, 15-24.

Tweede Kamer, 1998. Handelingen Tweede Kamer.

Tydeman, P., 1996. An ecological profile of natural, littoral musselbeds. Rikswaterstaat, National Inst. for Coast. and Mar. Man. (RIKZ). Report RIKZ - 96.026 (in Dutch).

UBA, 1996. Wasserbeschaffenheit ausgewählter Fließgewässer in der Bundesrepublik Deutschland, Text 14/96, Umweltbundesamt, Berlin.

Vergeer, L.H.T. and Hartog, C. den, 1994. Omnipresence of *Labyrinthulaceae* in seagrasses. Aquat. Bot. 48, 1-20.

Verity, P.G. and Smetacek, V., 1996. Organism life cycles, predation, and the structure of marine pelagic ecosystems. Mar. Ecol. Prog. Ser. 130, 277-293.

Vetter, W., Luckas, B., Heidemann, G. and Skirnisson, K., 1996. Organochlorine residues in marine mammals from the Northern Hemisphere. A consideration of the composition of organochlorine residues in the blubber of marine mammals. Sci. tot. Environ. 186, 29-39.

Vinther, M., 1995. Incidental catch of the harbour porpoise (*Phocoena phocoena*) in the Danish North Sea gill-net fisheries: preliminary results. In: Andersen, J., Karup, H. and Nielsen, U.B. (Eds.). Proceedings of the Scientific Symposium on the North Sea Quality Status Report 1993, Ebeltoft, 1994. Danish Environmental Protection Agency, Copenhagen, pp. 210-213.

Vogel, S. and Koch, L., 1992. Report on occurrence of grey seals (*Halichoerus grypus* Fabricius 1791) in the Schleswig-Holstein Wadden Sea. Säugetierk. Inform. 3, 449-459.

Voogt, P. de and Lourens, J., 1996. Lot en effecten van bestrijdingsmiddelen in de Noordzee. University of Amsterdam, ordered by the Rijkswaterstaat Tidal Waters Division.

Vooys, C. de, 1990. Expected biological effects of long-term changes in temperatures on marine ecosystems in coastal waters around The Netherlands. In: Beukema, J.J., Wolff, W.J. and Brouns, J.J.W.M. (Eds.). Expected effects of climate change on marine coastal ecosystems. Developments in Hydrobiol. 57, Kluwer Academic Publishers, Dordrecht, pp. 77-82.

Vooys, C. de, 1999. Numbers of larvae and primary plantigrades of the mussel *Mytilus edulis* in the western Dutch Wadden Sea. Neth. J. Sea Res. 41(3), 189 – 201.

Vorberg, R., 1995. On the decrease of sabellarian reefs along the German North Sea coast. Publ. Serv. géol. Lux. 29, 87-93.

Vorberg, R., 1997. Auswirkungen der Garnelenfischerei auf den Meeresboden und die Bodenfauna des Wattenmeeres. Schriftenreihe naturwissenschaftliche Forschungsergebnisse Bd. 54, Verlag Kovac, Hamburg, pp. 1-191.

Vrieling, E.G., Koeman, R., Schon, C., Scheerman, P., Peperzak, L., Veenhuis, M. and Gieskes, W.W.C., 1996. Identification of a domoic acid producing *Pseudonitzschia* species (diatoms) in the Dutch Wadden Sea with E.M. and molecular probes. Eur. J. Phycol. 31, 333-340.

Vroom, M.G., Steyaert, F.H.I.M. and Misdorp, R., 1989. Wadatlas. Rijkswaterstaat, DGSM.

Wader Study Group, 1992. The Flyway Concept. Wader Study Group Bull. 65, 12.

Walsh, G.E., Hansen, D.L. and Lawrence, D.A, 1982. A flow-through system for exposure of seagrass to pollutants. Mar. Environ. Res. 7, 1-11.

Walter, U., 1997. Die Bedeutung der Garnelenfischerei für die Seevögel an der niedersächsischen Küste. Berichte Forschungszentrum Terramare 3, Wilhelmshaven.

Warrick, R.A., Leprovost, C., Meie, M.F., Oerlemans, J. and Woodworth, P.L., 1996. Changes in sea level. In: Houghton, J.J., Meiro Filho, L.G., Callander, B.A., Harris, N., Kattenberg, A. and Maskell, K., (Eds.). Climate Change 1995, the science of climatic changes. Cambridge Univ. Press, Cambridge, pp. 359-405.

Watson, R.T., Zinyowera, M.C. and Moss, R.H. (Eds.), 1996. Climate Change 1995: Impacts, Adaptations and Mitigation of Climate Change: Scientific-Technical Analyses Contribution of Working Group II to the Second Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge, pp. 880.

Wellershaus, S., 1981. Turbidity maximum and mud shoaling in the Weser Estuary. Arch. Hydrobiol. 92(2), 161-198.

Wellershaus, S., 1986. Mud accumulation in estuarine channels a question of dredging? Env. Technol. Lett. 7, 255-262.

Wilde, P.A.W.J. de and Beukema, J.J., 1984. The role of the zoobenthos in the consumption of organic matter in the Dutch Wadden Sea. Neth. Inst. Sea Res. Publ. Ser. 10, 145-148.

Wilson, D.P., 1971. *Sabellaria* colonies at Duckpool, North Cornwall, 1961-1970. J. Mar. Biol. Ass. U.K. 51, 509-580.

Wolff, W.J., 1991. Ecology of the Wadden Sea. In: WWF (Ed.). The common future of the Wadden Sea. Technical report WWF, Husum, pp. 13-22.

Wulffraat, K.J., Smit, T., Groskamp, H. and Vries, A. de, 1993. De belasting van de Noordezee met verontreinigende stoffen 1980-1990. Report DGW-93.037, Tidal Waters Division of Rijkswaterstaat, The Hague.

Zeiss, B. and Kröncke, I., 1997. Macrofauna long-term studies in a subtidal habitat off Norderney (east Frisia, Germany) from 1978-1994. I. The late winter samples. Ocean. Acta 20(1), 311-318.

Zens, M., Michaelis, H., Herlyn, M. and Reetz, M.,1997. Die Miesmuschelbestände der niedersächsischen Watten im Frühjahr 1994. Ber. Forschungsstelle Küste, Norderney 41,141-155.

Zhang, H.Q., 1993. Stabilitätsparameter des Deichvorlandes und deren Beeinflußung durch Bewirtschaftungsverfahren. Mitt. d. Bodenkundige Gesellschaft 72, 297-300.

Zhou, J. L., Fileman, T.W., Evans, S., Donkin, P., Mantoura, R.F.C. and Rowland, S., 1996. Seasonal distribution of dissolved pesticides and polynuclear aromatic hydrocarbons in the Humber estuary and Humber coastal zone. Mar. Poll. Bull. 32, 599-608.

Zijlstra, J.J., 1978. The function of the Wadden Sea for the members of its fish-fauna. In: Dankers, N., Wolff, W.J. and Zijlstra, J.J. (Eds.). Fishes and fisheries of the Wadden Sea. Report 5 of the Final report of the section 'Fishes and fisheries' of the Wadden Sea Working Group. Stichting Veth tot Steun aan Waddenonderzoek, Leiden, p 20-25. Also published in: Wolff, W.J. (Ed). 1983. Ecology of the Wadden Sea, Vol. 2.Balkema, Rotterdam, pp. 20-25.

ZMK, 1996. Jahresstatistik 1996 des Zentralen Meldekopfes Küstenwache Cuxhaven. pp. 16.

Zwarts, L., 1991. Mosselbanken: wadvogels op een kluitje. Vogels 66, 8-12.