6 FISH

The following guidelines on fish monitoring cover selected fish key species and contaminants in fish. Furthermore, the information need from fishery have been compiled in (general fishery parameter).
Additional guidelines on fish communities (demersal and pelagic) will be elaborated in a later phase. In the meantime, the ongoing monitoring programs (e.g. Demersal Young Fish Survey) shall be continued.

6.1 MONITORING OF EELPOUT, FLOUNDER AND PLAICE

This guideline is not part of the Common Package as adopted in Annex 2 of the Stade Declaration.

6.1.1 Objectives

Monitoring the fish species eelpout *Zoarces viviparus*, plaice *Pleuronectes platessa* and flounder *Platichthys flesus* in the Wadden Sea is carried out in order to detect and assess

- the response of natural processes in the ecosystem to changes in pollution levels. The processes concerned here are food chain fluxes and reproduction (including recruitment). There are links with other processes;

- the response of these species to changes in pollution levels which may affect the abundance and physiological functions of species leading to structural changes in the ecosystem.

The fishing activities in the adjacent North Sea may also have significant impact on the abundance and recruitment of eelpout, plaice and flounder.

Eelpout, plaice and flounder were selected as key species, representing different indicator characters with respect to life history patterns and spatial utilization patterns.

6.1.2 Assessment

Changes in the abundance, reproduction or viability of eelpout, plaice and flounder may reflect natural fluctuations (including climate, weather, predation), and/or changes may be caused by nutrient loads and contaminant levels, or by combinations of these factors. The assessment therefore requires the monitoring information on these impacts. Further, the respective ecological targets, as formulated at the 7th Trilateral Governmental Conference (Leeuwarden, November 1994)will serve as assessment criteria.

Targets on tidal areas:
- An increased natural geomorphologically and biologically undisturbed tidal flats and subtidal areas.

6.1.3 Monitoring areas

(to be selected on national level)

6.1.4 Methods

Eelpout, plaice and flounder as keystone species of the Wadden Sea ecosystem are monitored to record changes in their abundance and biomass within a given area in response to changes in the eutrophication and/or contamination levels. Population (age, size) structure, mortality, fecundity and recruitment as well as larval abundance are also considered sensitive for such changes. Fish diseases may indicate the contamination level of the Wadden Sea with micropollutants.

a. Abundance

The abundance of eelpout, plaice and flounder is the number of individuals per unit area. It will be monitored once per year as a minimum in April/May and/or September/October, in accordance with existing time series. Abundance estimates may be calculated by using samples from the demersal young fish survey (DYFS, reference). The sampling gear is the standard 3-m-beam-trawl with 20 mm mesh size. Samples are processed upon catch, i.e. sorted, identified and further treated from fresh samples. The number of samples is chosen according to local conditions such as fish density, habitat diversity, depth gradients etc. using the best available knowledge. Samples should be representative for the fish population in a given area. Sampling should follow the stratified random strategy. Homogeneity of an existing time series has priority over comparability between locations.

b. Biomass

The biomass of eelpout, plaice and flounder in a given area is determined by samples taken for abundance estimates. The biomass of these species is the wet weight per unit area. It may be converted into ash free dry weight by using appropriate conversion factors (reference).

c. Age structure

The age structure of eelpout, plaice and flounder in a given area is determined by samples taken for abundance estimates. The age structure is the number of individuals per age-class over all age classes. Age may be determined 1stly by the Peterson - Method where age-classes are estimated from size classes, i.e. age structure corresponds to size composition and 2ndly by interpretation of the otolith structure. An age-length key (10 otoliths per age group) and a representative length distribution are required to obtain the age structure.

d. Growth

The growth of eelpout, plaice and flounder in a given area is determined by samples taken for abundance estimates. Growth is the average of the annual growth rates of each age-group in a given year.

e. Mortality

The total mortality of eelpout, plaice and flounder in a given area is determined by samples taken for abundance estimates. The total mortality rate (including natural and fishing mortality) for a species per area and year is calculated using the decreasing number per age group (Gulland 1969).

f. Recruitment

The recruitment of eelpout, plaice and flounder in a given area is determined by samples taken for abundance estimates. Recruitment is measured here as the abundance of the youngest age class (or the smallest size class, see c) in a given area. Recruitment is a process which is difficult to record at appropriate scales. Therefore, recruitment data as understood for the present purpose may be complemented by data on the abundance of larvae (see below), and the abundance and quality of food and predators from other parts of the TMAP, if necessary.

g. Fecundity

The fecundity of eelpout, plaice and flounder in a given area is determined by samples taken for abundance estimates. Fecundity is determined as the relative fecundity, i.e. the number of eggs or embryos per weight in grams of the female fish. Weight refers to fresh body weight without gonads, stomach and intestines (eviscerated weight). In eelpout, fecundity refers to the total number of embryos, dead or alive (Thoresson 1993).

h. Maturity

The maturity of eelpout, plaice and flounder in a given area is determined by samples taken for abundance estimates. Maturity is the state of gonad development according to the maturity key used by the International Bottom Trawl Survey IBTS (Anon. 1992).

i. Number of larvae

The number of eelpout, plaice and flounder larvae in a given area is determined by plankton samples. Larval abundance is calculated as numbers per m^3 volume of seawater filtered. Sampling is done using a BONGO plankton net with 0.350 and 0.500 mm mesh sizes in the cod end. Samples are collected by double oblique tows in the water column of the tidal stream in the tidal basin serving as monitoring area. The sampling depth is from near the sea floor to the surface. Tow duration should not exceed 30 minutes. The number of stations and samples is chosen according to local conditions such as larval transport, current velocity, depth gradients etc. using the best available knowledge. Samples should be representative for the larval population in a given area.

In addition, information on the growth and mortality of eelpout fry may be collected according to the guideline by Thoresson (1993) to allow for comparison with the respective eelpout data collected in the Baltic.

k. Pathology (diseases)

Eelpout, plaice and flounder from all samples are inspected visually for external symptoms of fish diseases. Positive records are specified in a protocol and the frequency of disease occurrence may be used for assessment purposes. Disease symptoms are identified according to descriptions by Anders & Möller (1992), and Vethaak (1992).

6.1.5 Quality assurance

Intercalibration campaigns (joint field surveys, joint evaluation and publication of results) at regular intervals.

6.1.6 Reporting requirements

(to be elaborated)

6.1.7 Monitoring authorities

Denmark
- Danmarks Fiskeriundersøgelser

Germany
- Bundesforschungsanstalt für Fischerei

The Netherlands
- Rijksinstituut voor Visserij Onderzoek (RIVO)
- Instituut voor Bos- en Natuuronderzoek (IBN),

6.1.8 References

Anders, K. & H. Möller, 1992: Atlas der Fischkrankheiten im Wattenmeer. Schmidt, Berlin, 112 pp.

Anonymous, 1992: Manual for the International Bottom Trawl Surveys, Revision IV. ICES, C.M. 1992/H 3, Addendum, 47 pp.

Thoresson, G., 1993: Guidelines for coastal monitoring. Fishery biology. Kustrapport 1993 1, Fiskeriverket, Kustlaboratoriet, Öregrund, Sweden, 29pp.

Vethaak, A.D., 1992: Diseases of flounder (*Platichthys flesus*) in the Dutch Wadden Sea and their relation to stress factors. Neth. J. Sea Res., 29 257-272