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FINAL REPORT

Life History and Habitat Use Tables

Subproject 1 - "Nursery Function Westerschelde"
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1 Introduction

Estuaries are known to be important areas for many fish species. The main role estuarine habitats fulfil is offering environments where juvenile fish find shelter from predation and abundant food supplies. Estaurine habitats are therefore considered to be nurseries for many fish species. If juvenile individuals choose to grow within estuaries their migration back to the adult population at sea constitutes export of estuarine production. Fish may thus play a vital role in the ecology of estuaries. Consequently, fish populations have received much attention in estuarine studies.

Many studies are available on how fish use estuarine habitats and what environmental parameters are important in structuring estuarine fish populations. Yet, for estuarine managers much of the available information is too scattered or not presented in a format that is easily accessible or usable. The scientific papers about estuarine fish populations mostly supply general information on the average estuary based on a study performed in a particular system.

Every estuary bears its own characteristics, which distinguishes it from all other estuaries. Generalisations can be made and some research findings may apply to all estuaries but not all are necessarily applicable in others.

Scientists studying fish populations of one estuary will possess a large expertise on the ichthyofauna of their study area. Only they can fully evaluate the local 'truthness' of research results made in other estuaries. Little of that expert knowledge is however publishable.

Considering the former issues, a uniform representation of the knowledge of the fish species occurring in the Westerschelde was not available to date. This document reports on a search for standardised information on life-history and habitat use of 44 species regularly occurring in the Westerschelde estuary. The spreadsheet tables that were produced wish to serve as a *tool in the integrated management of the Westerschelde by RIKZ, allowing accounting for the* fish fauna.

2 Methods

Information was collected from different sources to construct the spreadsheet tables. For each species the scientific literature was searched using 'Biological Abstracts' and 'Current Contents' to track the information needed for both tables. The scientific species' name was used to find articles related to that species. Titles and abstracts of the papers were used to select all papers that potentially contained relevant data or information. Not all papers found were subsequently read since not all journals were readily available. In those cases the abstract was used to extract the necessary.

Secondly, the 'Fishbase' database and the ETI database on the West-Atlantic fishes were consulted. These databases supply a large amount of life-history data and to a lesser amount information on the habitat of the species.

Further data and information were collected from books and reports.

Finally, the internet was searched as an additional source for information.

Based upon the literature searches and the consulted databases and other publications, a reference list has been constructed for each species in order to allow full access to all data. It would have been impractical to give a reference for each cell in all tables. It would have turned tables user-unfriendly. Moreover, The majority of the information was tracked consulting the FishBase database of ICLARM and the ETI database on the Northeast Atlantic fish species. If references were inserted into each cell it would nearly always have referred to both databases. The authors therefore thought it more wise to merely list the references that supplied data on all species, followed by a species specific list of publications that added information not found in the two mentioned databases.

When all of these sources did not supply the information sought expert opinions on the parameter in questions was inserted into the tables. This information is indicated in blue in the excell sheets. Unfortunately, not all parameters for which information was asked could be addressed. For these no information was found in the sources mentioned and no expert opinion could be given.

The 'database' contains information on 44 species. The selection of these species is based on studies made of the fish fauna of the Westerschelde by Cattrijsse (1994) and Hostens et al. (1996).

3 Definitions

There was a clear need to standardise the information found as the different sources supplied it under many formats. In order to focus each of the fields in the tables have been defined and where appropriate codes have been assigned to different values or classes.
The information collected applies to what has been documented in literature and to expert opinion from the authors. It needs mentioning that other experts may hold contradicting opinions on specific matter.

Not all information was inserted into the tables. This report will where necessary supply general information that could not be standardised or will elaborate on certain topics.

All information has been grouped into five different sheets, each containing information on parameters that belong together. The first sheet contains some general information on the species. The second sheet supplies ecological information. The third sheet gathers parameters on the habitat use of the species, while the fourth sheet includes reproductive characteristics. The fifth sheet collects the life history parameters of each species.

3.1 General information

This sheet contains general information on each of the 44 species and includes the scientific names, their common Dutch and English names and their latitudinal distribution.

The economic importance has also been indicated. Fish having an economic importance are those that are subject to a local or regional contemporary fishery as a target species or as bycatch and that are landed. A high economic importance means that the species is a target species, bycatch species have been given low economic importance.
The categories used are thus:

N : no economic importance
L : low economic importance
H : high economic importance

The minimum landing size of the economic species has been listed here as well. This length is defined as the minimum size commercial species may reach when fishermen land them. EC regulations prohibit marketing of fish smaller than the size given here. We could not track such information in the open literature or the information sources used. The information was finally obtained through the Department Sea Fisheries in Oostende. The figures given here are used by the EC for the North Sea area.

The last column of this sheet contains length biomass regression that have been standardised to calculate AshfreeDryWeights (ADW) or Wet Weigths (WW) in grams from total length (TL) or standard length (SL) measurements expressed in millimetres. Where possible a conversion factors has been supplied to estimate the ADW from WW or vice verse and to calculate the SL from TL or vice verse.
Species for which no regression was found, we suggest what species' regression should best be used to obtain a reliable biomass figure. A similar strategy could be adopted to estimate SL/TL from TL/SL measurements using the supplied conversion factors.

3.2 Ecological characteristics

3.2.1 Ecological guild

To group the species into this guild Elliott & Dewailly (1995) have been followed. The ecologcial guild defines the way in which a species uses the estuary as a habitat. Although the authors believe that this classification can be adopted to the species of the Westerschelde estuary, it should be noted that debate about the status of any species is likely to occur. The definition of each of the classes is therefore too less strict. Furthermore, species may adopt other uses in other systems. A classic example is flounder (*Platichthys flesus*) which according to Elliott & Dewailly (1995) is a catadromous species. Yet, it could seem more appropriate to classify the species as an estuarine resident. The spawning migration this species makes to the sea does not fully justify the classification as a catadromous species. The species can be found in very low salinities and even in fresh water, but the highest densities will be found in oligo- and mesohaline reaches of estuaries.

Value	Abbreviation	Definition
Estuarine Resident	ER	The species spends its entire life and breeds within the estuary
Catadromous/ Anadromous	CA	The species uses the estuary as a migration route to or from the spawning grounds in sea or river
Marine Adventitious	MA	The species is fully marine and occurs only accidentally within estuarine habitats
Marine Juvenile	MJ	The species uses the estuary as a nursery and spends only part of or its entire juvenile life within the estuary
Marine Seasonal	MS	The species occurs in the estuary on a seasonal basis

3.2.2 Feeding guild

Again, the classification into feeding guilds has adopted from Elliott & Dewailly (1995) but in a more simple fashion. The classes used here concern the main ecotrophic feeding group a species belongs to. Five different feeding guilds have been identified, given in the table below.

Since most fish species are opportunistic feeders and since feeding changes rapidly with growth, it is in most instances impossible to assign a species exclusively to one class. Therefore, species have been assigned to two or three trophic modes. In those cases the trophic modes have been placed in decreasing order of importance.

Value	Abbreviation	Definition
Detritus	D	The species feeds predominantly on plankton organisms.
Plants	V	Herbivorous fishes
Plankton	P	Planktivorous fishes
Invertebrates	I	Mainly feeding on molluscs, crustaceans, insects,...
Fishes	F	Piscivorous

A major remark that needs to be made here is the ontogenetic changes that occur in each fish species and that would make it necessary to classify lengthclasses (or distinct developmental stages) into the feeding guilds rather than the species. This adds to the complexity of defining structure into the 'feeding composition' of fish fauna.

In general larval and early postlarval fish will feed predominantly on plankton. After "settlement" into the adult habitat, early juvenile and juvenile fish will obviously feed on smaller preyitems than the adults will. Juvenile or sub-adult individuals in turn will, while growing, 'adjust' their diet to the adult one.

3.2.3 Feeding Preference

The feeding preferences for each fish species are listed as follows: blank cells mean that the preygroup is generally not taken by the fish. Important preyitems are indicated with black, less important prey items are indicated with grey. The way the feeding preferences are listed here is however subjective and not well categorised.

The different taxonomic groups show a great deal of overlap. The various sources supplying this type of information do not always describe a diet in a very detailed way. While some sources consider zooplankton as a preyitem, others will distinguish calanoid copepods and other zooplankton organisms as different prey. The same difficulty arises when authors speak about small invertebrates without specifying what preyitems this category eventually includes.

The categorisation into important and less important prey is subjective. Important preyitems are actually those that constitute an important part of the gravimetric and/or the numeric composition of the fish' diet. These data are not always given by the publications dealing with this matter. We therefore opted to check preylists of the various fish species and indicated a preyitem as important when several authors or sources reported it. In most cases however the categorisation into important or less important is an expert judgement.

3.3 Habitat characteristics

3.3.1 Habitat

The habitat is here defined as the environment or place where the species lives. Since the watercolumn, rather than the seabed is here regarded as the fish' habitat only three habitats are considered.
All species lead a planktonic life while being larvae. The habitat considered here is thus the habitat occupied after 'settlement' from the plankton or simply by the adult individuals.

Value	Abbreviation	Definition
Benthic	B	The species lives predominantly on, in strong association with and in dependence off the bottom, feeding almost exclusively on benthos.
Demersal	D	The species lives in association with the bottom, remains in the water layers close above the bottom and forages both on the bottom and in the watercolumn.
Pelagic	P	The species spends its life high up in the watercolumn feeding predominantly on plankton.

3.3.2 Salinity preferences

While some species prefer brackish waters, other will predominantly occur in waters with a higher or lower salinity. Since many species considered here use estuaries as nurseries, their occurrence will be governed by the species' gradual shift in its estuarine distribution over the growing season or during its growth. Younger specimens will generally frequent areas with lower salinities. While growing the young individuals will slowly migrate towards the sea.
The distribution of the species over the different salinity zones of the estuary is here defined as the salinity range over which the species will show its greatest abundance while present in the estuary. The different salinity zone used are :

salinity range (psu)	salinity zone	Abbreviation
0	Freshwater	F
0 - 10	Oligohaline	O
10 - 25	Mesohaline	M
25 - 34	Polyhaline	P

3.3.3 Bottom preferences

This column lists what substratum the fish species prefers. This does not imply fish cannot occur over another substratum than the one listed. It merely indicates over what sediment a fish species will attain its highest abundances or find its preferred fooditems.
Only four categories have been distinguished here.

Substratum	grain size range	Abbrevation
Mud	0 - 62 µm	M
Sand	62 µm - 2mm	S
Gravel	2 - 4mm	G
Rock	> 50mm	R

In case a species may occur over several of these bottom types all are indicated. When the species shows a clear preference for one type but occurs over other as well the former bottom type is separated from the latter types by a dash.

3.3.4 Turbidity preferences

No information on turbidity preferences of the species has been found in literature. Adding expert opinions couldn't lead to reliable figures.

Since estuaries are turbid environments, species using estuarine habitats will be able to cope with suspended solids in the watercolumn. Acute and even chronic tests showed that even clear species are capable of withstanding enormous high loads of suspended materials in the watercolumn (Cattrijsse 1997). Natural concentrations of suspended solids in the watercolumn therefore likely have limited influence on the distribution of estuarine dependent species (ie. estuarine residents, anadromous species and marine seasonal or marine juvenile species). Marine adventitious and freshwater species will likely be more effected in their estuarine distribution by turbidity.

We therefore opted to merely indicate a relative higher (H) and a relative lower (L) effect of turbidity on the distribution of fish species.

3.3.5 Current preferences

No information on current preferences of the species has been found in literature. Adding expert opinion is impossible here

The only exception to the lack of information on this topic was supplied for *Trisopterus luscus* who would congregate close to the bottom and would maintain its position when current speed exceeded 0.3-m s^{-1}. At current speeds smaller than 0.1-m s^{-1} the animals were more dispersed.

This figure could be applied to all demersal fish as an indicative rule of thumb.

3.3.6 Mobility

To describe the mobility of a species both the spatial and the temporal scale have been used here. A distance range given in the table below defines the spatial scale. The temporal scale is represented by only two categories. The home range is used for within habitat made on a tidal or diel basis. The seasonal range indicates the migrations for reproductive purposes or the seaward dispersal/migration of younger individuals while growing.

Value	Abbreviation
Below a few hundred metres	S
Between hundreds of metres and a few kilometres	M
above a few kilometres	L

All the information supplied here is expert opinion based on the general ecology of the species and the information given by the ecological guild.
The distance range is very difficult to quantify. Using clearly defined ranges like 1 to 10 kilometres or below 100 metres was absurd. Although the there is no clear definition as to what distance a species would disperse within his home range or his during seasonal migration, the adoption of this system seemed less vulnerable to criticism. The range over which seasonal migrations take place will in most cases exceed the length of the estuary. Data about the distance a species might travel within his habitat do not exist.

3.3.7 Depth distribution

Giving information on the depth distribution for each yearclass was impossible. Even categorising between juvenile and adult individuals yielded the same information for every species. Younger individuals occur in shallow water while older individuals prefer deeper habitats. The shift towards the deeper parts of the estuary is related to the growth of the animals.
The occurrence in the different depth strata considered here is based on the report of Hostens et al. (1996). The depthstratum where the highest abundances were observed during those beamtrawl surveys were indicated with a higher number of asterics.
The depth strata -3m and -1m were taken on the slope of intertidal sandbanks in the mesohaline part of the estuary. The -1m stratum includes also observations made in the marsh creeks of the eastern part of the estuary.

3.4 Reproductive characteristics

3.4.1 Spawning Period

The spawning period is the period of the year during which the female deposits or releases eggs. The beginning and end period given in the table defines the average first and last month during which eggs of this species have been observed. The peak period is indicated when such information has been found.

3.4.2 Spawning frequency

The number of times a female releases a batch of eggs per season is indicated in this column. Only for a few species such data have been found in literature.

3.4.3 Spawning Aggregation

Fish that form aggregations during spawning activity are indicate in with a Y (Yes). When these aggregations have been reported to be dense a (D) has been added to the Y. Species that surely don't aggregate during spawning activity have been indicated with N (No). For all other species information was lacking.
Only late summer spawners of *Bugglosidium luteum* would aggregate.

3.4.4 Spawning area

The information on the area where the species normally spawns has been given here in text format where possible.

3.4.5 Spawning in the Westerschelde

Whether the Westerschelde estuary is a spawning area for the species is difficult to judge. For most species we believe no spawning activity takes place in the estuary. Hyperbenthos trawls show that fish eggs are present in the Westerschelde. Yet, it cannot be claimed that these originate from local spawning activity.
The species that are most likely to spawn within the estuary have been indicated with a question mark. These are expert judgements since no proof can be given. Yet, the observation of larvae and early postlarvae within the estuary by the hyperbenthic surveys made by the Marine Biology Section are interpreted as an indicative.

3.4.6 Egg type

The classes given here define where the eggs reside after release by the female.

Value	Abbreviation	Definition
Pelagic	P	The eggs remain in the watercolumn.
Benthic	B	The eggs have been deposited on the sediment and remain amongst the sediment particles.
	Bgr	gr refers to gravel
	Bsa	sa refers to sand
Substrate	S	The species deposits the eggs attached to a substrate not on/in the sediment.
Specialised	Sp	The species does not deposit the eggs but exhibits a specialised form of broodcare. This includes two types: nest building and ovovivipary

3.4.7 Broodcare

Some species take care of the eggs after release and/or of the young after hatching. The presence of such behaviour is indicated with a Y (Yes). The male pipefishes keep the eggs and the young within a broodpouch. Eelpout eggs hatch within the mother individual who releases the young after a short growth period.

3.4.8 Size of the eggs

The size of the eggs is here given in mm. For most species a range has been given. For others an average value has been given.

3.4.9 Number of eggs per female

The number supplied here is the average number of eggs a female releases during one spawning activity. The figures given in blue are not the true figures supplied in literature but are estimates. In these cases the literature data referred to the number of eggs per gram female. Using the length at maturity and the length-biomass regression listed in the previous tables the figures needed here were calculated.

3.4.10 Spawning - Hatching Period

The time between the release of the eggs and the hatching of the larvae has been given in number of days. For *Zoarces viviparus*, an ovoviviparous species, both the time of development of the eggs and the larvae have been supplied.

3.5 Life-History characteristics

3.5.1 Maximum size at 0+, 1+, 2+ and 3+

For each of the yearclasses 0+, 1+, 2+ and 3+ the maximum total length (TL) or standard length (SL) of an individual has been given in centimetres.

3.5.2 Maximum length

The maximum length (total length TL or standard length SL) recorded for an individual is supplied here in centimetres. Data for males are preceded with m, data for females are preceded with f.

3.5.3 Length at maturity

The average length (total length TL or standard length SL) an individual attains reaching maturity given in centimetres. Data for males are preceded with m, data for females are preceded with f.

3.5.4 Age at maturity

The average ageclass an individual attains reaching maturity given in years. For gobies the age has been supplied in months. Data for males are preceded with m, data for females are preceded with f.

3.5.5 Mortality 0+ Westerschelde

The mortality figures (Z coefficients) supplied by Welleman et al. (2000) have been entered here in the table. All other information was too scarce and too various in formats that standardisation was simply impossible. Since the data supplied here have been estimated from 15 years of surveys, no better estimates than these can be given. Yet, some mortality figures in that report were still negative. These were therefore not listed here since negative mortality coefficients mean an increase in abundance. The figures supplied here apply to the time span of seven months between spring and autumn.

3.5.6 0+ Average mortality Dutch coast

Apart from mortality estimates for the Westerschelde estuary, Welleman et al. (2000) also supply mortality coefficients for other coastal areas. The average mortality figures for all other Dutch coastal areas have been listed here to allow further judgement of the mortality rate of the fish species considered.

3.5.7 Length at recruitment to fisheries

This length was defined as the length at which species become vulnerable to fisheries, ie. When the mrtality of the species increases significantly due to fishing activities. No such figures were found in the open literature or the information sources used. This column has not been supplied but was replaced by the data on the minimum landing size given in the sheet containing the general information on the species

4 Discussion

4.1 The role of estuarine habitats for fish

When evaluating fish habitat use in estuaries consideration can be given to four different functions that estuarine habitats may fulfil for fish (Elliott in press.) Habitats can serve as spawning grounds, nursery areas, feeding grounds and as pathways in diadromous migrations. A further use of habitats as refugia can be included although this is less straightforward.

A complete and detailed analysis of the use of the estuarine habitats by fish has been supplied by Hostens et al. (1996).

4 1.1 Spawning

The presence of gravid individuals and of high abundances of eggs and early larvae indicates whether spawning takes place within an estuary. Sediment characteristics, currents, depths, vegetation, etc. all determine the suitability of a habitat for fish to spawn. Only a few species spawn for sure occurs in the Westerschelde. 'Pregnant' male pipefish *Syngnathus rostellatus* have been observed regularly and very high densities of early larvae of the common goby *Pomatoschistus microps* are known to occur in the marsh creeks in summer (Cattrijsse 1994). Male pipefsh receive the eggs from female and fertilisation occurs in the male broodpouch so spawning in the estuary is almost certain. The common goby is known to breed in intertidal areas of estuaries. Given the enormous abundance of early larvae in the intertidals of the Westerschelde, this species almost certainly spawns in the estuary although nests have never been observed.
The same could be said for the sand goby (*P. minutus*) although the recorded abundances of these larvae have never been so high as for the common goby (Hostens et al. 1996).
Eelpout (*Zoarces viviparous*) is an estuarine resident and quite common in the Westerschelde. We may accept that this species spawns in the estuary. During one sampling campaign a gravid female eelpout was recorded by our team. Unfortunately no other information is available for this species (Hostens et al. 1996).
A complete lack on data on the presence of fish eggs or early larvae in the Westerschelde estuary actually does not allow for giving any reliable information unless for the above mentioned species. One would normally only expect the estuarine resident species to spawn within the limits of the estuary, but some species could find suitable habitats in the mouth of the Westerschelde. As long as no thorough egg and larvae survey have been made, the spawning activity in the Westerschelde will remain uncertain.

4.1.2 Nursery

A nursery could be defined as a habitat or area where juveniles aggregate, spatially or temporally separated from the adults, and where their survival is enhanced by better feeding conditions, optimal growth and/or refuge opportunities (Elliott , in press.)
It is difficult to define a habitat as a refuge even though its understanding is easy and mostly seen as a refuge from predation. It is not possible to quantify the refuge value in the field. Fish *may feed in the same habitat. Also adults may seek predation refuge and still feed in other* areas than their juveniles. Therefore the refuge functioning is best seen as an integral part of the nursery function.

For all estuarine residents, marine juveniles and diadromous species the estuary will function as a nursery. Which habitats function as nurseries depends on the species and on the life stage of the individuals. Generally the more shallow a habitat is, the younger the individuals will be in that habitat. While growing the fish will gradually occupy deeper habitats and at the same time they will move to areas with higher salinities. Estuarine residents will not necessarily start to migrate to sea while growing.
The Westerschelde has only two important nurseries: the marsh creeks and the intertidal flats. Both habitats are only accessible at medium to higher water levels. During the lowest waterheights the juveniles retreat into the shallow subtidal.
Marsh creeks are important nursery areas for early postlarval flounder (*Platichthys flesus*) common goby (*Pomatoschistus microps*) and seabass (*Dicentrarchus labrax*). Also the mullet species (*Chelon labrosus* and *Liza ramada*) occur in high numbers in those creeks. After a

short stay in those creeks these species move to the intertidal flats where they join the juveniles of flounder, dab (*Limanda limanda*) and plaice(*pleuronectes platessa*) and the other goby species *P. minutus* and *P.lozanoi.* Juveniles of *Clupea harengus* and *sprattus sprattus* occur as well in huge numbers around those tidal flats. For a detailed description of what species occur in what area of the Westerschelde and whether the Westerschelde is to be considered a nursery for those species, we refer to Hostens et al. (1996) who describe it all in the greatest detail.

Factors controlling the value of a nursery area are abundance of food, water depth and turbidity. Food abundance in the marsh creeks and the intertidal as a whole is high enough to qualify them as important nursery areas. No data are available on the relationship between food abundance and densities of juvenile fish in the mentioned habitats. Comparing the different areas in the Westerschelde amongst eachother or with other areas in the Delta or sea is therefore impossible.

Waterdepth may determine growth potential since shallow water may be warmer and also govern predation pressure since larger fish stay in deeper water. Yet, abundance data of different sizeclasses in different depth ranges remain little informative. While large fish are predominantly present in the subtidal they're not absent in the intertidal. Many species use the intertidal as feeding ground. Likewise, higher densities of small sized fish in the intertidal do not exclude their presence in the deeper habitats. During winter the differences in depth distribution between size classes are generally less pronounced. This general trend in size distribution can be a result of a lowered predation pressure on smaller fish, but that is difficult to measure.

Turbidity is also very important in lowering predation pressure and therefor a determining factor on the nursery value of any given habitat. No information on turbidity preferences on any of the species has been found. The same is true for currents. It likely has an influence on the nursery value of a habitat but no data are available.

Initially the habitat use table was to be broken down for both the adult and the juvenile stages. Following the above and the general ecological information, distinguishing the habitat use by adults and juveniles is a bit absurd.

Whether a species is pelagic, demersal or benthic the juveniles and the adults occupy the same waterlayer.

Salinity preferences are not important for estuarine residents since all individuals of these species normally are euryhaline and therefore occur abundantly throughout the estuary. Marine adventitious species, both adult and juvenile will remain in the polyhaline zone since they are true marine species. Marine juvenile species will concentrate in the brackish zone and gradually move seaward while growing. Also the juvenile anadromous species will gradually migrate to sea. The definition of these two ecological guilds excludes the presence of adults inside the estuary except for the gravid diadromous species who migrate to their spawning grounds. For these species the general rule of thumb applies that younger juvenile individuals will on average concentrate in lower salinities than the older juvenile individuals. Adult diadromous species, on their way to the spawning grounds, can be found in all salinity zones of the estuary. Marine seasonal species use the estuary on a seasonal basis rather than on an age basis and both juveniles and adults will concentrate in the same salinity zone(s).

The bottom preferences for both juvenile and adult individuals are thought to be similar for the species considered.

Since the information supplied for turbidity preferences and mobility are largely based on the general ecology of the species and the authors merely report their expert viewpoint, breaking down the tables for adults and juveniles would have resulted in twice the same table.
The information on depth distribution is based on the occurrence/abundance of the species rather than the size classes. Splitting this information for the adults and the juveniles would only for a number of species result in different information.
As explained, adults of marine juvenile species are in general absent in the estuary. Also diadromous species are largely represented by juvenile individuals, the adults are only passing through and their occurrence in any depth stratum is of minor importance. Marine adventitious species only occur accidentally and the information for these species is in many cases too scattered to allow the distinguishment between the depth distribution of both adults and juveniles. Consequently only for marine seasonal species and estuarine resident species the columns for depth distribution could be doubled for the adult and juvenile lifestages. Yet, our knowledge on depth distribution is not detailed enough. Trying to make such a table for both lifestages would have resulted in the construction of two opposite tables. Adult individuals being more abundant in the deeper parts and in contrast the juveniles reaching higher densities in the shallow habitats.

4.1.3 Feeding

Estuaries are highly productive systems and thus supply large amounts of food for adult and juvenile fish. Since the feeding of the juveniles is included in the definition of nursery, feeding here is defined as feeding of adult individuals. Elliott (in press.) demonstrated that this utilisation of estuarine habitats is by far the most important of the four usage's considered.

4.1.4 Diadromous migration

Anadromous and catadromous species will use estuarine habitats as pathways during their spawning migration. The Westerschelde does no longer allow for successful migration by diadromous species except maybe for the eel (*Anguilla anguilla*). It is a well known fact that the presence of the other diadromous species is largely negatively influenced by the water quality, a free passage to the potential riverine spawning grounds and the loss of spawning habitats. Consequently any individual of any anadromous species occurring in the Westerschelde is likely a 'strayer' ie. an individual that did not return to the river where it was born, but that is possibly in search of good spawning grounds.

4.2 Seasonal variations in habitat use

Seasonal variation in habitat use is related to growth and to water temperature changes. Creating a habitat use table for each season would be based upon this general information. This leads to a similar situation as explained above for differences in habitat use by juveniles and adults. Splitting the tables for documenting seasonal changes in habitat use would only be based upon the basic information given here.
Marine adventitious species are believed not to select estuarine habitats and surely not on a seasonal basis. For marine seasonal species no seasonal changes in habitat use can be documented apart from the fact that they prefer estuarine habitats during the season of their estuarine occurrence. Adult diadromous species use the estuary in spring for migrating to

their riverine spawning grounds and are merely passing by, not selecting habitats. Their juveniles occur in the estuary year round and occupy different habitats (depths) according to their size. Marine juvenile species and juvenile estuarine residents follow the same patterns. The difficulty in placing this information into a table format has been explained above. As juveniles grow they occupy deeper areas. Since their growth does not end within one season, seasonal changes in habitat use co-occur with changes in habitat use between younger and older individuals.

When changes occur in habitat use by adults then these are mostly governed by temperature changes. Spawning activity may trigger migration of adults and thus their occurrence in other habitats. Since information on spawning is completely lacking in the Westerschelde, this does not help us very much in constructing 'seasonal habitat use' tables. Since, only resident species are believed to spawn in the estuary proper extra information could be obtained here. Spawning migrations by estuarine residents could be indicated by their seasonal occurrence in different habitats. Only for a limited number of species this knowledge could be added to the tables. For the common goby *Pomatioschistus microps* and the sand goby *P. minutus* this has been documented. Their occurrence drops in the shallow areas in winter and increases again after spring. Information on the other estuarine is too scarce to allow for separating the information on seasonal changes in habitat use (Hostens et al. 1996).

This phenomenon is generally known for other species. When temperature drops during autumn and winter species prefer to occur in deeper habitats to avoid too cold environments. This also applies both to the adults as to the juveniles.

4.3 Life history data

As mentioned for the habitat use tables, information on spawning activity in the Westerschelde is lacking. Even though only the true estuarine species are potential candidates to spawn inside the estuary, no certainty can be given. The data given on spawning begin and end periods are taken from literature and not necessarily similar to the possible situation in the Westerschelde.

The other information on reproduction can most probably, if not with certainty, be applied to the Westerschelde.

Except for the mortality estimates, data on the life history parameters, though taken from literature, are fully applicable to the Westerschelde situation. For a full interpretation of the mortality figures we refer to Welleman et al. (2000).

Information on the length/age at recruitment to fisheries has however not been found. Although the nature of such figures seems straightforward, the type of the fisheries will greatly determine the values. Gear used, meshsize and hp will have a profound effect on the fishing efficiency of smaller or larger individuals. Fishing regulations though limit the minimum size of the fish landed but these figures do not indicate at what size a species becomes vulnerable to fishing mortality. Therefore it seemed better to list the minimum landing size of the economic important species.

4.4 Gaps in knowledge

A simple look at the tables and the above discussion quickly identify the gaps in the knowledge on the biology and ecology of the fish of the Westerschelde. The main issues are:

1. The spawning activity in Westerschelde is not described. There are no data on the occurrence of eggs or larvae in Westerschelde and it is therefore completely unclear what species spawn where, where eggs/larvae concentrate in the estuary and during what periods of the year.

2. What is the mobility of the species? The gradual seaward migration patterns of juvenile fish like seabass, dab, sole and others are fully undocumented. For most of these species their occurrence in the estuary cannot fully be related to their age or size. Eg. how long do juvenile seabass remain in the estuary?

3. The influence of (changing) geomorphology on the nursery value of a habitat is unknown. The effect of currents, turbidity or sediment composition on the value of any habitat could aid in evaluating the importance of the different areas in the Westerschelde. Additional to such evaluations the carrying capacity of the important habitats need to be studied.

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ADDENDUM : Print outs of the Excell sheets

Species	Dutch Name	English Name	Latitudinal distribution	Geographical range	Economic importance	Minimum Landing size (TL -cm)	Length mm/Biomass g Regression(s)
Alosa fallax	fint	twaite shad	temperate	70 - 27 N	L		use herring ln WW= -13 19+3 233 ln TL
Atherina presbyter	koornaarvis	sand smelt		60 - 15 N	N		ln WW= -12 478+3 103 ln TL
Clupea harengus	haring	herring	temperate	80 - 34 N	H		ln WW= -13 19+3 233 ln TL
Engraulis encrasicolus	ansjovis	ansjovis	subtropical	62 N - 19S	L		ln WW= -13 55+3 356 ln TL
Trachurus trachurus	horsmakreel	horsmackerel	subtropical		L		ln WW= -11 443+2 955 ln TL
Sprattus sprattus	sprot	sprat	temperate	69 - 30 N	H		ln WW= -13 55+3 356 ln TL
Chelon labrosus	diklipharder	thicklipped mullet	subtropical	70 - 10 N	N		use Liza ramada
Liza ramada	dunlipharder	thinlipped mullet	temperate	60 - 15 N	N		ln WW= -11 749+3 061 ln TL
Belone belone	geep	garfish	temperate		L		ln WW= -13 701+3 020 ln TL
Salmo salar	atlantische zalm	atlantic salmon	temperate	68 - 35 N	H		use seabass ln WW= -11 749+3 061 ln TL
Salmo trutta	forel	trout	temperate	68 - 25 N	H		use seabass. ln WW= -11.749+3 061 ln TL
Lampetra fluviatilis	rivierprik	river lamprey	temperate	66 - 37 N	L		ln WW=-15 245+3.326 ln TL
Osmerus eperlanus	spiering	smelt	temperate	70 - 38 N	L		use thicklipped mullet
Anguilla anguilla	paling	eel	temperate	70 - 25 N	H		ln WW=-15 245+3 326 ln TL
Syngnathus acus	kleine zeenaald	lesser pipefish	subtropical		N		ln WW= -16 651+3 80 ln TL
Syngnathus rostellatus	grote zeenaald	greater pipefish	temperate		N		ln WW= -18 036+3 652 lnTL, SL= 0 95 TL
Ammodytes lanceolatus	smelt	great sandeel	temperate		N		use sand eel
Ammodytes tobianus	zandspiering	sand eel	temperate	70 - 35 N	N		lnWW= -14 72+3 389 ln TL, TL= 2 354+1 078 SL, ln ADW= -16 122+3 491 ln SL, ln ADW= -16 737
Callionymus lyra	pitvis	dragonet	temperate	70 - 15 N	N		lnWW= -10 465+2 724 lnTL
Callionymus reticulatus	rasterpitvis	reticulated dragonet	temperate	60 - 35 N	N		use dragonet
Raniceps raninus	vorskwab	tadpole fish	temperate	68 - 44 N	N		use whiting ln ADW=(-13 35+3 066 ln SL)
Trigla lucerna	rode poon	red gurnard	subtropical		H		ln WW= -13 102+3 289 ln TL
Echiichthys vipera	kleine pieterman	lesser weever	subtropical		N		ln WW= -4 51+3 02 lnTL, ADW= WW/4 4
Agonus cataphractus	harnasmannetje	hooknose	temperate		N		ln WW= -11 911+3.023 lnTL
Liparis liparis	slakdolf	seasnail	temperate		N		ln WW= -11 416+3.088 ln TL
Pholis gunnellus	botervis	rock gunnel	polar		N		ln WW=-15.501+3.590 ln TL
Myoxocephalus scorpius	zeedonderpad	shorthorn sculpin	polar		N		ln WW=-11.983+3 148 ln TL
Pomatoschistus lozanoi	lozano's grondel	lozanoi's goby	temperate		N		ln ADW= (-7 842+3 448 ln SL)/1000, SL= -1 26+0 864 TL
Pomatoschistus microps	brakwatergrondel	common goby	temperate		N		ln ADW= (-7 851+3 46 ln SL)/1000, ln WW= -11 404+2 931 ln TL
Pomatoschistus minutus	dikkopje	sand goby	temperate	50 - 30 N	N		ln ADW= (-7 851+3 46 ln SL)/1000 , ln WW= -13 44+3 404 ln TL, SL= -1 26+0 864 TL
Zoarces viviparus	puitaal	eelpout	temperate		N		lnWW= -13.1+3 167 lnTL
Buglossidium luteum	dwergtong	solenette	subtropical		N		use sole ln WW= -13 097+3 262 lnTL
Limanda limanda	schar	dab	temperate		H		ln WW= -12 33+3 161 lnTL, TL= -0 523+0 123 SL
Platichthys flesus	bot	flounder	polar	60 - 30 N	N		ln WW=-11 051+2 926 ln TL
Pleuronectes platessa	schol	plaice	polar	90 - 20 N	H		ln ADW= (-6 42747+3 0855524 ln SL)/1000 , ln WW= -11 69+3 033 ln TL, TL= 0 72+0 122 SL
Scophthalmus rhombus	griet	brill	temperate	64 - 30 N	H		ln WW= -12 374+3.212 lnTL
Solea lascaris	franse tong	sand sole	subtropical	57 N - 32 S	H		use sole ln WW= -13 097+3 262 lnTL
Solea solea	tong	sole	subtropical	65 - 10 N	H		ln WW= -13.097+3 262 lnTL , TL=2 209+0 112 ln SL
Dicentrarchus labrax	zeebaars	seabass	temperate	30 - 55 N	H		ln WW= -11 749+3 061 ln TL
Ciliata mustela	vijfdradige meun	five bearded rockling	temperate	70 - 38 N	N		use whiting ln ADW=(-13 35+3 066 ln SL)
Gadus morhua	kabeljauw	cod	temperate	78 - 35 N	H		ln WW= -12 326+3 139 ln TL, TL= 0 07+1 099 SL
Gasterosteus aculeatus	driedoornige stekelbaars	three-spined stickleback	temperate	71 - 20 N	N		ln WW=-11 359+2 938 ln TL
Merlangius merlangus	wijting	whiting	temperate	72 - 35 N	H		ln ADW=(-13 35+3.066 ln SL), TL= 1 157+1 084 SL
Trisopterus luscus	steenbolk	bib	temperate	62 - 25 N	H		ln ADW= (-14 1+3 293 ln SL), TL= 2 35+1 102 SL

Species	Ecological guild	Feeding Guild
Alosa fallax	CA	P - F
Atherina presbyter	MJ	I - F
Clupea harengus	MJ	P - I - F
Engraulis encrasicolus	MS	P
Trachurus trachurus	MA	I - F
Sprattus sprattus	MS	P
Chelon labrosus	MS	P - I - D
Liza ramada	CA	P - I - D - V
Belone belone	MS	I - F
Salmo salar	CA	I - F
Salmo trutta	CA	I - F
Lampetra fluviatilis	CA	F
Osmerus eperlanus	CA	I - F
Anguilla anguilla	CA	P - I - F
Syngnathus acus	ER	I - F
Syngnathus rostellatus	ER	I
Ammodytes lanceolatus	MA	P - F
Ammodytes tobianus	ER	P
Callionymus lyra	MA	I
Callionymus reticulatus	MA	I
Raniceps raninus	ER	I - F
Trigla lucerna	MJ	I - F
Echiichthys vipera	MA	F
Agonus cataphractus	ER	I
Liparis liparis	ER	I - F
Pholis gunnellus	ER	I
Myoxocephalus scorpius	ER	I - F
Pomatoschistus lozanoi	MA	I
Pomatoschistus microps	ER	I
Pomatoschistus minutus	ER	I
Zoarces viviparus	ER	I
Buglossidium luteum	MA	I
Limanda limanda	MJ	I - F
Platichthys flesus	CA	I - F
Pleuronectes platessa	MJ	I
Scophthalmus rhombus	MJ	I - F
Solea lascaris	MA	I
Solea solea	MJ	I
Dicentrarchus labrax	MJ	P - I - F
Ciliata mustela	MS	V - I - F
Gadus morhua	MJ	I - F
Gasterosteus aculeatus	CA	I - F
Merlangius merlangus	MJ	I - F
Trisopterus luscus	MJ	I - F

Habitat Use

Species	Ecological guild	Habitat	Salinity Preferences	Bottom Preferences	Turbidity Preferences	Current Preferences	Mobility		Depth Distribution		
							Home range	Seasonal	subtidal	-3m	-1m
Alosa fallax	CA	P	F - P		L			L	*		
Atherina presbyter	MJ	P	O - M		L			L	***	**	*
Clupea harengus	MJ	P	O - P		L		M	L	***	*	**
Engraulis encrasicolus	MS	P	O - P		L		M	L	***	**	*
Trachurus trachurus	MA	D	P	S	H	< 0 3 m/s		L	**	*	
Sprattus sprattus	MS	P	O - P		L		M	L	***	*	**
Chelon labrosus	MS	D	O - P	R	L	< 0 3 m/s		L			*
Liza ramada	CA	P	O - P		L			L			*
Belone belone	MS	P	P		L			L	*		
Salmo salar	CA	P	F - P		L			L			
Salmo trutta	CA	P	F - P		L			L			
Lampetra fluviatilis	CA	B	F - P	MSG	L			L	**	*	
Osmerus eperlanus	CA	P	F - P		L			L			
Anguilla anguilla	CA	B	F - P	MSG	L			L	*	*	**
Syngnathus acus	ER	B	M - P	MSG	L		S	M	*		
Syngnathus rostellatus	ER	B	M - P	S	L		S	M	***	**	*
Ammodytes lanceolatus	MA	B	P	S	H		M	L	*	*	
Ammodytes tobianus	ER	B	M - P	S	L		M	M	***	**	*
Callionymus lyra	MA	B	P	MSG	H		M	L	*		
Callionymus reticulatus	MA	B	P	S	H		M	L	*		
Raniceps raninus	ER	B	M - P	R (+seaweeds)	L						
Trigla lucerna	MJ	B	P	MSG	L		M	L	*	*	
Echiichthys vipera	MA	B	P	S	H		S	L	**	*	
Agonus cataphractus	ER	B	M - P	S	L		M	M	**	*	
Liparis liparis	ER	B	M - P	MSGR	L		M	M	**	*	
Pholis gunnellus	ER	B	M - P	MSGR	L		S	M	**		*
Myoxocephalus scorpius	ER	B	M - P	R	L		M	M	**	*	
Pomatoschistus lozanoi	MA	B	P	S	H		S	L	**	**	*
Pomatoschistus microps	ER	B	O - P	M	L		S	M	*	**	***
Pomatoschistus minutus	ER	B	M - P	S	L		S	M	**	**	*
Zoarces viviparus	ER	B	M - P	R - MSG	L		S	M	***	**	*
Buglossidium luteum	MA	B	P	S	H			L	*		
Limanda limanda	MJ	B	M - P	S	L		M	L	**	*	
Platichthys flesus	CA	B	F - P	MSG	L		M	L	***	**	*
Pleuronectes platessa	MJ	B	M - P	MSG	L		M	L	***	**	*
Scophthalmus rhombus	MJ	B	P	MSG	L		L	L	*		
Solea lascaris	MA	B	P	MSG	H			L	*		
Solea solea	MJ	B	M - P	MSG	L		M	L	***	**	*
Dicentrarchus labrax	MJ	D	O - P	MSGR	L	< 0 3 m/s	M	L	*	**	***
Ciliata mustela	MS	B	M - P	R - MSG	L		M	M	*		
Gadus morhua	MJ	D	P	MSG	L	< 0 3 m/s	L	L	*	*	
Gasterosteus aculeatus	CA	P	F - P		L		M	M	*	*	*
Merlangius merlangus	MJ	D	M - P	MSGR	L	< 0.3 m/s	L	L	*	*	
Trisopterus luscus	MJ	D	M - P	MSGR	L	< 0 3 m/s	L	L	*	*	

Species	Spawning period Begin	Spawning period End	Spawning period Peak	Spawning Frequency	Spawning Aggregation	Spawning Area	Spawning Area Westerschelde	Egg Type	Broodcare	Eggsize (mm)	Number eggs per female	Spawning-hatching period (days)
Alosa fallax	May	July			Y	Tidal parts of rivers in s	N	B sa B gr	No		64	4 - 8
Atherina presbyter	June	July		5 - 10	Y	Marine, inshore	N	S	No	1 65 - 1 9	36-637	15 - 16
Clupea harengus	March	April		1	Y (D)	Bays inshore waters or	N	B gr	No	0 9 - 1 6	220 - 240	6 - 15
Engraulis encrasicolus	April	November	July-August		Y (D)	inshore	N	P	No	0 5 - 1 9		1 - 3
Trachurus trachurus	May	June		Multiple	Y (D)	Inshore waters of Belgiu	N	P	No	0 76 - 1.04	1655	3 - 4
Sprattus sprattus	January	December	June-August	Variable	Y	near the coast or up to 1	N	P	No	0 8 - 1 5	100 - 400	2
Chelon labrosus	April	May				No recorded spawning i	N	P	No	1 3	275 - 465	
Liza ramada	August	October		1		No recorded spawning i	N	P	No		275 - 465	
Belone belone	May	June				Inshore shallow areas of	N	B - S	No	2 8 - 3 5	136	14 - 21
Salmo salar	June	November		Once a lifetime		Cold, clear brooks in 0 5	N	Sp (Nest)	No		3- 10	
Salmo trutta	June	November		Once a lifetime		River beds	N	Sp (Nest)	No	4.0 - 5.0	1-3	28-140
Lampetra fluviatilis	April	May		Once a lifetime		River beds	N	Sp (Nest)	No	1	230 - 400	15
Osmerus eperlanus	February	March			Y	Lower reaches of stream	N	B	No	0 6 - 1 3		35
Anguilla anguilla	January	January			N	Western Atlantic - Sarg	N	P	No	0 9 - 1 4		
Syngnathus acus	May	July					Yes	Sp (ovovivipary)	Male broodpouch			
Syngnathus rostellatus	June	August					N	Sp (ovovivipary)	Male broodpouch	1		
Ammodytes lanceolatus	March	October				Inshore, including the int	N	B	No			
Ammodytes tobianus	February - September	April - November					N	B sa, B gr	No	0 7 - 1.0		
Callionymus lyra	April	August					N	P	No	0 7 - 1.0		
Callionymus reticulatus	March	June					N	P	No	0 7 - 0 9		
Raniceps raninus	May	September			N	Nearshore 50-70m	N	P	No	0 7 - 0 9		
Trigla lucerna	May	July				Marine, at least 20-30 m	N	P	No	1 1 - 1 7		
Echiichthys vipera	March	August	June July			Southern North Sea	N	P	No	1 0 - 1 4		9 - 10
Agonus cataphractus	February	May					N	S	No	1 7 - 2 3	50-78	280 - 336
Liparis liparis	February	March		Once a lifetime	Y	Fully marine conditions	N	S	No	1.4 - 1 7		35 - 56
Pholis gunnellus	November	March					N	B	Yes	1 7 - 2 2		56 - 70
Myoxocephalus scorpius	November	February				Intertidal areas or below	N	B	Yes	1 8 - 2 5		35
Pomatoschistus lozanoi	May	August				Offshore	N	B	Yes			
Pomatoschistus microps	April	August		Up to 10	N	Offshore to inshore	Yes	S	Yes	0.7 - 0 8	3583-28667	10 - 15
Pomatoschistus minutus	March	July		Variable	N	Inshore and shallow wat	Yes	S	Yes	0 9 - 1 4	345-895	7 - 14
Zoarces viviparus	August	September					?	no free eggs	Ovovivipary			Eggs 30 - Larvae 150
Buglossidium luteum	July	August			late summer spawners	Southern North Sea	N	P	No	0.6 - 1 0		
Limanda limanda	March	June				Offshore	N	P	No	0 7 - 1 2	3300	3 - 12
Platichthys flesus	January	April				Coasts of Belgium, Neth	N	P	No	0.8 - 1.1		7
Pleuronectes platessa	December	March				Shallow inshore waters	N	P	No	1 7 - 2.2	220 - 265	22
Scophthalmus rhombus	April	August					N	B	No	1.2 - 1 5		
Solea lascaris	June	September					N	P	No	1 3 - 1.4		
Solea solea	April	August				Shallow coastal waters a	N	P	No	1 0 - 1.6		5 - 10
Dicentrarchus labrax	January	June			Y	English Channel	N	P	No	1 1 - 1 5	200 - 600	3 - 5
Ciliata mustela	February	May					N	P	No	0 7 - 1 0		6
Gadus morhua	February	April			Y	Inshore or on offshore b	N	P	No	1 2 - 2 0	500	10 - 30
Gasterosteus aculeatus	March	July				Mainly in fresh water, als	N	Sp (Nest)	Yes	1 1 - 1 9		
Merlangius merlangus	January	July		Variable		North sea	N	P	No	1.0 - 1 3	1700	12 - 15
Trisopterus luscus	January	May				Inshore 50 m or less	N	P	No	0 9 - 1 2		10 - 12

Species	Size 0+ cm	Size 1+ cm	Size 2+ cm	Size 3+ cm	Maximum Length cm	Length at Maturity cm	Age at Maturity cm	Mortality Z coeff 0+ Westerschelde	0+ average
Alosa fallax	6-8 SL	9-14 SL	25-30 SL	40-50 SL	60 TL	40 SL	3-4		0 68
Atherina presbyter	7 TL	10 TL	12 TL	12-13 TL	21 TL	12 TL			
Clupea harengus	5-6 SL	8-10 SL	14-15 SL	18-20 SL	56 TL	12-15 TL	2-3	0 44	0 30
Engraulis encrasicolus	11 TL		12-18 SL	9-12 SL	20 SL	11 TL	1		
Trachurus trachurus	4-9 TL	5-12 TL	15-20 TL	20-50 TL	70 TL	21 TL	2 5		
Sprattus sprattus	5 SL	7-12 SL	10-12 SL	12-16 SL	16 SL	8-11 SL	2-3	0 20	0 20
Chelon labrosus	5 SL	5-12 SL	12-20 SL	20-45 SL	55 SL	25-30 SL	m9, f11		
Liza ramada	8 SL	8-12 SL	12-18 SL	18- 40 SL	70 TL	25 TL	3-4		
Belone belone		12-15 SL	62 SL		90 SL				
Salmo salar	15 TL	30 TL	50 TL	70 TL	150 TL		2-3		
Salmo trutta	10 TL	10-22 TL	22-40 TL	40- 72 TL	140 TL	40 TL	3		
Lampetra fluviatilis					45 TL	8-13 TL	4-6		
Osmerus eperlanus	4 TL	4-8 TL	8-16 TL	17-18 TL	45 TL	10 TL	2		
Anguilla anguilla	12 TL	18 TL	22 TL	28 TL	46 TL	m30-45 TL, f45-65 TL	m6-12, f10-20		
Syngnathus acus					46 TL				
Syngnathus rostellatus	10-11 TL	15 TL	17 TL	18 TL	18 TL				
Ammodytes lanceolatus					40 SL				
Ammodytes tobianus	7-8 SL	13-14 SL	15-16 SL	17-18 SL	20 SL		2		
Callionymus lyra	7-8 TL	12-13 TL	15 TL	17-18 TL	m30 TL, f20 TL	m 13 TL		0 60	0 26
Callionymus reticulatus					m11TL, f 6 5TL				
Raniceps raninus					25 TL				
Trigla lucerna	10 TL	20-21 TL	30 TL	40 TL	75 TL				
Echiichthys vipera	4 TL	7 TL	9 TL	10-11 TL	15 TL				
Agonus cataphractus	5-6 TL	8-10 TL	11-12 TL	12-13 TL	21 TL	10 TL	1	0 10	0.16
Liparis liparis		4 5-8 5			15	5-9	1		
Pholis gunnellus					25 SL	9-10	2		
Myoxocephalus scorpius	11-12 SL	17-18 SL	21-22 SL	24-25 SL	90 TL	15 SL	2	0 00	
Pomatoschistus lozanoi	5-5 5 TL	6 5-7 TL	8 TL	---	8TL				
Pomatoschistus microps	2-2 5 TL	4-4 5 TL	6 TL	---	9 TL		8-10 months		
Pomatoschistus minutus	5-5 5 TL	6.5-7 TL	9 TL	—	11TL				
Zoarces viviparus	10-12 TL	15-17 TL	18-21 TL		50 TL	18-20 TL	2		
Buglossidium luteum	3 5 TL	5.5-6 TL	7-7.2 TL	8-8.5 TL	15 TL	8 TL	3		
Limanda limanda	7-8 SL	13-14 SL	17-18 SL	20-21 SL	40 SL	27 TL	2-3	0 68	0 44
Platichthys flesus	10-11 TL	17-18 TL	24-25 TL	27-28 TL	52 TL	30 TL	3-4	0 06	0 04
Pleuronectes platessa	6-7 TL	13-14 TL	17-18 TL	21-22 TL	100 SL	m30-37 TL, f32-43 TL	m2-3, f4-5	0 48	0 16
Scophthalmus rhombus	18-20 TL	28-30 TL	31-33 TL	35 TL	75 SL	33-41 TL	f3		
Solea lascaris					40 SL	f22 TL	4		
Solea solea	8-9 TL	12-14 TL	22-23 TL	27-28 TL	75 TL	m23-24 TL, f32 TL	4	0 05	0 28
Dicentrarchus labrax	10-12 TL	18-20 TL	25-30 TL	30-35 TL	100 SL	m31-35 TL, f35-45 TL	m4-7, f5-8		
Ciliata mustela	12 TL	13 TL	18 TL	23 TL	25 TL	14 TL	1		
Gadus morhua	10-18 TL	20-30 TL	35-45 TL	55-60 TL	200 TL	40-60 TL	m1-3, f2-5	0.26	0 20
Gasterosteus aculeatus	3	4.5	5 5	6	10				
Merlangius merlangus	10 TL	15-20 TL	20-25 TL	25-30 TL	70 TL	m25 5 TL, f27 5 TL	1-2	0 36	0 34
Trisopterus luscus	16 7 - 17.2 TL	22 8 - 22 2 TL	26 4 - 27 3 TL	30 1 - 32 5 TL	40 TL	m23 TL, f22 TL	2	0 39	0 38