

An ecosystem approach in sustainable fisheries management through local ecological knowledge (LECOFISH)

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During the last decade, a shift has occurred internationally in the governance of marine fisheries towards an ecosystem approach. Its main goal is to achieve sustainable use of resources in which all components of the marine ecosystem and their interactions are covered. A growing interest in Local Ecological Knowledge (LEK) as the recognition that LEK can contribute to sustainable use of resources is also underway. LEK can be defined as knowledge held by a group of people about their local environment. In the LECO FISH project (2009-2011)⁶ LEK has been used to collect fisheries data from Belgian fishermen. In several Belgian research projects it became clear that there are serious knowledge gaps related to fisheries in the Belgian Part of the North Sea (BPNS) (Maes *et al.*, 2005; Maes *et al.*, 2007; Deros *et al.*, 2007) and that certain spatial information is only fragmentary available. Fisheries boxes and data provided by the International Council for the Exploration of the Sea (ICES) do not sufficiently cover information that can be used for a well-balanced fisheries management that takes into account local ecosystem processes in the BPNS, mainly due to the large grids used by ICES and the small area of the BPNS. The growing interest in LEK as a knowledge system and the recognition that LEK can make a contribution to sustainable use of resources has already been proven by others (Neis *et al.*, 1999; Usher 2000; Berkes *et al.*, 2000; Wilson *et al.*, 2006). We departed from the hypothesis that LEK can add significant insights in fisheries resources and practices, revealing spatial information contributing to maritime spatial planning.

Concretely, oral data and information from 20 commercial and 12 recreational fishermen engaged in coastal fisheries was gathered from the 1950's till 2010. Commercial fishermen were limited to the small fleet segment with engine power up to 300 HP, representing a mix of 50% active and 50% non-active at the time of information gathering. LECO FISH is quite unique by capturing information from Belgian recreational fishermen too. This group of fishermen is mostly neglected by policy and scientists due to limits on accessibility, a problem of representation as a group or doubts about their knowledge.

A questionnaire and semi-structured face to face interviews were used to gather LEK data and information, supplemented by spatial maps to allow fishermen to indicate important areas (fishing grounds, spawning grounds, etc). Knowledge of the respondents regarding location of fishing grounds, fish catches, by-catches, fishing techniques, fish species and shift in fish species during past 60 years was collected. The responses of the interviewees were transcribed and analysed with NVIVO 9 software. Spatial data have been translated into spatial maps for the BPNS by making use of Corel Draw 12. Analyzed data were discussed with members of the follow-up committee and in focus groups, although LECO FISH data have not been corrected during the project. Information is presented as provided by the fishermen.

LECO FISH provided data on the evolution of fishing techniques. From the sixties on we see an increased use of beam trawling by commercial fishermen with peaks from 1980 till 1994, although beam trawling is since the seventies the major fishing technique till today. The use of drift nets is declining since the mid nineties, while angling is gradually replacing the use of drift nets. Also the use of standing rigs is gradually increasing since the nineties. In fact often a combination of various gear is used depending on the target species, such as beam trawling in combination with drift nets. Otter trawling is often in combination with standing rigs, angling and since the last 20 year an increased beam trawling. The gear used by recreational fishermen depends on sea fishing or beach fishing. At sea there is an increased use of drift nets, a stable otter trawling and an expanding wreck and anchor fishing since the seventies. In fishing from the beach there is a decline in using hook fishing since the mid eighties and an increase in using rods, while net dragging is gradually replacing the use of standing rigs. The last ten years there is an increased use of flat nets.

⁶ The LECO FISH project was funded by the Belgian Science Policy (BELSPO). See http://www.belspo.be/belspo/SSD/science/pr_terrestrial_en.stm.

The fishermen confirmed that sand banks along the coast are the most important fishery areas, while these are also the most important areas for biological diversity and as such should be additionally protected. Some detailed information is given about sedimentation in the bank areas, effects of water turbidity and clear water on fish behaviour and catches closely linked with wind directions, effects of blooms on fisheries and blooming seasons.

More precise information on seasonal catches, physical conditions, habitats, food web position or feeding patterns, spawning, migration and catch locations are given for a selection of species, such as cod, sole, plaice and shrimps. For other species less information is available, although always indicating catch locations during a time span of 50 years for sea bass, eel, herring, crab and lobster. Additional locations are provided for non-commercial species such as sand mason and other worms, razor clams, starfish, brittle star, seals, harbour porpoises and dolphins.

For cod fishing it becomes clear that fishermen are catching smaller species than 30 years ago. In the seventies the average weight of cod caught by commercial fishermen was 7-8kg (trawl in pair) / 8-10kg (otter trawl) and 10-12kg (1971) / 8-9kg (1980's) in recreational fisheries. In 2010 the average weight of cod caught is 3-4kg or less (commercial and recreational fisheries). Fishermen always argue that there is still sufficient cod to be caught, however these are mainly small species compared to the ones caught in the seventies and before. In fact most cod caught today is not able to reach its full grown size anymore, effecting the full potential of regeneration or its maximum sustainable yield. Another concern is the fact that some fishermen report plastic found in the stomach of cod, while the cod food web is mainly crab, shrimp, razor clams, worms, sandeel and to a lesser extent herring and brittle star. Migration of cod is besides prey availability, also due to water temperature, leaving the coast for deeper water during summer or migrating to deeper water during frost and snow. Next to food sources and habitat types (sand banks), spawning behaviour has an influence on cod seasonal fishing locations. In contrast to cod, sole is mainly caught during spring and summertime with the highest concentration in April, May and July. The peak in July is mainly due to fishing by recreational fishermen. Many fishermen link the sole season with spawning behavior, the co-appearance of shrimp and in a certain degree their feeding pattern. The main food source of sole are worms, followed by shellfish, essentially razor clams and shrimps. Sole, as shrimp, prefers warm water (+/- 8° C). Cold water temperature or periods of frost influence the location of sole as it will move to deeper waters (40 meters or pits). A comparable water temperature is preferred by sea bass. When the temperature drops below 8°C, sea bass will migrate to the Channel or wrecks at deeper places. Wrecks form an important area for sea bass, as well as for cod, next to sand banks. Largest sea bass and cod is caught in the neighborhood of wrecks. The seasonal catches of plaice have no sudden peaks in a certain month. Nevertheless, catches are higher during summer and winter. Plaice prefers razor clams, shellfish and worms, in particular lug worms. The wind has a great effect on the catching of plaice. Wind coming from the west, northwest or southwest brings plaice closer to the coast. Bad weather or storm do not result in plaice catches. Plaice is mentioned several times as a by catch of sole, cod, whiting and shrimp. Shrimp is rather common from spring until November. Nevertheless, the catch peak for both commercial and recreational fishermen occurs during late summer and autumn. Shrimp is characterized as a scavenger and fishermen call them 'the dustbins' of the sea as they eat death fish and other rotten organisms. Additionally, shrimp serves as a food source to other species such as cod, sole and whiting.

Fishing locations in the BPNS are indicated by commercial and recreational fishermen covering a time span of more than 50 years, with seasonal variations and catch areas at the level of decades. LECOFISH provides an atlas with maps of fishing locations of cod, sole, sea bass, eel, plaice, herring, shrimp, crabs and lobsters that are relevant for fishing claims in a context of maritime spatial planning and place based fisheries management. The maps indicate that sole was more present at the west coast and at certain sand banks, near the coast as well as in the exclusive economic zone, depending on the seasons. These locations are also relevant for catches of plaice and herring which were exclusively found at the west coast. In contrast, sea bass was mainly caught in the whole territorial sea with a slightly higher appearance at the west coast and in the neighbourhood of wrecks outside the territorial sea. Eel was solely caught in the territorial sea close to the beaches and more at the west coast. Shrimps were mainly caught in the territorial sea with a higher catch concentration at the east coast compared to the west coast. Lobster and hermit crab was mainly caught in the area of the Oostdyck and Buiten Ratel sand banks, next to wrecks at the west coast. The catches of crabs were more spread over the sand banks in the territorial sea, with a higher concentration at the west and mid coast compared to the east coast, although depending on the crab species.

Besides maps with locations of catches of target species, there are maps indicating the presence of sand mason and other worms, razor clam and starfish, as well as maps with locations where seals, harbour porpoise, dolphins and whales have been observed by fishermen, albeit in an irregular way.

The authors realize that due to the selection of fishermen, mainly small vessels with an engine power up to 300 HP (daily fisheries), we have not been able to capture fishing location data and experiences from foreign fishing vessels in the BPNS and from larger Belgian vessels on their way to or arriving from fishing grounds outside the BPNS. Surprisingly, fisheries knowledge of recreational fishermen is equally important and for some species often more precise than the information provided by certain commercial fishermen.

Unfortunately, due to lack of time and limited funding the LECOFISH research was not able to fully compare all the LEK data with available Scientific Ecological Knowledge (SEK), which was the original aim of LECOFISH. For the same reason LECOFISH researchers were not able to contact the fishermen interviewed for a second round in order to ask for additional information or some further clarification to the information given. Nevertheless, LEK data compared with SEK for a limited number of species such as cod, sole and shrimp, revealed that the spatial data were highly reliable. LECOFISH contributes to a better sustainable management of fisheries and nature conservation in the BPNS by providing additional spatial information about fisheries locations.

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