

Theme Session K – Monkfish / anglerfish across the world; common problems and common solutions

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With decreased abundance of traditional demersal species, substantial and lucrative monkfish / anglerfish (*Lophius* spp) fisheries developed on both sides of the north Atlantic during the eighties and nineties and in the south Atlantic off Namibia and Brazil. In general, stock assessments have proven problematic due to the developing nature of the monkfish / anglerfish fisheries, making it difficult to use catch per unit of effort as an index of stock size. In addition, the low catchability of monkfish to the fishing gear used on traditional bottom trawl surveys means that useful fishery independent indices of abundance are difficult to obtain. Management areas have been defined as the fishery developed but those are unlikely to delimit distinct biological populations. Studies in reproduction and growth need further development. In the North East Atlantic, the location of the bulk of mature females remains unknown and growth rates are very uncertain.

This theme session had the objective of assembling scientists and contributions from different parts of the world to review common characteristics of monkfish/anglerfish and discuss possible common approaches for the study of these species. Contributions were invited on:

- Stock structure;
- Life history characteristics;
- Population dynamics (recruitment);
- Stock size indices;
- Bycatches;
- Ecosystem interactions;
- Stock assessment methodology;
- Adaptive management.

The session, which was well attended, attracted a total of 31 contributions from scientists in North America, Europe and Brazil, with 18 oral presentations and 13 posters spanning a full day of the ICES Annual Science Conference. Among the 7 *Lophius* species existing worldwide, contributions relating to *L. americanus*, *L. gastrophysus*, *L. piscatorius* and *L. budegassa* were presented. These covered aspects of monkfish / anglerfish biology, fisheries, stock assessment and fisheries management. The following provides a synthesis of the work presented and discussed.

Biology and Distribution

A number of common issues arose from the presentations concerning the biology of *Lophius* species.

Relating to growth, different calcified structures are used for regular ageing of *Lophius*: otoliths (*L. piscatorius*), illicia (*L. piscatorius* and *L. budegassa*, K:03, K:07, K:31) and vertebra (*L. americanus*,K:11). A general perception was that no structure is more reliable compared to the others and the interpretation of different structures of the same fish (K:24) might bring more knowledge on the real growth pattern of *Lophius* species. For this approach the cooperation between scientists experienced in interpreting different structures would be essential. Additionally, growth rates estimated from recent tagging studies (K:21) suggest that current age-reading criteria could underestimate growth, in particular for small specimens. In a number of studies based on age reading (of different species), growth rate is estimated to be

almost linear (K:11, K:24) or slows only slightly at older ages (K:07, K:31), making the typically used asymptotic growth curves (e.g. von Bertalanffy) inappropriate.

Another recurring feature of the biological information presented during this theme session was the changing gender ratio over length classes. Equal proportions of males and females tend to occur at small sizes, a higher proportion of males at moderate sizes followed by an increase in the proportion of females, with only females being present at the largest sizes. This feature was observed in both *L. piscatorius* (K:06, K:07) and *L. budegassa* (K:05) in the northeast Atlantic and *L. americanus* in the northwest Atlantic (K:04).

Recently published results of tagging experiences with data-storage-tags, showed large vertical and geographical migrations of monkfish / anglerfish contradicting the general idea that specimens were generally of low activity and with a static feeding behaviour. Vertical migrations might take large mature females into shallow waters in some Norwegian fjords (K:17) that might be important spawning areas.

Fisheries

The fisheries for monkfish/anglerfish have developed rapidly around the world and in many cases without appropriate controls or monitoring systems. In many regions what was once a relatively unimportant by-catch or discard species has now become a valuable target species or important component of mixed fisheries (e.g. K:13). Monkfish/anglerfish are caught in gillnet and mixed demersal trawl fisheries in varying proportions in all areas where monkfish/anglerfish fisheries exist (K:09, K:33). Important information on discarding has until recently largely been ignored. In southern European waters discards of small fish have increased recently and studies show discard information to be useful in identifying strong year classes (K:28, K:29).

Stock Assessment and Fisheries Management

Relative to stock assessment, the approach followed in the northwest Atlantic, with the development of an age structured model that is able to incorporate information of different sources (length distributions and abundance indices for adults and recruits), without the requirement of detailed age information (only mean lengths at age), seems to be a good approach (K:15), since monkfish / anglerfish have in some areas data of a large variety of sources but generally of poor quality. Also, the application of methods able to extract common trends from different time series of abundance indices and/or parameter estimates is useful in the case of monkfish / anglerfish due to the general noisy nature of basic data (K:01). Assessment of the Northern Shelf anglerfish in the northeast Atlantic has been particularly problematic in recent years due to extremely poor quality commercial data and historically limited survey information. In this area, a joint science-industry survey (K:12) has been set up to obtain absolute abundance estimates while commercial CPUE trends are being obtained from confidential tallybook information (K:16).

Throughout the theme session, a recurring theme was the need for collaboration between scientists, managers and the fishing industry. This has proved particularly useful in obtaining improved survey abundance indices in both the northeast (K:12) and northwest Atlantic (K:04). Cooperation between researchers and the fishing industry has resulted in the development of specific monkfish/anglerfish surveys with stakeholder involvement at all stages, from the gear and survey design to the use of chartered fishing vessels to carry out the surveys.

A contribution (K:10) giving insights into habitat preferences and feeding ecology of monkfish / anglerfish highlighted that data collection for population studies or abundance indices should take differential habitat preferences during the life history into account.

The discussion of similar problems was considered very useful in the case of monkfish / anglerfish. A number of issues arose from the discussions which it was felt were particularly important to highlight:

- Despite recent tagging studies, monkfish/anglerfish stock identity is still not well understood and further work on this topic is needed
- The involvement of the fishing industry in obtaining improved survey and fishery data was felt to be particularly helpful
- Few estimates of natural mortality are available with different values being assumed in different areas.

Co-conveners and participants agreed to dedicate the session to our colleague Hervé Dupouy recently retired from IFREMER (Lorient, France). Hervé was the driver of the ageing method based on *illicia*, applied on a regular basis to European anglerfish. He coordinated the first ageing workshops in the beginning of the nineties and his method was followed by scientists in many other countries and was the starting point for the first age structured stock assessments of anglerfish within ICES.