

Theme Session K

Monkfish across the world; common problems and common solutions

ICES CM 2007/K:01

Management advice for the Iberian Anglerfish stocks based on combined estimates from Bayesian and non-Bayesian assessments

Manuela Azevedo, R. Duarte, F. Cardador, C. Fariña, P. Sampedro, J. Landa, and G. Costas

The motivation for this paper arises out of the perception that when different methods and approaches show agreement on a fish stock trajectory there is increased confidence (evidence) and belief on the results. In this paper, several methods are applied to assess the Iberian anglerfish (*Lophius piscatorius* e *Lophius budegassa*) stocks. These include production, age-based models and Bayesian and non-Bayesian approaches. The stock key parameters are estimated and compared between methods and approaches. We explore ways of combining these estimates, taking into account model fitting criteria and uncertainty. Results are used to discuss how to provide guidance on management advice for these stocks.

Keywords: anglerfish, assessment methods, bayesian approach, Iberian waters, management.

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ICEC CM 2007/K:02

Recent changes in the distribution of monkfish (*Lophius piscatorius*) in Icelandic waters

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This study describes recent changes in the spatial distribution and abundance of monkfish in Icelandic waters, based mostly on data collected from the Icelandic groundfish survey that has been conducted annually since 1985 during the month of March. The stock size of monkfish appears to have been increasing dramatically since 1998 and the species has been extending its spatial distribution along the continental shelf west off Iceland all the way to the areas northwest and north of Iceland.

According to the Icelandic groundfish survey monkfish is rarely found in waters where bottom temperature is below 5°C. It has furthermore been constituted in the survey that the area of Icelandic waters above 400 m where the bottom temperature is more than 5°C has doubled in size during the survey period. The changes in the distribution of monkfish and increased stock size have thus co-occurred with rising water temperatures, and the latter seem to have expanded suitable grounds for the species. These environmental changes may especially have benefited juveniles, since recruitment was hardly observed before year-class 1998 but since then several large year-classes have been observed.

It is possible that a part of the stock of monkfish in Icelandic waters originates from distant areas, either due to larval drift or active migration of larger fish. However, it is likely that since 1998 local recruitment contributes more to the stock than possible migrations from other areas.

Keywords: monkfish, Iceland, distribution, environmental changes, temperature, recruitment.

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ICES CM 2007/K:03

Verification of anglerfish (*Lophius piscatorius*) age estimation through comparison of length modes of age read fish (*illicia*) to length modes of big year-classes appearing in the Icelandic stock

Einar Jónsson

Age estimation of anglerfish has always been somewhat problematic. Various authors have described the difficulties arising, which are due to multiple zones (rings) in the calcified hard structures used, i.e. *sagittae* (otoliths) and *illicia* (from the first dorsal fin-ray) and their interpretation. In order to validate age readings (*illicia*) of white anglerfish (*Lophius piscatorius*) length modes of large year-classes that have characterised the Icelandic stock since 1998 were compared with length modes from age read samples. The length modes of these year-classes can be followed as peaks in the length distributions for several years and thus their actual age assumed accurately. The results show that there is a fairly good agreement between the non-age-

read length modes and the corresponding length modes established through age readings indicating that the *illicia* age readings are based on true interpretation of year-rings.

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ICES CM 2007/K:04

Population Biology and Assessment of Monkfish (*Lophius americanus*) in USA waters

Anne Richards

This paper provides an overview of the biology and recent assessment approaches of monkfish in USA waters of the northwest Atlantic. Much of the information comes from two industry-based surveys for monkfish which were conducted because of low catch rates of monkfish in standard resource surveys conducted by the US National Marine Fisheries Service (NMFS). In the Northwest Atlantic, monkfish are distributed from the Grand Banks and northern Gulf of St. Lawrence (Canada) south to Cape Hatteras, North Carolina (USA), from shallow inshore waters to depths of at least 1000 m. Monkfish north and south of Georges Bank in USA waters are managed as separate units; however, genetic studies show no divergence, and growth and maturation rates are similar between the two areas. Length at 50% maturity is 36 cm (age 4) for males, and 43 cm (age 5) for females. Growth is rapid at about 10 cm per year to a maximum observed size of approximately 140 cm for females; males reach a maximum size of about 70 cm. The USA directed fishery developed rapidly in the 1990s and peak landings of 28,500 metric tons were attained in 1998. Despite the economic importance of monkfish, assessments have been difficult due to incomplete landings data before the 1990s and imprecise survey indices. Biological reference points are currently based on historical biomass indices (Bmsy proxy) and yield-per-recruit analyses (Fmsy=0.2). Assessment approaches used in the most recent stock assessment (July 2007) are reviewed.

Keywords: monkfish, *Lophius americanus*, population biology, population assessment, industry-based surveys

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ICES CM 2007/K:05

The *Lophius budegassa* component of monkfish catches in Scottish waters

Chevonne Laurenson, H. Dobby, and A. McLay

Monkfish landings from Scotland are dominated by *L. piscatorius* and as a result research efforts in Scottish waters have concentrated on that species. In this paper, data for *L. budegassa* that have been collected during both observer trips and chartered surveys between 1998 and 2006 are analysed. *L. budegassa* were found to account for an average of 17% of the monkfish caught on the shelf to the West of Scotland; this decreased to 5% on the shelf around Shetland, 1% on the slope to the west of Scotland and 0.1% at Rockall. *L. budegassa* from 16 to 89 cm were recorded and the modal length was 40 cm. Overall, the sex ratio was found to be 1:1. The findings for *L. budegassa* in Scottish waters are compared to those for other areas.

Keywords: monkfish, Scotland, Shetland, Rockall, *L. budegassa*.

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ICES CM 2007/K:06

Biological aspects of the *Lophius piscatorius* catch in Scottish waters

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In this paper, data on 49258 *L. piscatorius* that have been sampled between 1998 and 2006 during observer trips and chartered surveys at Shetland, the West of Scotland and Rockall are analysed. Results from the analysis of this large dataset highlight the complexities of the stock structure over the study area. In all three areas there were significant differences in length at depth, and at certain depths some significant between-areas differences in length existed. Significant differences were found in the sex ratio of catches between some areas, depths and seasons. Proportions of mature monkfish also differed between areas and depths with highest proportions of mature monkfish in deep water at Rockall and the west of Scotland. The overall L50% maturities were 101.8 cm for females and 58.0 cm for males.

Keywords: monkfish, *L. piscatorius*, Scotland, Shetland, Rockall.

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ICES CM 2007/K:07

Biology of anglerfish *Lophius piscatorius* in Faroese waters

Lise H. Ofstad and C. Laurenson

Anglerfish in Faroese waters are exploited in the Faroese gillnet and trawl fisheries. There is no assessment for this area.

The age and growth of anglerfish is studied using data from 2001–2006. Age was determined by counting the growth rings in sectioned illicia, sampled from anglerfish caught by the commercial fleet and in fisheries research surveys.

The parameters of the von Bertalanffy growth curve were estimated and the results showed that female anglerfish grow larger and have a slower growth rate than male anglerfish. The females are bigger than males after about age five, and there are no males in the samples older than 11 years. The growth rate until maturation was about 10 cm per year and about 8 cm per year afterwards. The mean length at age in Faroese waters show a similar trend as in the other Nordic countries for the youngest age groups.

The results obtained were compared with those of other anglerfish growth studies in different areas of the north Atlantic.

Keywords: Faroe Islands, *Lophius piscatorius*, anglerfish, age, growth.

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ICES CM 2007/K:08

The role of closed areas in rebuilding monkfish populations in the Gulf of Maine

Jonathan H. Grabowski, Melissa D. Smith, and Philip O. Yund

The use of fish reserves as a management tool to protect juvenile fish habitat and adult spawning grounds has become increasingly popular even though knowledge of the direct effects of marine reserves on juvenile fish populations is limited. Given that goosefish landings account for a considerable percentage of the monetary value derived from the groundfish fishery, investigating the factors that influence goosefish population dynamics will assist managers in sustaining this important natural resource. We conducted trawl surveys to determine the effects of reserve (inside vs. outside the Western Gulf of Maine Closure Area [WGMCA]) and habitat type (mud bottom in isolation from gravel or cobble bottom vs. mud that is adjacent to these more complex habitats) on the distribution, abundance, and diet composition of goosefish, *Lophius americanus* in the Gulf of Maine. Surprisingly, the abundance of adult goosefish did not differ in vs. out of the reserve, and juvenile goosefish were more abundant outside of the WGMCA. Therefore, our results suggest that this reserve is not important habitat for goosefish.

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ICES CM 2007/K:09

A history of the monkfish fishery and its management in the Northeastern USA

Phil Haring and J.-J. Maguire

The history of the development and management of the monkfish fishery off the Northeastern United States of America are described. The domestic USA fishery was virtually non-existent in the early 1980s, but as the market for monkfish became globalized in the 1980's, and fishermen realized the value in what had been a discarded catch component until then, directed effort and landings increased rapidly. As the average size of fish in the landings declined under high and unmanaged exploitation over the next decade, the industry appealed to managers to develop a fishery management plan. The review covers the data available, the development of reference points and decision rules.

Keywords: monkfish, fishery management, decision rules.

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ICES CM 2007/K:10

Diet and habitat shifts in New England (USA) monkfish (*Lophius americanus*): insights from stable isotopes and implications for fisheries assessments

Graham D. Sherwood, and Jonathan H. Grabowski

Despite their importance as one of New England's most valuable commercial fishery species, a great deal remains to be learned about monkfish life-history characteristics (e.g., habitat requirements, diet preferences and growth/condition). To fill some knowledge gaps in the basic biology of New England monkfish, we have undertaken a study to examine diet and stable isotope signatures (tissue stable carbon and stable nitrogen ratios) of monkfish of various sizes (47-115 cm) from two different habitats (structured [i.e. rocky/ledge] vs. non-structured [i.e. sand/mud]). Preliminary results show that monkfish from structured habitats are larger and in better condition (higher liver and somatic condition) than monkfish from non-structured habitats (those that are typically sampled during trawl surveys). Diet of monkfish from structured habitats tended to be made up of either small (invertebrates) or large prey (large fish), while the diet of monkfish from non-structured habitats was made up mostly of medium-sized prey. These results suggest that monkfish associate with different habitats to optimize prey selection; a generic optimality model based on prey size only will be presented and compared to monkfish condition data. We are currently waiting on stable isotope analyses to provide further insights on diet shifts (results will be presented at meeting). Our results thus far suggest that monkfish surveys should be designed to take into account diet and habitat preferences in order to obtain non-biased estimates of population size and age/size structure.

Keywords: monkfish, diet, condition factor, stable isotopes, habitat.

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ICES CM 2007/K:11

Biology of Large Monkfish, *Lophius americanus*

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Monkfish (*Lophius americanus*) support important commercial fisheries in the Northwest Atlantic. Although life history information is available for smaller monkfish, the biology of large monkfish is poorly understood. During 2006 and 2007, we collected 320 monkfish 85 cm and larger (maximum size 118 cm) from commercial gillnet fishermen operating in the mid-Atlantic Bight and in the Gulf of Maine to investigate: (1) growth rates of large monkfish; (2) reproductive biology; and (3) rates of cannibalism. All of the large monkfish collected were females. Growth rates of monkfish slowed from ~10 cm/yr (ages 2-8) to ~5 cm/year (ages 9-11). Gonado-somatic indices peaked between February and May in samples from the southern areas (off Maryland and Virginia), and during June in samples from the northern areas (Rhode Island to Massachusetts). This suggests a seasonal progression in spawning from south to north. Evidence of cannibalism was seen in 6.6% of the samples and frequency of cannibalism was correlated with reproductive condition. Cannibalism rates are higher than those observed during Northeast Fisheries Science Center resource surveys (0.13%; n=10,236), which capture relatively few large monkfish.

Key words: *Lophius americanus*, age, growth, reproduction, cannibalism.

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ICES CM 2007/K:12

Progress in estimating the absolute abundance of anglerfish on the European northern shelf from a trawl survey

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The anglerfish stock which occupies the northern European shelf is part of a valuable mixed and targeted demersal fishery. There is a perception amongst participants in this fishery that anglerfish abundance is high, and that the abundance has increased in recent years. However, traditional assessments of their abundance are uncertain and ICES considers their abundance as unknown. In 2005, Fisheries Research Services started a three year project with the objective of determining the abundance of this stock. The project is unique in aiming to determine the absolute estimate of abundance and involves the participation of the fishing industry in many aspects of the planning and execution of the survey. The desire for an absolute abundance estimate required several types of gear measurements to be made in order to determine an accurate swept area and contact with the seabed. Studies of the catchability of the survey trawl were also essential, although these were carried out in a separate sister project. In 2006, the Irish Marine Institute joined in the survey,

extending the area coverage into Irish waters. This paper presents the results of the surveys in 2005 and 2006, paying particular attention to error propagation to determine the uncertainty of the estimates. Suggestions for incorporation of the survey estimates into the assessment of this species are also made.

Keywords: anglerfish; trawl surveys; absolute abundance; industry participation.

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ICES CM 2007/K:13

The Danish fishery for Anglerfish: From by-catch to target fishery

Sten Munch-Petersen and Bo Sølgaard Andersen

At present Danish landings of Anglerfish from the Northern North Sea and Skagerrak constitute a significant part of the total international landings taken in these areas. Until the 1990s, the landings of this species were mainly taken as by-catch in various bottom trawl fisheries on Fladen Ground, in the Norwegian Deep and Skagerrak. By-catches still constitute a significant fraction of total anglerfish landings. However, in recent years the high economic value of anglerfish and the increased catch restriction of other demersal species have implied a more directed (basis of economical value of landings) fishing activities on anglerfish. Presently, anglerfish is among the 10 most valuable species in the Danish landings in the North Sea (or entire Danish landings ???), and either no analytical or descriptive studies exist of this fishery

On basis of information from official log-book, sale-slips and vessel register records, an temporal description of changes in fishing activities for anglerfish is presented for the Danish fleet. Logbook recorded effort by main fishery and corresponding effort (days and kW*days) have been analysed, and it is discussed whether the annual fluctuations in CPUE figures also reflect changes in stock abundance.

Size composition data on landings and discards for 2002–2006 are presented as well as data on the species composition (target fishery as well as by-catch) in the landings are presented.

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ICES CM 2007/K:14 **Withdrawn**

ICES CM 2007/ K:15

An investigation of the population dynamics of monkfish (*Lophius americanus*) in the Northeastern USA.

Anne Richards and Jean-Jacques Maguire

Length-based and age-structured modelling approaches were used to investigate the population dynamics of monkfish in the Northeastern USA. Analyses of length and age composition data obtained from the commercial fisheries and research vessel surveys (including two monkfish trawl surveys) were conducted to evaluate trends in recruitment and fishing mortality using various assumptions about natural mortality rates and fishery selectivity. Results are discussed in the context of existing reference points and decision rules.

Keywords: stock assessment, monkfish, reference points, population dynamics

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ICES CM 2007/K:16

Improving the quality of information on Scottish anglerfish fisheries – making use of fishers' data

Helen Dobby, L. Allan, M. Harding, C. Laurenson, and A. McLay

In recent years, the ICES WG on the assessment of Northern Shelf demersal stocks (WGNDS) has been unable to provide an analytic assessment for anglerfish. One of the reasons for this has been the poor quality of the commercial catch and effort data, with both ICES and STECF highlighting the need for more reliable information.

Following consultation with the fishing industry, an anglerfish tallybook project has been implemented in Scotland as part of a long-term approach to providing better data. The tallybooks are completed on a haul-by-haul basis with skippers being asked to record catches of anglerfish (by size category) and other species where possible, together with information on haul location, duration and depth. Individual vessel catch-rates

are calculated and can be used to provide insights into temporal trends in the stock and the spatial distribution of the fishery. This paper provides an overview of the project and summarizes the results of the analysis to date.

Key words: tallybook, fishers' data, catch-rate.

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ICES CM 2007/K:17

Are Norwegian fjords important spawning areas for anglerfish (*Lophius piscatorius*)?

O. Bjelland and L. Asplin

The knowledge about anglerfish spawning in the northeastern Atlantic is limited. Mature females are rarely seen in the major commercial fisheries within the area, and the general perception has been that the main spawning takes place at great depths west of the British Isles.

The seabed temperature north of the Wyville-Thomson ridge is usually close to 0° C at water depths greater than 500 m, which probably make these areas unsuitable for anglerfish spawning. However, in the deep fjords of western Norway, warmer water is found all the way down to the seabed (down to more than 1000 m). During the last few years we have collected information on large, mature female anglerfish in shallow water from some of these fjords, which is presented here. Most of these occurrences appeared in late winter/early spring, and most reports came from the Hardangerfjord area.

A drift model for this fjord and the adjacent offshore areas was configured to simulate the drift of egg-bands and pelagic larvae at different buoyancies and duration of the pelagic phase. The work indicates that the fjords could represent important spawning areas providing recruitment to the major fishing grounds along the Norwegian coast.

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ICES CM 2007/K:18

Large-scale (from Cape Hatteras, North Carolina to the Gulf of Maine) migratory patterns of monkfish (*Lophius americanus*) populations in the Northwestern Atlantic.

Gretchen Bath Martin, Jonathan Grabowski, and Anne Richards

In the eastern United States, monkfish are managed as separate northern (Gulf of Maine and northern Georges Bank) and southern (southern Georges Bank and Mid-Atlantic Bight) stocks. The degree to which these stocks intermingle, or even whether or not they represent separate stocks, is unknown. Determining the relative magnitude and direction of exchange between northern and southern stocks is of critical importance to managers charged with sustaining monkfish populations in the Northwestern Atlantic. We hypothesized that monkfish populations along the Mid-Atlantic Bight contribute substantially to monkfish populations in the Gulf of Maine and on Georges Bank. Sectioned otoliths have been sampled using laser ablation inductively coupled plasma-mass spectrometry (LA-ICPMS). Recent otolith (i.e., outer edge of the otolith) signatures of juvenile and adult monkfish are compared among all six sites to assess if differences in elemental composition can be detected among the water masses of each site. To determine if juvenile monkfish are retained within each region into adulthood, otolith elemental composition of early life history phases are compared to more recent signatures within each site. Furthermore, comparison of earlier otolith elements of monkfish collected at northern sites with more recent signatures of monkfish from southern sites should indicate areas of residency at different stages of their life and the whether these independently managed populations are connected.

Keywords: monkfish, *Lophius americanus*, otolith chemistry, LA-ICPMS.

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ICES CM 2007/K:19

Aspects of the fishery and biology of *Lophius gastrophysus* in southeastern Brazil

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Of the seven species of the genus, only *Lophius gastrophysus* occurs off the south-southeast coast of Brazilian, where it is known as tamboril or toadfish. Historically, it has been a bycatch component of the shrimp-trawler fishery, but in mid-2002 it became a main target of the regional trawler and gillnet fisheries,

by virtue of its high value in the international fish market. Because of this strong fishing pressure and the shortage of information on the biology, fishery and ecology of this species, in 2002 a management program for the fishery in Brazilian waters was developed to promote the sustainable use of this resource. The program defined management measures for commercial exploration of *L. gastrophysus* through a quite restrictive government regulation of the gillnet fishery. In order to provide information to guide future modifications in the legislation and to generate basic biological data on *L. gastrophysus*, specimens of this species landed by the commercial trawler fleet of the state of Rio de Janeiro were studied. Aspects of the fishery, reproduction and feeding off southeastern Brazil were emphasized. This trawling fleet fishes water 50 to 130 m deep, using double-rig nets with a net opening about 24 m. The trips average 12 days at sea, making four, six-hour trawls per day. The data obtained showed that the fishery takes mostly specimens of the "small" commercial category (individuals less than 1 kg), i.e., it strongly impacts juvenile fish, which congregate in shallower areas. Juvenile fish were considered those with a total length less than that estimated for the first sexual maturation of females (50 cm). This situation continues during the reproductive peak, as shown by the CPUE analysis, where the highest values were recorded at the end of spring and beginning of summer, coinciding with the reproductive period of the species (November and December). On the other hand, the small number of mature females captured by the trawling fleet suggests that the females spawn in deeper water and then move to shallower areas. An added difficulty in managing this primarily piscivorous species is its high position in the food web: 85% of the prey items in stomach contents were fish. It is concluded that management of the *L. gastrophysus* shrimp-trawler fishery catch could be appropriately minimized. Cooperative studies now in progress by several universities and research centers in several states of southeast-southern Brazil will soon be able, based on adequate biological data for the species, to provide information supporting proposals for the management of this fishery.

Keywords: Biology, fishery, *Lophius gastrophysus*, management, southeastern Brazil, toadfish

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ICES CM 2007/K :20

Lophius in the Atlantic: what we know?

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World wide, seven species of *Lophius* are currently known, six of them are found in different coastal areas of the Atlantic Ocean and are commercially exploited. In European waters two species, *Lophius piscatorius* and *L. budegassa* are distributed. The aim of this paper is to review, through the fisheries, biological features and data available the common life strategies of the *Lophius* species in distant geographical areas and point out the relevant biological questions that remain still poorly known.

Keywords: Atlantic Ocean, fisheries, growth, life histories, life strategies, *Lophius*, reproduction

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ICES CM 2007/K:21 Poster

Growth of white anglerfish *Lophius piscatorius* tagged in the northeast Atlantic and review of age validation studies

Jorge Landa, R. Duarte, and I. Quincoces

Growth of white anglerfish *Lophius piscatorius* was studied based on the first tagging study in southern European waters. A total of 1098 fish, caught by bottom trawl and gillnet commercial vessels and trawl surveys, were tagged with spaghetti T-bar tags from 1995 to 2002. The recovery index was 4.5% and the mean growth rate was 13.6 cm yr⁻¹. A revision of growth was performed based on all available information on growth validation of white anglerfish in Atlantic waters, such as other tagging-recapture study, modal lengths of catches and microstructure analysis of hard parts. The growth estimated in these studies showed many similarities with the present results, and an overall growth pattern at the first ages was estimated. A von Bertalanffy growth curve was adjusted to all results and the growth parameters were determined as $L_{\infty} = 163.5$ cm, $k = 0.081$ year⁻¹ and $t_0 = -0.852$ year. This overall growth is faster than that estimated by illicia ageing in recent studies. The current growth based on illicia ageing and used in the assessment of European northern and southern stocks of white anglerfish seems to be underestimated in the first ages.

Keywords: anglerfish, growth, illicia, *Lophius piscatorius*, monkfish, tagging.

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ICES CM 2007/K:22 Poster

Parasites as biological tags in population studies of white anglerfish (*Lophius piscatorius*) from European western waters

Lucía Cañas, M.A. Torres, M.P. Sampedro, A.C. Fariña, P. Abaunza and J. Landa

Parasites have been used widely as biological tags to investigate the population structure of commercially marine fish. The basic principle is that the host can become infected with a particular parasite species only within the endemic area and therefore from the host parasite species composition and abundance can be inferred possible migratory movements through those endemic areas.

In this paper, samples of white anglerfish *Lophius piscatorius*, a commercial benthic species in the bottom fishery of European western waters, were analysed. The aims of the study were 1) survey of the entire meso and macroparasite fauna of the white anglerfish in the area of study, 2) select parasites candidates for using as biological tags, and 3) analyse the infestation levels of those parasites (prevalence, abundance and intensity) to look at possible differences among areas. In the analyses, the length, age and sex of the host were also taken into account.

Keywords: parasites; biological tags; migration, white anglerfish; *Lophius piscatorius*.

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ICES CM 2007/K:23 Poster

Anomalies in anglerfish (*Lophius piscatorius* and *L. budegassa*): orange and albino-blind specimens from the Bay of Biscay

Jorge Landa, M. Ámez, and P. Pereda

Specimens of anglerfish (*Lophius piscatorius* and *L. budegassa*) with atypical characteristics are very scarce, and four of them, caught by the commercial fleet in southern Bay of Biscay in the last years, are described. Three of them were orange or had orange spots on their dorsal side and on the edges of the pectoral fins on the ventral side. Another specimen was totally albino and blind, characteristics that seem to be associated, and with unpigmented peritoneum. Possible causes of these atypical characteristics are discussed.

Key words: albinism, albino, anglerfish, Bay of Biscay, blindness, *Lophius budegassa*, *Lophius piscatorius*, monkfish, pigmentation.

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ICES CM 2007/K:24 Poster

Comparing age and growth estimates for large monkfish (*Lophius americanus* V.) using illicium and vertebral ageing methods

Daniel Cullen, A.K. Johnson, Kathy Lang, and Anne Richards

The monkfish or goosefish, *Lophius americanus* V. is an important benthic species that supports one of the most valuable commercial capture fisheries in the Northwest Atlantic Ocean. However, some aspects of monkfish biology are not-well known including growth rates of large individuals. This presents an impediment to estimating potential yield to the fishery. To examine age and growth in large monkfish, individuals (≥ 90 cm TL; $n = 200$) were collected by gillnetters weekly from spring 2006 to spring 2007 from various sites in the Northwest Atlantic ranging from Gloucester, MA south to Chincoteague, VA. Age was estimated by counting presumed annuli on vertebrae and on sectioned illicia (first dorsal fin ray). Annulus counts were made by three independent age readers and agreement between two readers was considered a true count. Von Bertalanffy growth curves estimated from illicium counts and vertebral counts were compared. Age-at-length estimates were generally greater when derived from illicia than from vertebrae.

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ICES CM 2007/K:25 Poster

Age-length-keys and catch-at-age of white anglerfish (*Lophius piscatorius*) in Atlantic Iberian waters from 1996 to 2006

Jorge Landa, R. Duarte, P. Sampedro, M. Azevedo, C. Fariña, and G. Costas

The aim of this study is to present age data of the Iberian stock (ICES Div. VIIIc and IXa) of white anglerfish (*Lophius piscatorius*) for a VPA-based assessment. Samples were collected from commercial landings and research surveys (IEO and IPIMAR) for a ten year period (1996-2006). A total of 7527 individuals, ranging from 10 cm to 186 cm in length, were aged based on transversal sections of the *illicium* (first dorsal fin ray). Age reading was based on the standardized ageing criterion from recent workshops. The analysis performed on the age-length-keys (ALK) indicate similar growth pattern during the time series. Annual catch-at-age obtained from the commercial length distribution is used to depict cohort signals.

Keywords: Age-length-keys; anglerfish; catch-at-age; growth; *illicium*; *Lophius piscatorius*; monkfish.

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ICES CM 2007/K:26 Poster**Abundance and distribution of anglerfish (*Lophius piscatorius* and *L. budegassa*) on the Porcupine Bank**

Francisco Velasco, J. Landa, and J. Barrado

This poster presents the first results on abundance and distribution of white anglerfish (*Lophius piscatorius*) and black anglerfish (*L. budegassa*) of the Porcupine bottom trawl surveys, carried out every September for six years (2001–2006), covering an area previously not sampled by any other bottom trawl surveys. Total abundance indices in weight and number, and geographical distribution of both species are presented. The abundance by age class of white anglerfish is also studied using ALKs made from *illicia* ageing collected on board. The consistency of the ageing is analysed following the cohorts during the time series. In white anglerfish, a remarkable peak of small individuals was observed in 2001. In 2002, abundance indices decreased, but in 2003 and 2004 there are new increases, probably related to the growth of the recruitment observed in 2001. In 2005 and 2006 a decrease in abundance was found. Recruits and younger ages are mainly distributed around the Porcupine Bank central mound. Older ages spread more evenly along the bank, therefore it seems that some white anglerfish migrations occur there, including fluxes to and from other areas. Recruits abundance was smaller in 2003 and 2004 than in 2001, but of similar magnitude between the central mound and the southern Irish shelf. The recruits in 2005 and 2006 were very scarce in both areas. Therefore, the recruitment signals probably follow different yearly patterns. Black anglerfish has smaller abundance in Porcupine Bank area and only in 2003 a peak in abundance was found.

Keywords: abundance, anglerfish, distribution, *Lophius budegassa*, *Lophius piscatorius*, monkfish, Porcupine Bank.

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ICES CM 2007/K:27 Poster**Standardisation of Catch per unit effort for Anglerfish caught by Iberian artisanal gillnet fleet in ICES Division VIIIc**

Gersom Costas, C. Fariña, P. Sampedro, J. Landa, R. Morlán, M. Azevedo, R. Duarte, and F. Cardador.

The Iberian artisanal fishery anglerfish represents around 40 % of the yearly catches of anglerfish (*Lophius piscatorius* e *Lophius budegassa*). For Southern stocks Spanish gillnet fleet target these species reach 75 % of artisanal catches.

In spite of the importance of the artisanal fishery for these stocks, till now no abundance index of this fishery has been used for stock assessment purposes. Catch-per-unit-effort (CPUE) data from commercial fishing operations have traditionally been used as a relative index of fish stock abundance. The utility of indices of abundance based on catch and effort data can be improved by standardizing them to remove the impact of factors other than changes over time in stock abundance. The Generalized Linear Model (GLM) technique is the most common method to standardize CPUE.

This paper presents the results obtained from applying a GLM on catch and effort data of one of the most important artisanal gillnet fleet in Atlantic Iberian waters (Cedeira port). For this purpose catch trips by vessel from 1996 to 2006 and technical specification of vessels were used.

Keywords: anglerfish, standardization, CPUE, GLM, Iberian waters, gillnet.

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ICES CM 2007/K:28 Poster

Preliminary estimates and causes of Anglerfish Discard in the Spanish Trawl fishery in the Northeast Atlantic

P. Díaz, J. Santos, I. González Herraiz, A. Punzón, F. Velasco, J. Ruiz, and N. Pérez

Anglerfishes are valuable commercial species in the Spanish otter-trawl fisheries in ICES Sub areas VI and VII. Discard data of these species have never been used in stock assessment.

Total discard, discard length distribution, and discard/total catch ratio (in weight and number) were estimated by fishing units. The discard data were gathered by observers on board in different discard programs, and are available for the periods 1988–1989, 1994, 1999–2000 and 2003–2006. Discard weight estimates were obtained from the sampled trips and available raising methods (raising by landings and by effort). In part of the fleet analysed estimated discards in weight of anglerfish present high inter-annual variations for both species, with the highest value found in 2004 for white anglerfish and in 2006 for black anglerfish. Discards rate in weight range around 2% in both species, however in terms of number the values increase to circa 28% in both species.

Also, most of specimens discarded are juveniles, and the motive argued by skippers, interviewed on board about the reasons for discarding anglerfish, is due the small fish size. As a consequence, discard practises are highly dependent on the recruitment abundance, as shown by the positive correlation between quantities discarded and recruitment index in Spanish Porcupine trawl survey, carried out on Porcupine Bank, part of the distribution area of these stocks. The inclusion of a quality discard data set on the assessment could be a useful tool to improve assessment and management of both anglerfish species.

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ICES CM 2007/K:29 Poster

Preliminary estimates and patterns of Anglerfish discard in the Spanish bottom trawl Coastal area fishery

J. Santos, P. Díaz, A. Punzón, A. Serrano, and N. Pérez

This study focus on the estimation of the discards of anglerfish (*Lophius piscatorius* and *L. budegassa*) as fraction of the total catch of these species hauled by the trawling Spanish fleet operating in ICES Divisions VIIIc & IXa. Total catch data collected from the observers on board program were used. Gathered data corresponds to the years '94, '97, '99-00, and the '03-'06 annual series. The total number of discarded yield inter-annual variation of discarding rates for both species; the highest value belongs to 2006, the lowest was found in 2000. Total weight and number of individuals discarded were raised by two methods: ratio estimator (total landings) and fishing effort (trips number). Landings were selected to estimate the total fleet discarded. Most of individual discarded are juveniles showing that the discard reason is due to low weight either on white (Perc.95= 296.4 gr.) or black anglerfish (Perc.95=235,5 gr.) Results were compared with information from Spanish Demersal Surveys (SP_GFS) to determine the relation of discard with periods of high recruitment of both species. The resulting total catch length distribution is compared with Spanish landings. The use of this kind of data could increase the goodness-of-fit in the assessment methods currently used to the management of anglerfish.

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ICES CM 2007/K:30 Poster

Distribution of Juveniles of Anglerfish Caught by Spanish Trawl fishery in Northeast Atlantic Areas

P. Díaz, I. González Herraiz, N. Pérez, J. Santos, and J. Ruiz

The “Spanish Discard Sampling Programme” was started in 1988, however it has not had a continuous implementation in time. Information is available for years 1988-1989, 1994, 1997, 1999-2001 and 2003-2006. The sampling level has varied along the time series of the “Spanish Discard Sampling Programme”, showing its highest level since 2003, when the “Community Sampling Fishery Programme” was completely implemented in Spain. Nevertheless important information on juveniles geographic catch distribution of both Anglerfish species is available along the whole period.

Results on Northeast Atlantic Anglerfish catch length distribution were obtained sampling on board the Spanish trawl fleet operating in the Northeast Atlantic areas. Discarding strategy varies between fleets,

depending mainly on the target. Spatial distribution of juveniles and differences along the time series were investigated. Values are presented on a base of different trawl metiers.

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ICES CM 2007/K:31 Poster**Age-length-keys and catch-at-age of black anglerfish (*Lophius budegassa*) in Atlantic Iberian waters from 1996 to 2006**

R. Duarte, J. Landa, M. Azevedo, P. Sampedro, C. Fariña, and G. Costas

The aim of this study is to present age data of the Iberian stock (ICES Div. VIIIc and IXa) of black anglerfish (*Lophius budegassa*) for a VPA-based assessment. Samples were collected from commercial landings and research surveys (IEO and IPIMAR) for an eleven year period (1996-2006). A total of 9303 individuals, ranging from 5 cm to 101 cm in length, were aged based on transversal sections of the illicium (first dorsal fin ray). Age reading was based on the standardized ageing criterion from recent workshops. The analysis performed on the age-length-keys (ALK) indicate similar growth pattern during the time series. Annual catch-at-age obtained from the commercial length distribution is used to depict cohort signals. A comparison to white anglerfish growth rate and cohort signals is performed.

Keywords: Age-length-keys; anglerfish; catch-at-age; growth; *illicium*; *Lophius budegassa*; monkfish.

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ICES CM 2007/K:32 Poster**Determination of metal concentrations in Monkfish, *Lophius americanus***

Bernice Bediako, A.K. Johnson, and Ed Wirth

Monkfish, *Lophius americanus*, are sedentary, bottom-dwelling fish found in the northwest Atlantic Ocean. Once considered 'trashfish', monkfish currently ranks as the fourth largest commercial species in the US fishery, with tails, livers and whole fish being consumed. As bottom dwellers, monkfish are often in direct contact with sediments which may contain deposits of elemental contaminants. Bioaccumulation of these trace elements may pose potential health risks to humans, may have adverse effects on the organism's reproductive capacity, and result in pathological alterations of the liver, heart, kidney and ovary. Therefore, this study aimed to determine the concentrations of these metals in monkfish muscle, liver and gonads and examine the potential risks posed by these contaminants to humans.

Monkfish were collected using gill nets from three sites in the northwest Atlantic Ocean during the spring of 2007. Muscle, liver and gonads were collected from each fish and analyzed for several trace metals (arsenic, cadmium, copper, selenium, zinc) and total mercury. Histopathological analyses (liver, spleen, kidney and gonads) and organo-somatic indices (hepatosomatic, spleno-somatic and gonadosomatic indices) were determined and used as measures of health status. The results from this study will serve as an important tool in the assessment of essential fish habitat for monkfish and begin to assess the risk related to consumption of this commercial fish species.

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ICES CM 2007/K:33 Poster**Geographical distribution and seasonality of métiers targeting Monkfish in Northern Spain**

Esther Abad, A. Punzón, J. Castro, and J. Landa

New available geo-referenced data about catches and effort from Spanish logbooks enabled the spatial distribution analysis of them, providing useful information to the fisheries management based on ecosystem approach.

In ICES Divisions VIIIc and IXa, the most important Spanish fleets targeting Monkfish are otter trawl and gillnet. Official logbooks (vessel bigger than 10 m) for the period 2003-2006 provided by the Spanish Ministry of Agriculture, Fisheries and Food were used. Data included in the analysis were fishing ICES statistical rectangle, effort (number of fishing trips), date, landed weight by species, type of gear and technical fleet information. According to métier definition as a homogeneous subdivision of a fishery by vessel type, as combination of gear, target species and fishing area, a multivariate statistical analysis based on non-hierarchical clustering method, was used to define métiers targeting monkfish.

Results showed catch profiles of the métiers, identifying fishing trips targeting monkfish, geographical distribution and seasonality of them, high effort density and high catches areas and conflict zones with overlapping fisheries. In addition, new catch rates for monk was provided for otter trawl fishery targeting demersal species.

Keywords: monkfish, cluster, métiers, gillnet, otter trawl, spatial distribution, Northern Spain.

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ICES CM 2007/K:34

Changes of the growth ring number along the illicia and possible impacts on age reading criteria

P. Frias and R. Duarte

The objective of this study is to analyse changes on the number of growth rings along the *illicia*. A total of 53 black anglerfish (*Lophius budegassa*) illicia were sliced from the base until the top. Fish total lengths ranged between 9.6 and 82.9 cm. All cuts were observed on an optical microscope and growth rings were identified. Analysis were performed on the shape of the illicium and on the presence/absence of previously identified growth rings. The height of the illicia zone where the number of growth rings decreases is very dependent on the fish length.

Keywords: black anglerfish; *Lophius budegassa*; illicium; ring number.

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