

The Monkfish *Lophius piscatorius* – its Biology and Fishery in Shetland Waters. Chevonne Laurenson

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Introduction

The monkfish is of considerable economic importance to the local fishing fleet. A significant number of local boats now rely heavily on monk for a substantial part of their income. Although monk landings accounted for only 5.9%, by weight, of landings in Shetland in 1997, this fishery was worth 31% of the total whitefish landings. As monk is a species of recent economic importance there has been little previous research into either the biology of, or fishery for, the species.

From the latter part of 1997 through 1998 landings at local fish-markets were sampled, length-weight relationships were investigated and otoliths (ear bones) removed for ageing purposes. During 1998 and early 1999 observers were placed on board commercial fishing vessels to collect first hand, important biological and fisheries data including overall catch rates of monk and other species; length-frequency distributions and discard levels of monk, and fishing positions. Similar research and data collection programmes will continue for at least the next three years.

Biology

General

Two species of the genus *Lophius* occur in Northern European waters. However, both species look similar and are not separated during either selling or processing. *Lophius piscatorius*, the white-bellied monk (Figure 1), is the predominant species in the northern North Sea. *Lophius budegassa*, the black-bellied monk (so named as the lining of the mouth and body wall is black in colour) has a more southerly distribution and although regularly caught throughout the North-eastern Atlantic it is predominantly found in the Mediterranean.



Figure 1. The white-bellied monkfish, *Lophius piscatorius* which makes up 95% of the monk catch in Shetland waters.

Length/weight Relationship

From landings at local fish markets the total length to gutted weight relationship of *L. piscatorius* was calculated. This relationship is illustrated in the following graph (Figure 2). As would be expected a longer individual is proportionately heavier than a smaller individual.

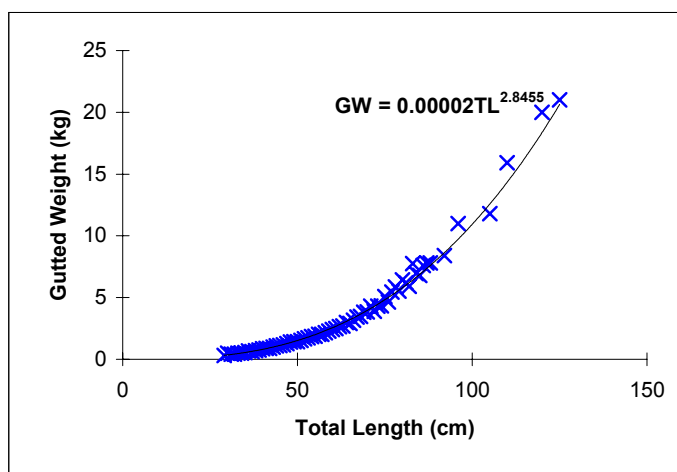


Figure 2. Mean total length / gutted weight relationship.

Monk *Lophius piscatorius* - its Biology and Fishery in Shetland Waters.

Age and Growth

All calcified ageing structures work on the principal that during summer there is a period of fast growth during which new bone material is laid down. This bone is dense, opaque and appears white in colour. During the winter months the fish grow more slowly, if at all. Any bone laid down during winter is produced very gradually, is less dense and appears semi-transparent (hyaline). When viewed under a microscope the bone can be aged from the number of summer and winter bands. This is similar to ageing a tree from the number of growth rings.

During the present study the otoliths (ear bones) were used for routine ageing work (Figure 3). They are easily removed from their position under the fish's brain through the gut cavity. Because no additional cuts are made, gutted fish can be sampled without affecting the market value.

The alternative methods of ageing such as using the *illicia*, the first dorsal fin ray (which is modified into the lure) or the vertebrae were rejected due to their likely effect on the market value.

Figure 4 represents the age-length relationship as estimated from age readings of otoliths. In fish over 80 cm ageing is problematic. It is suspected that the age assigned may be underestimated due to the closeness of the opaque and hyaline bands.



Figure 3. Otolith from a 93 cm monk.

Sexual Maturity and Reproduction

Compared to many other species females are particularly late to mature with sexual maturity being attained from around 70 cm in length. With high fishing pressure the percentage of reproducing females can be very low. The ovaries ("raans") are peculiar, eggs are released in a gelatinous raft or "egg veil" which floats in the surface layers and can reach lengths in excess of 10 metres. Ripe ovaries are found during the late winter and early spring. During the ripe stage the ovary occupies most of the

body cavity and bright orange oocyte (cell which goes on to form an egg) clusters can be seen within the clear gelatinous matrix.

Males reach sexual maturity at around 50 cm in length and do not grow beyond one metre. Females can reach about two metres in length, the largest fish are therefore predominantly female. The reasons for this difference in growth are unknown.

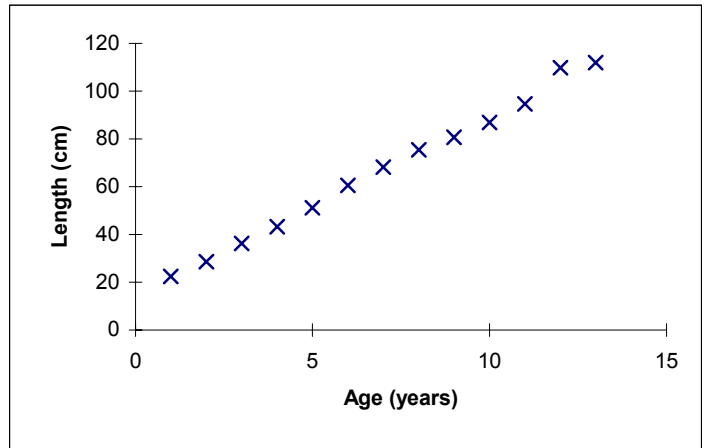


Figure 4. The relationship between fish length and age.

Fishery Data

Recently published figures show that landings of monks into Scotland by UK boats increased from a reported 8887 tonnes during 1990 to 16815 tonnes (standard weight) in 1997, with a corresponding increase in value from £18.9 million to £38.1 million in 1997 (*Scottish Seafish Statistical Tables*, 1998). Monk are a high value species - in 1997, monk commanded £2260 / tonne compared to £1121 for cod, *G. morhua* and £615 for haddock, *M. aeglefinus* (*Scottish Seafish Statistical Tables*, 1998).

Survey Data

Figure 5 shows catch and discard rates by ICES statistical square. Catch rates are calculated as both the total number, and the gutted weight per hour towing time; the discard rates are expressed as the number per hour towing time. The survey duration in each ICES statistical square is shown in parentheses.

Monk *Lophius piscatorius* - its Biology and Fishery in Shetland Waters.

<p>18.4 kg / hour 6.6 monk / hour 0.33 discards / hour (39:20 hrs)</p> <p>51 E8</p>	<p>20.0 kg / hour 6.8 monk / hour 0.33 discards / hour (108:40 hrs)</p> <p>51 E9</p>	<p>12.3 kg / hour 5.5 monk / hour 1.15 discards / hour 26:00 hrs)</p> <p>51 F0</p>
<p>14.1 kg / hour 6.7 monk / hour 0.2 discards / hour (186:35 hrs)</p> <p>50 E8</p>	<p>8.3 kg / hour 6.0 monk / hour 1.2 discards / hour (94:05 hrs)</p> <p>50 E9</p>	<p>50 F0 (0 hrs)</p>
<p>(4 hrs)</p> <p>0.0 kg / hour 49 E8</p>	<p>(0 hrs)</p> <p>49 E9</p>	<p>6.4 kg / hour 2.3 monk / hour 0.1 discards / hour (171:30 hrs)</p> <p>49 F0</p>
<p>(24:10 hrs)</p> <p>0.1 kg / hour 0.2 monk / hour 0.08 discards / hour 48 E8</p>	<p>(0 hrs)</p> <p>48 E9</p>	<p>(0 hrs)</p> <p>48 F0</p>

Figure 5. Average catch rates expressed as gutted weight (GW), number (No.) and discards (D) per hour in each ICES statistical square covered during the study.

When the catch rates are expressed as gutted weight (kg) per hour towing time, the catch rates appear to be quite variable, e.g. the catch rate in square 51 E9 is more than double that of 50 E9 however the yields are similar when expressed as numbers per hour fishing time. This anomaly is due to differences in the length frequency distributions of the catches in different fishing areas (*Figure 6*). Monk which are discarded are generally less than 30 cm in length. It can be noted that discard rates in all squares surveyed was low.

As can be seen in *Figure 6* the majority of the length-frequencies peak in the 50 - 65 cm size ranges, however the monk caught in both squares 48 E8 and 50 E9 have lower average lengths. The vast majority of the smaller monk caught in both of these squares were caught relatively close to the shore. From *Figure 6* it is seen that a very small percentage of the monk which were caught in the surveyed areas were under Grade 5 (34.5 - 43.5 cm), the discard levels are generally low as can also be seen from *Figure 5*.

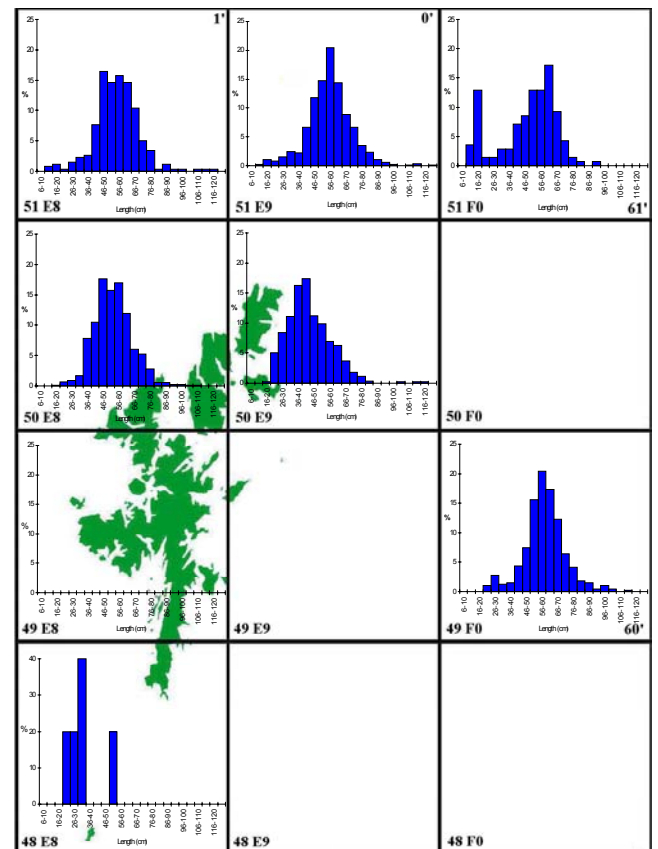


Figure 6. Length-frequency distribution (as percentage) of monks by ICES statistical square.

From applying known maturation rates, it is estimated 71 to 95% of the male monkfish catch is immature while 90.8 to 100% of caught females are immature.

Estimation of Population Density

Reasonably constant catch rates during fishing operations supports the belief that monk are evenly distributed over the seabed. It is believed that monk do not herd during trawling and therefore it is only those directly in front of the net which are caught. Over a typical 7 hour tow at a speed of 2.5 - 3.0 knots between 17.5 - 21 nm (32 - 39 km) are covered. Given an average distance between the wing ends of 25 m, an average catch rate of 6 monk per hour, and a catch rate of 50%, monk densities in the surveyed areas could be in the region of 86 - 104 individuals per square kilometre.

Monk *Lophius piscatorius* - its Biology and Fishery in Shetland Waters.

Landing Composition

Of the 16 marketable species caught during the surveys cod, haddock and monk were the most important by weight (*Table 1*). These percentages are slightly different to the total Shetland landings as much of the survey work occurred in squares 50 E8, 50 E9, 51 E8, 51 E9 and 51 F0.

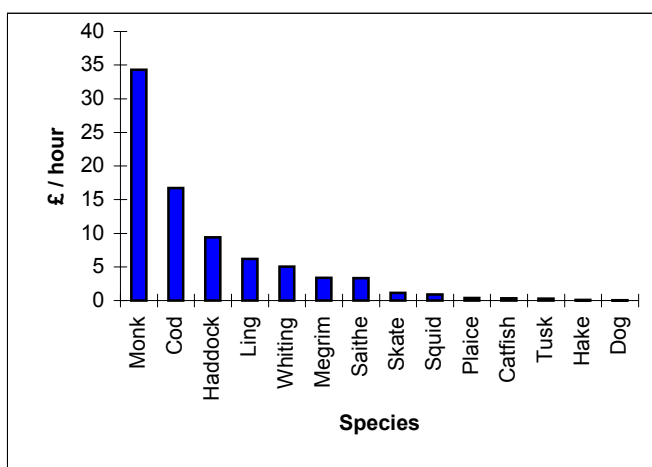
Species	Percentage
Cod	34.0
Haddock	23.2
Monk	13.5
Whiting	8.4
Ling	8.6
Saithe	5.1
Others	7.2

Table 1. Average landing compositions (% by weight) during surveys.

Value of Catch

Figure 7 illustrates the estimated value of fish caught per hour towing time. This was calculated using average landing composition data as collected during the surveys in conjunction with the average price per kilogram as calculated from published data (*Shetland in Statistics*, 1998). From *Figure 7* monk is the most lucrative species to catch.

Figure 7. Estimated value (£) of fish caught per hour towing time in areas to the north of Shetland (ICES squares 50 E8, 51 E8, 50 E9, 51 E9 and 51 F0) where monk and gadoids are targeted.



Conclusions

The catch rates (by weight) of monk in surveyed areas are lower than other target species e.g. cod and haddock. However, in terms of value gained for a given fishing effort, monk is undoubtedly the most lucrative species to catch. Despite relatively low catch rates, the very high prices demanded guarantee that monk will continue to be targeted.

Monk is a relatively slow growing and maturing species, with females maturing particularly late. From applying known maturity rates onto length frequency data it is estimated that on average 55% of males and 92% of females are immature when caught.

Fishermen who target monk are relying on its high value for a significant portion of their income; any reduction in catch rates will jeopardise the economic viability of this sector. However, the slow growing and slow maturing nature of the species and the high percentages of immature fish caught in the fishery raise serious concerns over the future sustainability of the stock at present fishing levels.

References

Scottish Office Agriculture and Fisheries Department (1998). *Scottish Seafisheries Statistical Tables 1997*. Pub. Government Statistical Service. pp 1- 29.

Shetland Islands Council - Development Department (1999). *Shetland in Statistics 1998*. ISBN 0 904562 69 7. pp 1 - 72.

Acknowledgements

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