International Council For the Exploration of the Sea. Shellfish Committee CM1995 K: 13

THE SIGNIFICANCE OF SQUID IN IRISH FISHERIES

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Abstract

The squid catch and by-catch of Irish fisheries has been investigated for the years 1991-95 and includes 9 species, the most important of which is *Loligo forbesi*. Annual, seasonal and geographic variation in squid landings in Irish waters are reviewed for the years 1976-1993; official landings of squid were not divided into species, but were assumed to be *L. forbesi* since this is the only species of current commercial value on Irish markets, and hence the only species retained by fishermen. Variation in squid landings is related to the current knowledge of the life cycle of *L. forbesi*. There were two components to the *L. forbesi* landings, inshore catches which peaked in the autumn and landings from the Rockall Bank, during the summer. Annual landings fluctuated from 7 to 730 tonnes, but were typically in the range 150-300 tonnes. Catches from ICES area VI (West of Scotland and Rockall Bank) showed considerable annual variation, probably due to the unpredictable summer fishery on the Rockall Bank. Landings in coastal areas were comparatively stable. The autumn peak in landings in inshore areas corresponded to the main period of recruitment of immature *L. forbesi*, and the subsequent drop in catches indicates that the squid had emigrated or died. The fishery potential of other squid species, particularly the ommastrephid squids, in Irish waters is discussed.

Introduction

With the depletion of stocks of traditional finfish species alternative resources such as cephalopods have become the subject of increased interest, and there have been substantial increases in cephalopod landings in the last thirty years (Worms, 1983; Boyle, 1990; FAO, 1993). In particular attention has turned to two families of squid, the Ommastrephidae and the Loliginidae. The ommastrephid squid are typically oceanic or shelf-break species and have primarily been exploited by far east nations such as Japan and Korea, principally by jigging, but also by trawling. The loliginids are coastal species, typically inhabiting depths of less than 400 m and are of significant commercial value in southern European countries. Traditionally the cephalopods have not been commercially exploited in British and Irish waters, being used mostly as bait, however increased demand from southern European countries has led to limited exploitation in the last twenty years.

Two loliginid species, *Alloteuthis subulata* (Lamarck) and *Loligo forbesi* Steenstrup, are abundant in Irish waters (Massy, 1928). Of these only *L. forbesi* is of current commercial interest since *A. subulata* is usually too small to be retained by standard commercial fishing gear. *L. forbesi* is taken as a by-catch in bottom trawl and seine fisheries and occasionally becomes a target species when abundant, notably on the Rockall Bank, where in certain years there is a targeted fishery during the summer (Howard *et al.*, 1987; Pierce *et al.*, 1992). The biology and ecology of *L. forbesi* has recently been investigated (Collins *et al.*, 1994, 1995a, b, c, d). It is essentially an annual species, spawning principally in the winter months and dying shortly after spawning. There is also evidence of some summer spawning.

Ommastrephid squids support some of the major squid fisheries around the world (e.g. *Illex argentinus* Castellanos in the Falklands; *Todarodes pacificus* (Steenstrup)in the Pacific), but as yet are unexploited in the waters around the British Isles. Massy (1928) recorded 3 ommastrephid species in Irish waters (*Todaropsis eblenae* Ball, *Todarodes sagittatus* (Lamarck) and *Sthenoteuthis pteropus* (Steenstrup), but there is little or no published data on the abundance or distribution of these species around the British Isles. *T. sagitatus* and *T. eblanae* have recently been reported in Scottish waters (Joy, 1990; Hastie *et al.*, 1994).

This paper reviews the current status and potential of squid in Irish fisheries, assesses regional, seasonal and annual variations in *L. forbesi* landings in Irish waters and relates them to the biological features of the life-cycle.

Methods

Since 1991, as part of on-going cephalopod research at University College Cork, samples of squid have been obtained from commercial fishing vessels operating in Irish waters. These have been mostly comprised of the abundant species, but fishermen have also been encouraged to land rarer specimens. Squid were identified and their and depth position of capture recorded.

Official landing statistics for squid from Irish waters into Irish ports were obtained from the Department of Marine, Ireland and from ICES statistical tables. Official landings are divided into ICES areas, and these are illustrated in Figure 1. Official statistics record only landings in Irish ports and do not include catches by vessels fishing in Irish waters that are landed elsewhere. Prior to 1976 squid was included in a mixed shellfish category and so precise data were not available. For statistical purposes landings from adjacent ICES areas are often combined (*e.g.* VIIb and VIIc; VIIg and VIIh). Prior to 1990 no landings were recorded from area VIb (Rockall Bank), but these were probably included in area VIa (West of Scotland) and so landings from areas VIa and VIb have been combined. A monthly breakdown of the landings for each ICES area was only available for the years 1987-1989.

Additional monthly landings data were obtained from the fishermen's co-operative at Dunmore East, County Waterford, which was the major source of samples for investigations into the life-cycle of *L. forbesi* (Collins *et al.*, 1994, 1995a, b, c).

Results

Table 1 lists the squid species that were obtained from fishing vessels in Irish waters in the years 1991-95, with comments on their abundance and fishery potential. The only species frequently caught in commercial catches were *L. forbesi*, *I. coindetii* and *T. eblanae*. Of these only *L. forbesi* was regularly landed, the others usually being discarded. Of the other ommastrephids *Todarodes sagittatus* was frequently by-caught in trawls in deeper water and occasionally in surface drift nets; eleven *Ommastrephes bartrami* were caught in a bottom trawl on the Rockall Bank in August 1992 and three were caught in tuna nets off the south coast in May 1994. Three specimens of the giant squid *Architeuthis dux* (Steenstrup) were caught in bottom trawls off the west of Ireland between April and June of 1995 and a single *Histioteuthis bonnellii* (Ferussac) was caught in a trawl west of Ireland in April 1994.

Annual fluctuations in total squid landings in Irish waters from 1976 to 1994, divided into the ICES areas, are illustrated in Figure 2. Although these figures are for all squid, for the reasons stated above they are likely to be *L. forbesi*. Total recorded landings fluctuated between 7 tonnes in 1976 and 730 tonnes in 1986, but were usually

between 150 and 300 tonnes. Prior to 1976 squid were recorded in the mixed shellfish category and the 1976 figure may be low since this was the first year squid were separately logged The majority of the squid was landed from areas VIab (West of Scotland and Rockall Bank) and VIIa (Irish Sea). Landings in area VIIa have remained relatively consistent through the period, except for the years 1990-1993 when landings were unusually small, but landings from VIIgh and VIIjk were higher during these years. Landings in area VI showed considerable annual variation and in years when total landings were high such as 1986 and 1989 the increase was largely due to increased landings from area VI.

Figure 3 shows the catch in ICES area VIa (West of Scotland) for each month for the years 1987-1989. These figures almost certainly included landings from the Rockall Bank (VIb), since no specific landings are recorded from this area. In 1987 and 1989 the highest catches came in June, with additional peaks in the autumn. In 1988 there was no summer peak in landings and maximum catches came in October.

Monthly landings in areas VIIa-k are illustrated in Figure 4 for the years 1987-1989. In 1987 landings were relatively small, with no obvious seasonal peaks. In 1988 and 1989 catches were highest during the autumn months of September and October. There was a small second peak in May 1988.

Monthly landings of *L. forbesi* in the port of Dunmore East are illustrated in Figure 5 for the years 1991-1993. Landings were highest from September until December, reflecting the official landings for areas VIIa-k in previous years, with only small quantities of squid landed from January until August.

The ommastrephid squids *I. coindetii* and *T. eblanae* were caught principally through the winter months off the west and south-west coasts. They first appeared in commercial catches in September-October, with peak abundance in March-April and declining in the early summer. Currently Irish vessels are discarding catches of these species, though some Spanish vessels operating in the area are now believed to retaining these species (K. Flannery, pers comm).

Discussion

For statistical purposes squid landings are not divided into species and are reported simply as 'squid'. Although other species of squid occur in Irish waters (see Table 1), it is likely that the vast majority of the squid landed are *L. forbesi*. *Loligo* is the only genus currently of commercial value in Ireland, and hence other species when caught are usually discarded. *L. vulgaris* does occur in Irish waters, but is rare and from over 4000 *Loligo* examined from commercial catches from south coast ports and the Irish Sea only one *L. vulgaris* was found (Collins *et al.*, 1995a). However should other species such as *I. coindetii* be commercially exploited it will be important to

distinguish ommastrephid (short-finned) and loliginid (long-finned) squid in landing statistics.

There appear to be two main components to the Irish *Loligo* fishery, with landings from coastal waters peaking in the autumn, whilst landings from Rockall Bank are maximal during the summer. Pierce *et al.* (1992) identified the same two components in the Scottish squid fishery. Irish coastal landings remained relatively constant during the time for which data were available, but the Rockall Bank fishery has shown considerable variation, which is difficult to assess accurately; since the landings are included in area VI. In coastal waters *L. forbesi* is principally a by-catch in a multi-species trawl fishery and consequently annual fluctuations in fishing effort are likely to be small, however on the Rockall Bank *L. forbesi* is frequently targeted and hence effort may vary considerably. Annual variations in total landings are thus due primarily to the unpredictable nature of the Rockall fishery.

The annual cycle of landings (Figures 3-5) provides further evidence of a one year life cycle in *L. forbesi*. The autumnal peak in coastal landings is compatible with the knowledge of the life cycle of *L. forbesi* in Irish waters. Immature *L. forbesi* first appear in commercial trawls in August at 120-150 mm mantle length, they grow rapidly and mature with spawning commencing in November and continuing through the winter (Collins *et al.*, 1995a). The commercially caught animals are thus predominantly pre - spawning animals. A second period of recruitment was identified in commercial catches in the Celtic Sea in December 1991-1992 (Collins *et al.*, 1995a) and a second cohort of *L. forbesi* was identified in the Irish Sea in the autumn (Brierley, 1992; Collins *et al.*, 1995d), but there is little evidence from landings of its recruitment into commercial catches in Irish waters.

It is not clear how the Rockall Bank squid relate to the coastal population, Pierce *et al.* (1994) and Brierley *et al.* (1995) found little evidence of genetic or morphometric differences between the coastal and Rockall squid. The animals caught at Rockall in the summer are immature, but considerably larger than the *L. forbesi* caught inshore at this time (Collins *et al.*, 1995a). It is not known if spawning occurs on the Rockall Bank, but the summer caught animals would probably be expected to spawn in the autumn and large amounts of *Loligo* spawn are reported off the west of Ireland at this time (K. Flannery, pers. comm.).

Currently there is no management of *L. forbesi* stocks in Irish waters or in UK. waters (Pierce *et al.*, 1992). This lack of management is unlikely to present problems, since Caddy (1983) suggested that for cephalopods in mixed fisheries management is unnecessary because cephalopod stocks are likely to be more resistant to overfishing than those of finfish. Pierce and Guerra (1994) point out that as it is a by-catch fishing mortality may represent a small proportion of total *L. forbesi* mortality. However, should *L. forbesi* be the subject of more intense exploitation then some management of

stocks will be essential. There appears to be little potential for increased exploitation by trawling in Irish coastal waters, although given the relatively high value of the species it may be targeted during the autumn. There may be potential for increased exploitation on the Rockall Bank, but since the appearance of squid in this area is unpredictable further research is necessary.

Given the extent of fishing activity in the coastal areas it is unlikely that there are significant unexploited cephalopod resources in these areas, however in deeper areas, further offshore there may be significant quantities of *I. coindetii*, *T. eblanae* and *L. forbesi* worthy of directed exploitation.

Jigging is commonly used to catch ommastrephid squids and is successfully employed to capture *L. forbesi* in the Azores (Martins, 1982), *L. forbesi* and *L. vulgaris* off the Portuguese coast (Cunha and Moreno, 1993) and in Galician waters (Guerra *et al.*, 1992), and to capture *L. vulgaris reynaudii* in South African waters (Augustyn *et al.*, 1992). In South African waters *L. vulgaris reynaudii* was caught as part of a multi-species trawl fishery until a jig fishery began in 1985, and jigging subsequently accounts for 80% of the squid catch (Augustyn *et al.*, 1992). As well as being species specific jigging produces better quality squid, that tends to fetch higher market prices. Small scale jigging trials for *L. forbesi* have been attempted in Scottish (Pierce *et al.*, 1992) and Irish waters (M.C, unpublished), but with little success, however when jigging it is important to first locate concentrations of squid rather than operate 'blindly' which may have been the case in the past. Jigging could also be employed to capture the ommastrephid squids if concentrations of these species are identified.

Acknowledgements

Cephalopod research at University College Cork has been conducted as part of research studentships with the financial assistance of B.I.M. Thanks to Bernadettte McGuire, Laura Jo Rossiter and Niamh O'Herelehy at the Department of Marine and to the staff of Dunmore East Fishermens' Co-op for providing data. Thanks to Kevin and Michael Flannery and the crew of the Shannon for providing many specimens and to Peter Boyle, Graham Pierce for comments on the paper. Martin Collins is currently employed under EC contract AIR1-CT92-0573.

References

Augustyn, C. J., Lipinski, M. R. and Sauer, W. H. H. 1992. Can the Loligo squid fishery be managed effectively? A synthesis of research on *Loligo vulgaris reynaudii*. South African Journal of Marine Science, 12: 903-918.

Boyle, P. R. 1990. Cephalopod biology in the fishery context. Fisheries Research, 8: 303-321.

Boyle, P. R. and Ngoile, M. A. K. 1993a. Assessment of maturity state and seasonality of reproduction in *Loligo forbesi* (Cephalopoda: Loliginidae) from Scottish waters. In Recent advances in cephalopod fisheries biology, pp. 37-48. Ed. by T. Okutani, R. K. O'Dor and T. Kubodera. Tokai University Press, Tokyo. 752pp.

Boyle, P. R. and Ngoile, M. A. K. 1993b. Population variation and growth in *Loligo forbesi* (Cephalopoda: Loliginidae) from Scottish waters. In Recent advances in cephalopod fisheries biology, pp. 49-59. Ed. by T. Okutani, R. K. O'Dor and T. Kubodera. Tokai University Press, Tokyo. 752pp.

Brierley, A. S. 1992. Aspects of genetic diversity and population structure in squid. Ph.D. Thesis, University of Liverpool. 154pp.

Brierley, A. S., Thorpe, J. P., Pierce, G. J. Clarke, M. R. and Boyle, P.R. 1995. Genetic variation in the neritic squid *Loligo forbesi* (Myopsida: Loliginidae) in the northeast Atlantic Ocean. Marine Biology, 122: 79-86.

Caddy, J. F. 1983. The cephalopods: Factors relevant to their population dynamics and to the assessment and management of stocks. In Advances in assessment of world cephalopod resources, pp 416-452. Ed. by J. F. Caddy. FAO Fisheries Technical Paper No. 231. FAO, Rome.

Collins, M. A., De Grave, S., Lordan, C., Burnell, G. M. and Rodhouse, P. G. 1994. Diet of the squid *Loligo forbesi* Steenstrup (Cephalopoda: Loliginidae) in Irish waters. ICES Journal of Marine Science, 51: 337-344.

Collins, M. A., Burnell, G. M. and Rodhouse, P. G. 1995a. Recruitment, maturation and spawning of *Loligo forbesi* Steenstrup (Cephalopoda: Loliginidae) in Irish waters. ICES Journal of Marine Science, 52: 127-137.

Collins, M. A., Burnell, G. M. and Rodhouse, P. G. 1995b. Reproductive strategies of male and female Loligo forbesi (Cephalopoda: Loliginidae). Journal of the Marine Biological Association of the UK, 75.

Collins, M. A., Burnell, G. M. and Rodhouse, P. G. 1995c. Age and growth of the squid *Loligo forbesi* (Cephalopoda: Loliginidae) in Irish waters. Journal of the Marine Biological Association of the UK, 75.

Collins, M. A., Burnell, G. M. and Rodhouse, P. G. 1995d. Distribution and demography of Loligo forbesi in the Irish Sea. Biology and Environment. Proceedings of the Royal Irish Academy, 95B,

Cunha, M. M. da and Moreno, A. 1993. Evolution of the Portuguese fishery for squid. ICES CM. 1993/K:38.

FAO. 1993. Review of the state of world marine fishery resources. FAO Fisheries Technical Paper No. 335. FAO, Rome. 136pp.

Guerra, A., Rocha, F., Casas, F. and Fernandez, M. T. 1992. *Loligo vulgaris* and *Loligo forbesi* (Cephalopoda, Loliginidae): their present status in Galician fisheries. ICES CM. 1992/K:40.

Hastie; L. C., Joy, J. B., Pierce, G. J. and Yau, C. 1994. Reproductive biology of *Todaropsis eblanae* (Cephalopoda: Ommastrephidae). Journal of the Marine Biological Association of the UK, 74: 367-382.

Holme, N. A. 1974. The biology of the squid *Loligo forbesi* (Mollusca: Cephalopoda) in the Plymouth area. Journal of the Marine Biological Association of the United Kingdom, 54: 481-503.

Howard, F. G., Ngoile, M. A. and Mason, J. 1987. *Loligo forbesi:* Its present status in Scottish fisheries. ICES CM. 1987/K:15.

Lum-Kong, A., Pierce, G. J. and Yau, C. 1992. Timing of spawning and recruitment in *Loligo forbesi* (Cephalopoda: Loliginidae) in Scottish waters. Journal of the Marine Biological Association of the United Kingdom, 72: 301-311.

Martins, H. R. 1982. Biological studies of the exploited stock of *Loligo forbesi* (Mollusca: Cephalopoda) in the Azores. Journal of the Marine Biological Association of the United Kingdom, 62: 799-808.

Massy, A. L. 1928. The Cephalopoda of the Irish coast. Proceedings of the Royal Irish Academy, 38 B: 25-37.

Ngoile, M. A. K. 1987. Fishery biology of the squid *Loligo forbesi* Steenstrup (Cephalopoda: Loliginidae) in Scottish waters. Ph.D. Thesis, University of Aberdeen. 218pp.

Pierce, G. J., Boyle, P. R., Hastie, L. C. and Howard, F. G. 1992. The Scottish fishery for *Loligo forbesi*: current trends. ICES CM. 1992/K:6.

Pierce, G. J., Boyle, P. R., Hastie, L. C. and Key, L. 1994. Life history of *Loligo forbesi* (Cephalopoda: Loliginidae) in Scottish waters. Fisheries Research, 21: 17-41.

Pierce, G. J. and Guerra, A. 1994. Stock assessment methods used for cephalopod fisheries. Fisheries Research, 21: 255-286.

Pierce, G. J., Thorpe, R. S., Hastie, L. C., Brierley, A. C., Guerra, A., Boyle, P. R., Avila, P., Jamieson, R. and Avila, P. 1994. Geographic variation in *Loligo forbesi* in the northeast Atlantic Ocean: analysis of morphometric data and tests of causal hypotheses. Marine Biology, 119: 541-547.

Rathjen, W. F. and Voss, G. L. 1987. The cephalopod fisheries: a review. In Cephalopod life cycles volume II. Comparative reviews, pp. 253-275. Ed. by P. R. Boyle. Academic Press, London. 441pp.

Worms, J. 1983. World fisheries for cephalopods: A synoptic overview. In Advances in assessment of world cephalopod resources, pp. 1-20. Ed. by J. F. Caddy. FAO Fisheries Technical Paper No. 231. FAO, Rome. 452pp.

Species	Abundance	Depth range	Fishery Status/Potential
Loligo forbesi	Seasonally abundant in bottom trawls	25-400 m	Currently exploited
Loligo vulgaris	Uncommon	< 200 m	None
Alloteuthis subulata	Abundant in research trawls	10-100 m	None
Ommastrephes bartrami	Occasional by-catch of bottom trawl and surface nets	>200 m	Unlikely
Todarodes sagittatus	Frequent by-catch in bottom trawls and surface nets on west coast	>100 m	Unlikely
Todaropsis eblanae	Seasonally abundant in bottom trawls on west coast	>50 m	Potential on west coast
Illex coindetii	Seasonally abundant in bottom trawls on west coast	>50 m	Potential on west coast
Architeuthis dux	Rare by-catch in bottom trawls	?	None
Histioteuthis bonnellii	Rarely caught	?	None

Table 1. Records of squid species by-caught by Irish fishing vessels between 1991 and 1995, with comments on abundance and fisheries potential.

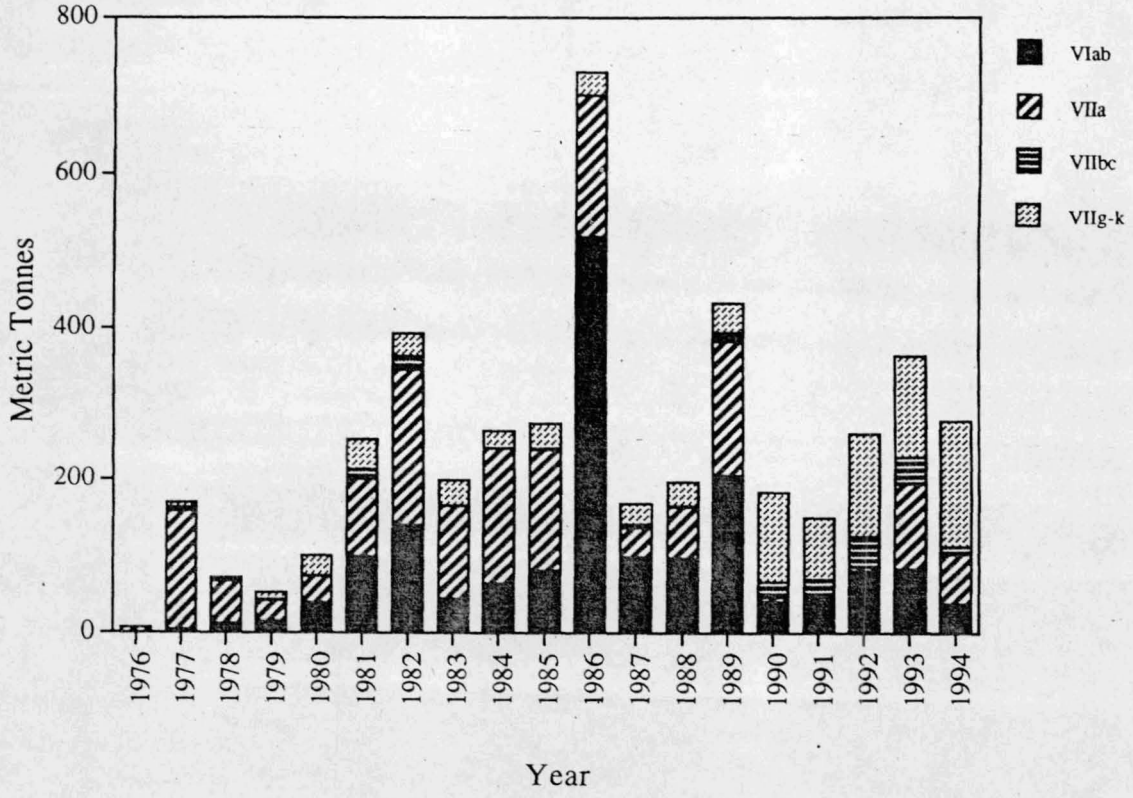

Figure 2. Annual landings of squid from Irish waters into Irish ports for 1976-1994

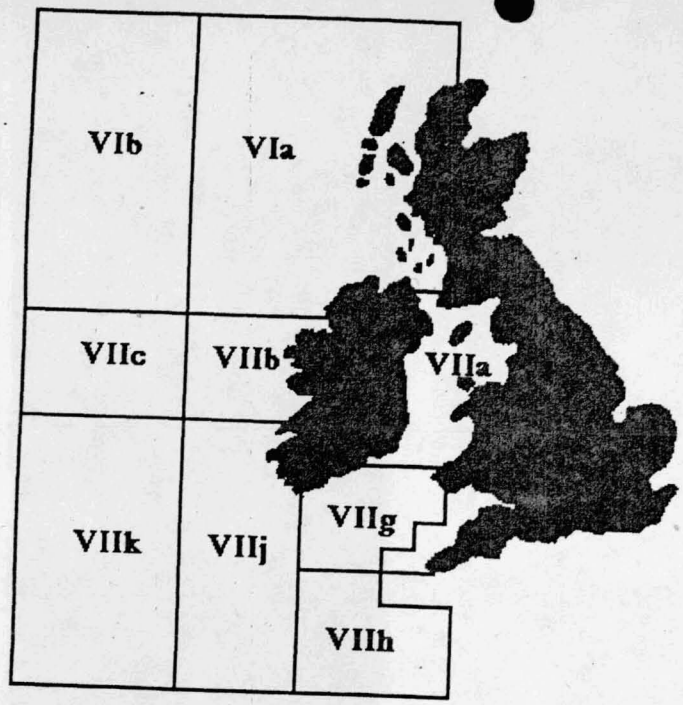

Figure 1. ICES Statistical areas around Ireland.

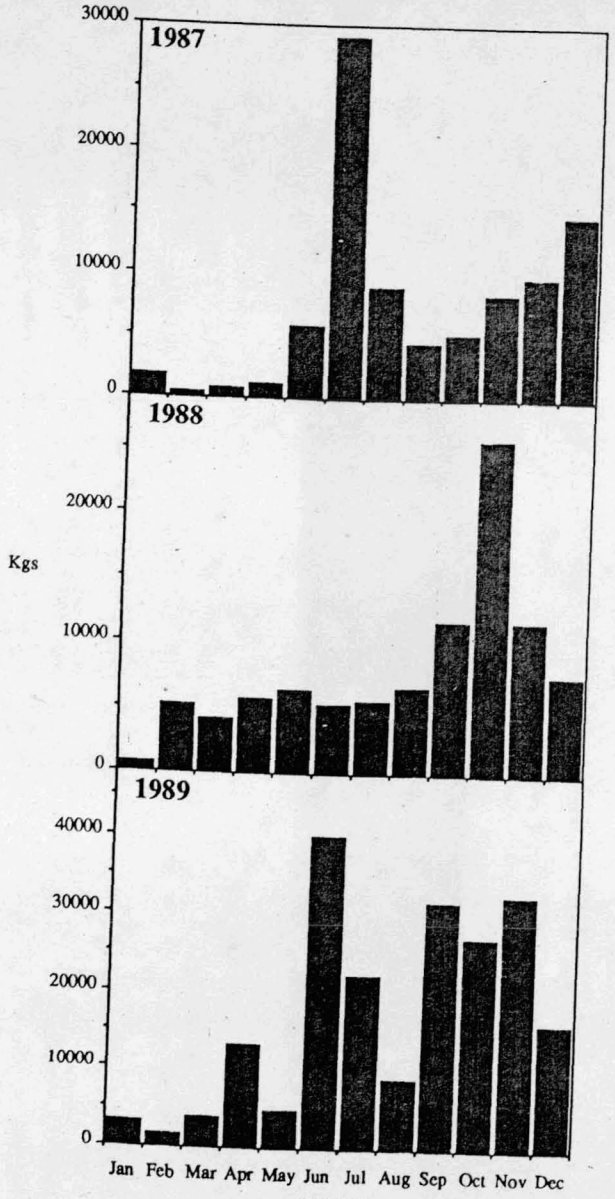

Figure 3. Monthly landings of squid in Irish ports from ICES areas VIab for the years 1987-1989.

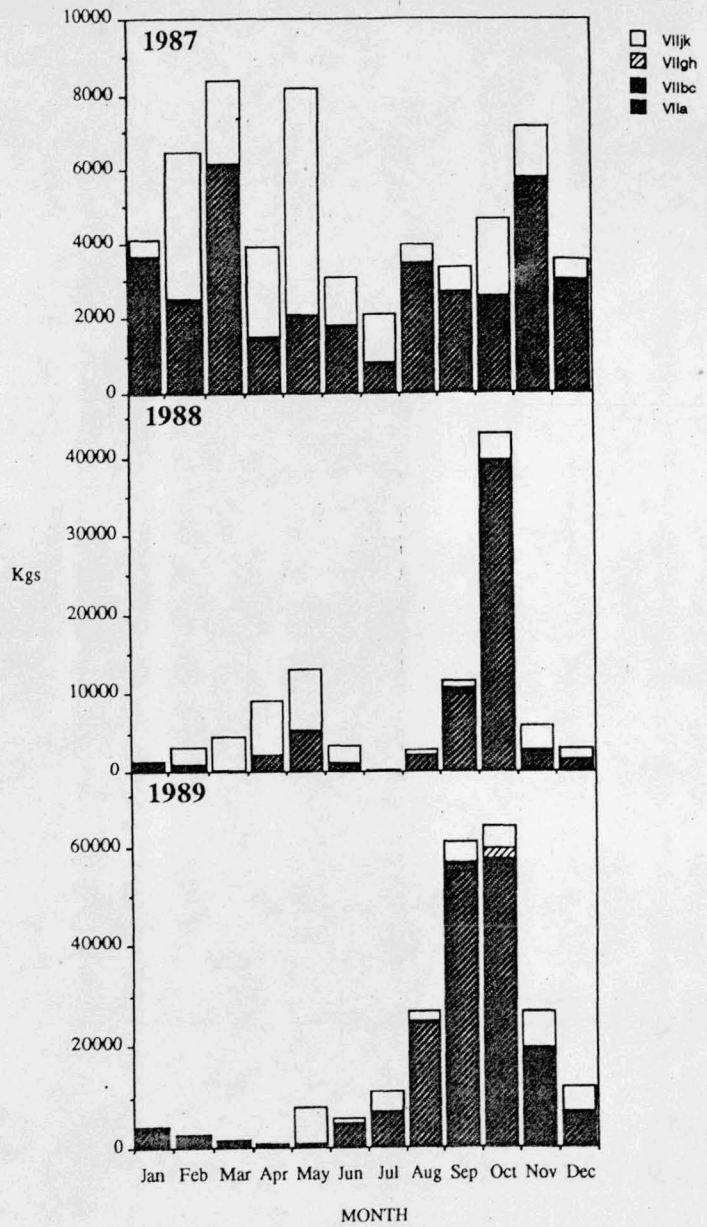

Figure 4. Monthly landings of squid in Irish ports from ICES area VII for the years 1987-1989.

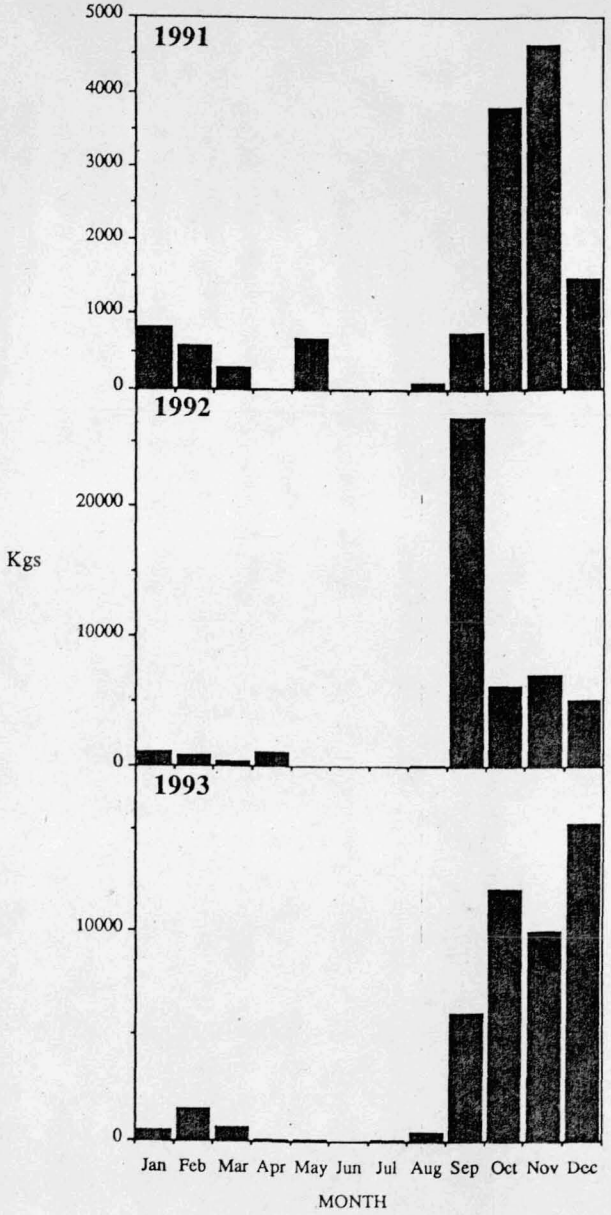

Figure 5. Monthly landings of *Loligo forbesi* in the port of Dunmore East, County Waterford for the years 1991-1993.