Arch. Ryb. Pol.	Archives of Polish Fisheries	Vol. 4	Fasc. 2a	249 - 266	1996

THE RIVER SHANNON EEL FISHERY - A MANAGEMENT REVIEW

D. Quigley & T. O'Brien

Salmara Fisheries Ltd., 39 Merrion Square, Dublin 2, Republic of Ireland

A B S T R A C T. The River Shannon has supported important eel fisheries for many centuries but following the construction of hydroelectric dams on the lower reaches in 1928, the immigration of elvers was seriously impeded. An additional elver pass was constructed in 1958 and during the following year a development programme was established, involving overland transport of elvers to regions upstream of the dams. During the 1940s the annual catch of silver eels averaged 17.8 tonnes, but this decreased to 9.6 tonnes during the 1950s. Following the commencement of the elver restocking programme, catches began to increase steadily from an average of 19.3 tonnes during the 1960s to 33.0 tonnes in the 1970s and 47.3 tonnes in the 1980s with apparent stabilisation at this level in recent years.

Extensive long-line fishing for eels took place until 1968 when fishing for yellow eels was banned by the Electricity Supply Board (ESB), the fishery owners. However a limited amount of yellow eel fishing has been permitted since 1983. Catches increased from 2.9 tonnes in 1983 to 10.2 tonnes in 1992. Additional licences have been issued in 1993. The main markets are Germany for large silver eels and the Netherlands for small and medium-sized silver and yellow eels.

Current and previous management programmes are discussed, together with proposed future plans for the development of the fishery. A review of the economic and socio-economic aspects of the fishery are also reviewed.

Key words: RIVER SHANNON, EEL, FISHERY, SOCIO-ECONOMIC ASPECTS, MANAGEMENT.

INTRODUCTION

The River Shannon has supported important eel fisheries for many centuries (Went 1950). Indeed, there is evidence that eels were exploited on the Shannon by Mesolithic man some 9,000 years ago (Moriarty 1988) and many specialised eel fishing spears have been discovered throughout the catchment (Went 1974).

The Shannon is the longest river in Ireland - 257 km (Fig. 1). It drains a total catchment area of 11,880 km^2, which is equivalent to almost one third of the entire surface area of the country. The system includes several large lakes which together amount to a combined surface area in excess of 35,000 ha. Most of the lakes are eutrophic in nature and the alkalinity ranges from 100 to 205 m eq/l (Moriarty 1989).

Following the construction of hydroelectric dams on the lower reaches of the river in 1928 by the Republic's state-owned Electricity Supply Board (ESB), it was discove-

Fig. 1. The Shannon Catchment

red that the immigration of elvers was seriously impeded. In order to address this problem (as well as other problems relating to salmon stocks), ESB was entrusted through the 1935 and 1938 Shannon Fisheries Acts with statutory responsibilities for the management of the river's fisheries. In 1988, responsibility for the commercial eel fishing operations was transferred to ESB's newly established aquaculture subsidiary - Salmara Fisheries Ltd., while responsibility for the management of the fishery remained with ESB's Fisheries Conservation Unit.

DESCRIPTION OF EEL FISHERY

ESB began commercial eel fishing operations in 1937 at three locations on the Shannon - Killaloe, Athlone and Castleconnell (Fig. 1). In 1940, a new eel weir was built at Killaloe in order to replace several smaller weirs which were situated further downstream in the old river channel at Castleconnell (O'Leary 1970a, McGrath et al. 1976). However, when the inefficiency of the Killaloe weir became apparent, three more weirs were subsequently built further downstream on the Ardnacrusha headrace canal at Clonlara in 1966, 1981 and 1982 (O'Leary 1982). Other catching stations have been operated, albeit infrequently over the years, at upstream locations such as Meelick, Boyle, Lough Rinn, River Inny and River Big Brosna (Anon 1981). Ascending juvenile eels and elvers are captured at Parteen and Ardnacrusha Dams and are restocked further upstream in the system (Moriarty 1983a, 1986a).

MANAGEMENT PROGRAMMES

Prior to the commencement of the hydroelectric scheme in 1928, catches of at least 69 tonnes of silver eels per annum had been recorded (Anon 1908). Indeed, over 65 tonnes was taken in 1927 (Anon 1928). However, after the dams were built, catches declined dramatically from an average of 17.8 tonnes during the 1940's to 9.6 tonnes during the 1950's (Fig. 2). Following the initiation of an elver restocking programme in 1959, catches increased from an average of 19.5 tonnes during the 1960's, and continued to increase from 33.0 tonnes during the 1970's to 47.3 tonnes during the 1980's, and would appear to have established at around this level in recent years.

1. KOOPS MANAGEMENT PLAN (1971)

In order to address the overall decline in recruitment and catches experienced during the 1950's, ESB constructed an additional elver pass at Ardnacrusha Power Station in 1958, and during the following year, an elver collection and restocking programme was started (Fig. 3). Initially, elvers were transported overland only as far as Lough Derg, the first major lake on the system (Table 1). The stocking programme was extended to the midland lakes during 1968 and then to the upper lakes in 1971 following the advice of Koops (1971) who estimated that at least 20.7 million elvers

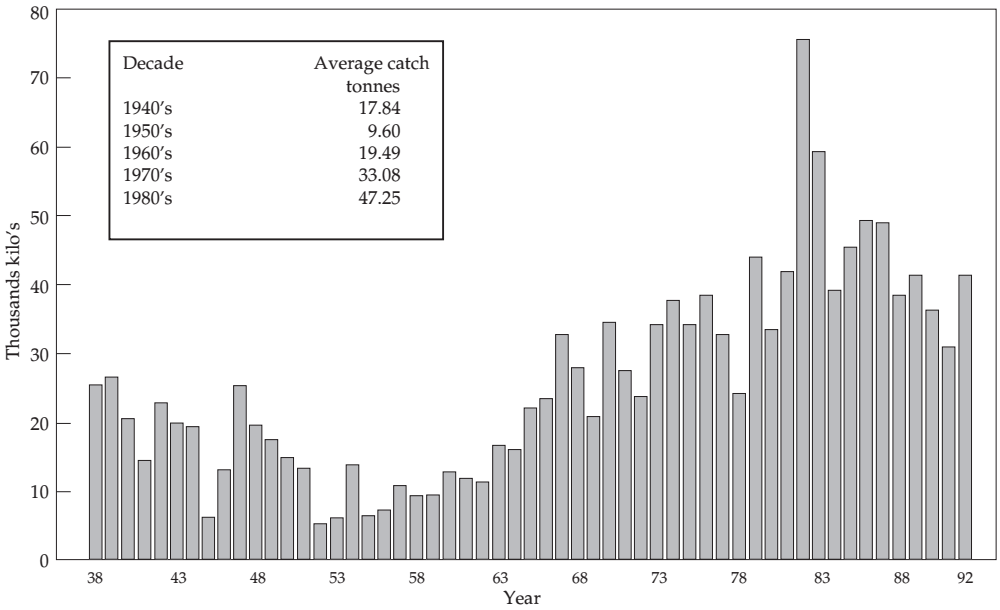

Fig. 2. Silver eel catch River Shannon 1938-1992

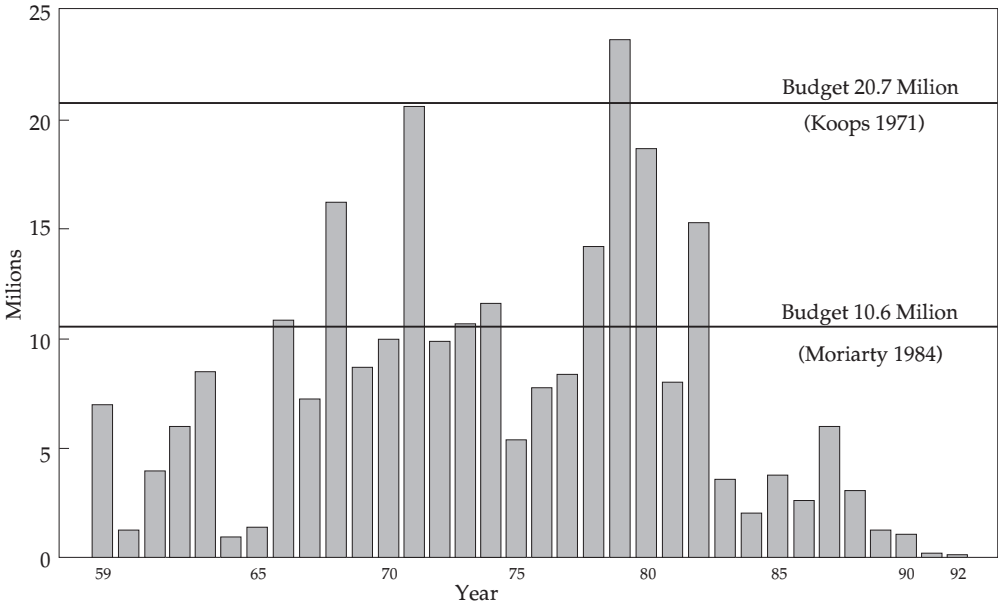

Fig. 3. Elver restocking River Shannon 1959-1992

TABLE 1

Juvenile eels & elvers stocked into various parts of the Shannon system (millions), 1959–1992

	Lough Derg	River Suck	Brosna Lakes	Inny Lakes	Lough Ree	Loughs Forbes Bofin	Lough Key	Lough Allen	Total
1959	7.0								7.0
1960	1.3								1.3
1961	4.0								4.0
1962	6.0								6.0
1963	8.5								8.5
1964	0.9								0.9
1965	1.4								1.4
1966	10.8								10.8
1967	7.3								7.3
1968	8.8		2.7	2.5	2.2				16.2
1969	4.5		2.1		2.1				8.7
1970	2.2			1.2	6.6				10.0
1971	10.0		0.5	2.2	5.0	0.7	1.3	0.9	20.6
1972	3.7			0.5	2.7			3.0	9.9
1973	8.1			0.4	2.2				10.7
1974	6.2	0.2		1.2	4.0				11.6
1975				1.1	4.0		0.3		5.4
1976	2.3	0.4			4.9		0.2		7.8
1977	4.3			0.9	2.9		0.3		8.4
1978	4.5			0.7	6.1	1.6	1.3		14.2
1979	10.3				4.4	1.5	7.5		23.7
1980	9.1	0.2	0.2		8.0		1.3		18.7
1981	6.0	0.2	0.2		1.2		0.5		8.1
1982	8.0	0.5	0.9	0.9	3.0		1.2	0.8	15.3
1983	2.5	0.1	0.1		0.5			0.4	3.8
1984	1.8				0.3				2.1
1985	3.7	0.1							3.7
1986	2.1	0.2	0.2	0.2					2.7
1987	5.1	0.3			0.7				6.1
1988	3.1								3.1
1989	1.3								1.3
1990	1.2								1.2
1991	0.3								0.3
1992	0.2								0.2
Total	156.5	2.2	6.9	11.8	60.8	3.8	13.9	5.1	260.9
Average	4.6	0.06	0.2	0.3	1.8	0.1	0.4	0.2	7.7
Proposed Annual Budget									
(Koops 1971)	6.4	0.4	0.9	2.4	5.4	1.5	2.0	1.8	20.7
(Moriarty 1984)	4.2	-	0.5	1.4	3.8	-	0.7	-	10.6

TABLE 2

Total catch (Nos) of elvers and juvenile eels 1977–1992

Year	Parteen	Ardnacrusha	Feale	Maigue	Total
1977	698,500	2,241,000	4,379,000	1,223,000	8,541,500
1978	1,965,000	3,150,000	8,300,000	875,000	14,280,000
1979	630,000	15,075,000	8,067,500	25,000	23,797,500
1980	1,189,050	10,076,000	6,455,000	975,000	18,695,050
1981	583,750	4,730,000	2,780,625		8,097,375
1982	348,000	6,925,000	6,680,000	1,320,000	15,273,000
1983	186,000	1,400,000	2,042,500		3,628,500
1984	105,000	1,130,000	860,000	20,000	2,115,000
1985	213,000	2,473,000	1,110,000		3,796,000
1986	569,000	2,111,000			2,680,000
1987	2,560,000	3,540,000			6,100,000
1988	2,790,000	320,000			3,110,000
1989	1,282,000	59,000			1,341,000
1990	214,000	1,030,000			1,244,000
1991	82,000	199,000			281,000
1992	129,030	47,000			176,030

(500 elvers/ha) would be required each year in order to maximise the potential yield of the fishery, estimated at 828-1,657 tonnes per annum (20-40 kg/ha).

However, it was clear that the numbers of elvers required by Koop's management programme were rarely available from the Shannon system alone. It was therefore decided to supplement the Shannon catch with elvers from several other nearby systems, particularly the Rivers Feale and Maigue (Table 2). A special low head elver trap was designed by O'Leary in 1970 in order to improve catches in rivers affected by arterial drainage works. Despite the fact that some relatively large catches were taken during the late 1970's and up to the mid 1980's, Koop's elver requirement was only achieved on one or two occasions (1971 & 1979) during the last 34 years (Fig. 3).

2. MORIARTY MANAGEMENT PLAN (1984)

Following the initiation of the elver restocking programme, a number of stock assessment surveys confirmed that the population of yellow eels in the Shannon had increased dramatically since 1959 (Moriarty 1974, 1981, 1982, 1984 and 1987). However, despite the apparent increase in the stock of immature eels, as well as attempts at inc-

TABLE 3

Potential eel yield (at 20 kg/ha) based on a stocking requirement of 350 elvers/ha in shannon lakes of area > 500 ha and conductivity > 125 S/cm (Moriarty 1984)

Shannon catchment	Area (ha)	Potential yield (kg)	Stocking requirement (kg at 3,000 elvers/kg)	No. elvers (millions)
Derg	11,635	233,100	1,396	4,188,000
Derravaragh	1,100	22,000	132	396,000
Ennell	1,400	28,000	168	504,000
Gara	1,100	22,000	132	396,000
Key	900	18,000	108	324,000
Owel	950	19,000	114	342,000
Ree	10,500	210,000	1,260	3,780,000
Sheelin	1,900	38,000	228	684,000
	29,485	590,100	3,538	10,614,000

reasing silver eel trapping efficiency and effort, the actual yield of the fishery remained much lower than expected. Indeed, Moriarty (1984) estimated yields of no more than 1.4 kg/ha between 1976 and 1980 compared with yields of 15.4 - 20.5 kg/ha from Lough Neagh, a fishery situated in Northern Ireland, which in terms of physical characteristics, is very similar to the Shannon catchment (Moriarty 1987, Wood 1989).

Moriarty estimated that the largest lakes on the Shannon system should be capable of giving a combined yield of at least 590 tonnes of eels per annum (20 kg/ha), based on an elver stocking rate of 350/ha (Table 3), a total of 10.6 million elvers each year. These requirements have only been achieved on 9 (26.5%) occasions during the lat 34 years (Fig. 3). However, during the last 22 years, his budgeted annual juvenile eel biomass requirement (3,538 kg) was achieved on 11 (50%) occasions (Fig. 4). Indeed his biomass budget was exceeded by a factor of two on at least 4 occasions, while the annual average weight of juveniles stocked (4,031 kg) was 14% above budget. Despite this the annual yield of the fishery has never exceeded 76 tonnes, not to mention his estimated maximum yield of 590 tonnes.

3. FUTURE MANAGEMENT PLANS

(a) Elver & Juvenile Eel Recruitment

Although the elver restocking programme began in 1959, the budgeted rate of 350 elvers/ha was not achieved until 1966, so considerable improvements in catches

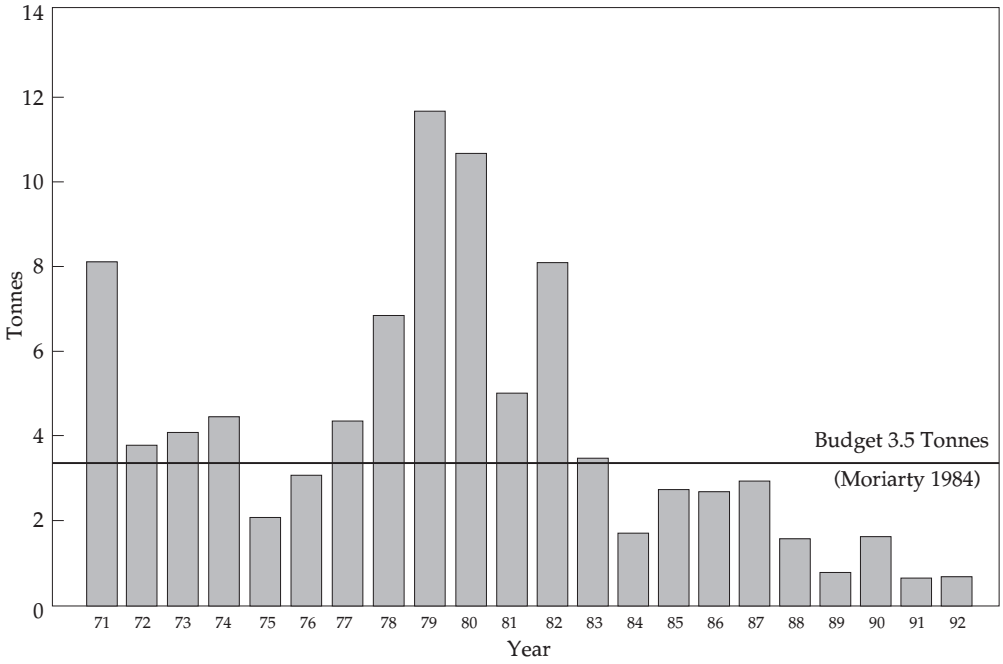

Fig. 4. Biomass of elvers and juvenile eels stocked River Shannon 1971-1992

may yet take place. The practice of stocking with supplementary elvers should be continued and extended wherever possible. However, during the last decade there has been a very serious decline in the elver runs, with a major collapse in the River Shannon in 1991 and 1992 (Fig. 3).

In view of the serious shortage of elver stocks, every effort should be made to improve catching methods and survival rates.

Stocking methods, locations and times should also be examined in order to achieve maximum survival and to minimise losses due to predation. Perhaps better survival could be achieved by artificially rearing the elvers to an optimum size before releasing them into the wild.

(b) Yellow Eel Stocks

Moriarty (1984) suggested that fishing effort may not have been increasing at a rate which would be sufficient to harvest the increased stocks of immature eels efficiently.

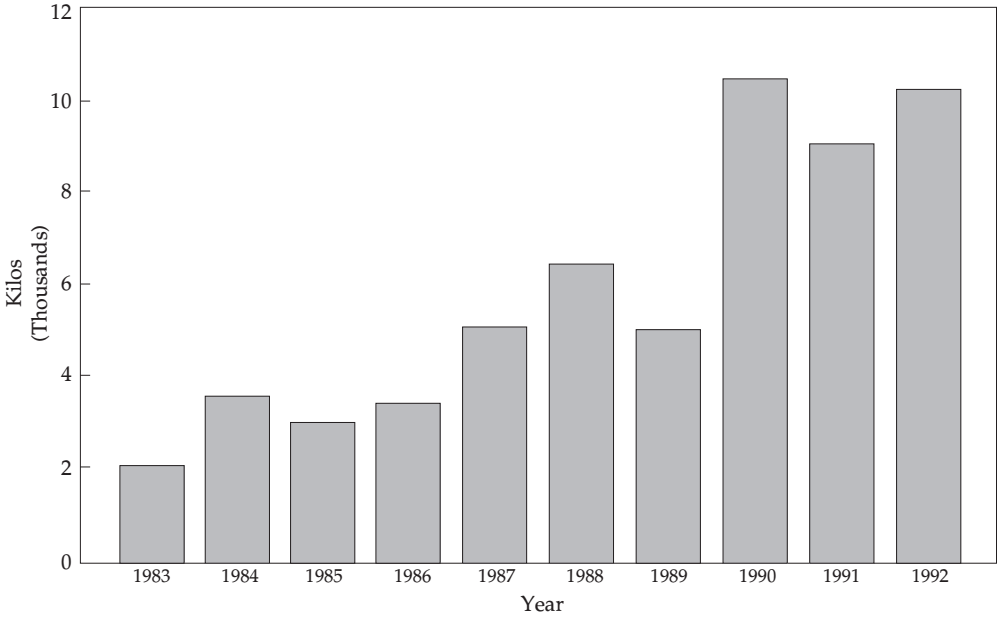

Fig. 5. Yellow eel catch in River Shannon 1983-1992

Extensive long-line fishing took place until 1968 when fishing for yellow eels was banned by ESB in the interest of conserving immature eels. However, since 1983, a limited, albeit increasing, amount of fyke net fishing for yellow eels has been permitted. Only 10 licences were operated in 1992, increased to 20 in 1993. Annual catches have been relatively low, but they have increased in parallel with fishing effort from 2.0 tonnes in 1983 to over 10.2 tonnes in 1992 (Fig. 5).

However, in the Lough Neagh fishery, about 180 licensed eel fishermen use long lines exclusively and catch more than 20 times as much as that recorded on the Shannon. Moriarty (1990a) suggested that the difference between the two fisheries appears to depend entirely on fishing effort and concluded that the Shannon lakes contain a stock which cannot be fully exploited by the current low intensity fishing effort.

(c) Silver Eel Stocks

Moriarty (1987) pointed out that the Lough Neagh silver eel fishery captures more than double that of the Shannon. Indeed, from 1965 to 1988, the silver eel catch at Toome Weir (Lough Neagh) varied from 121 to 341 tonnes (Wood 1989).

Significant improvements will have to be made at the Shannon eel weirs in order to increase the overall catch efficiency. Attempts should also be made at reactivating currently abandoned weirs.

(d) Protection of the Shannon Eel Fishery

The practical problems of policing such a large catchment area as the Shannon hardly needs emphasis. While poaching is known to the place, it is considered by Moriarty (1987) not to have any noticeable effect on the stocks. The issuing of a sufficient number of eel fishing licences should help to establish a self-policing system. However, certain statutory changes in Irish fishery law are required regarding the legal possession of eels and sufficient resources to implement such laws must also be made available to the appropriate regulatory authorities.

(e) Ecological Factors

Finally, ecological factors, such as greater competition for food, and/or higher predation in the Shannon system may prevent the development of eel populations of similar density to those inhabiting Lough Neagh (Moriarty 1984).

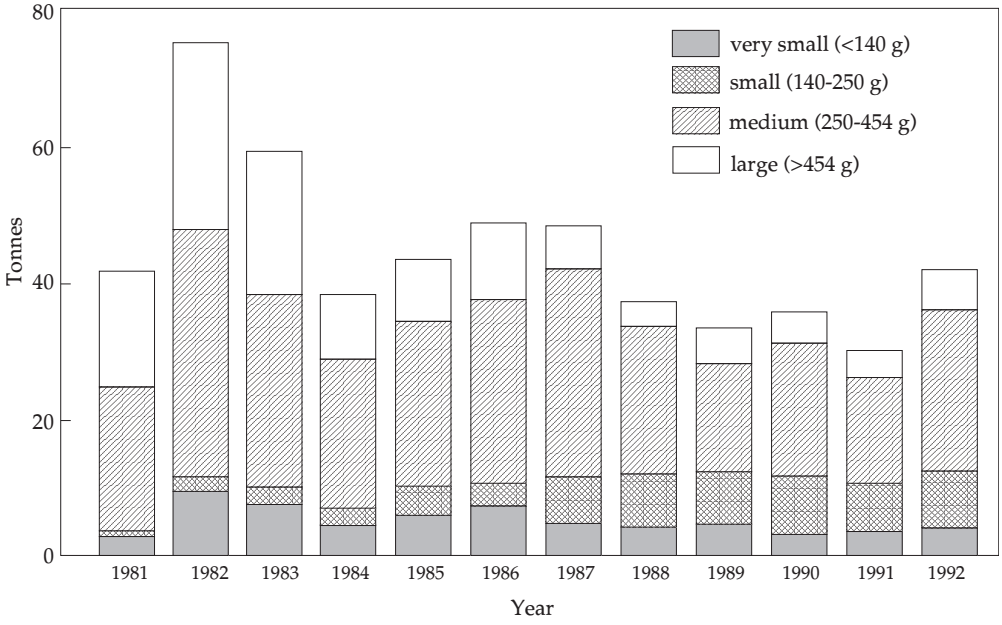

Fig. 6. Size frequency distribution of silver eel sales - River Shannon 1981-1992

ECONOMIC ASPECTS OF THE SHANNON EEL FISHERY

Over 99% of the catch from the Shannon eel fishery is exported, either alive (as ungraded yellow eels) or frozen (as silver graded eels), to European markets; mainly Holland (70-75%) and Germany (11-15%).

The Dutch market has a preference for small and medium grade eels while the German market prefers the medium and large grades. In recent years there has been a noticeable decrease in demand for the very small eel grade due to increasing competition from European farmed eels as well as cheaper imports from North America, Australia, New Zealand and Asia. This is disturbing development in view of the fact that very small eels constitute a not insignificant and increasing proportion (6.7 - 14.3%) of the total annual catch.

CHANGES IN PERCENTAGE SIZE FREQUENCY DISTRIBUTION OF THE COMMERCIAL SILVER EEL CATCH

There have been significant changes in the catch composition during the last 12 years (Fig. 6). In 1981, small grade eels made up only 2.4% of the total annual catch, but by 1992 this had increased to 20.3%, whilst the percentage of large grade eels fell from 40.4% to 14.0%. In contrast, the percentage of very small and medium grade eels appears to have remained relatively steady. The total annual tonnage does not appear to have been affected implying that the emigrating number of small eels has been increasing but that the average size of all emigrants combined has been decreasing.

By 1981 Moriarty (1984) had noted that the continuing elver restocking programme had brought about a marked increase in yellow eel numbers especially smaller eels. Fewer large silver eels are also found (Moriarty 1984, 1990b).

Parsons et al. (1977) also noted a marked increase in the proportion of (smaller) male silver eels migrating from Lough Neagh following each period of elver transport. Between 1965 and 1974, they observed a progressive increase in the percentage of male eels from 9.3 to 86.0% and concluded that elver transport was directly implicated, possibly due to overstocking of Lough Neagh.

In contrast, a study of the silver eel migration in the unstocked Burrishoole Fishery in western Ireland between 1959 and 1988 revealed a significant change in the sex ratio from 94.5% males in 1962 to 37.5% in 1988. Although the total weight of the catch did not change, there was a significant decrease in the number of migrants but a major

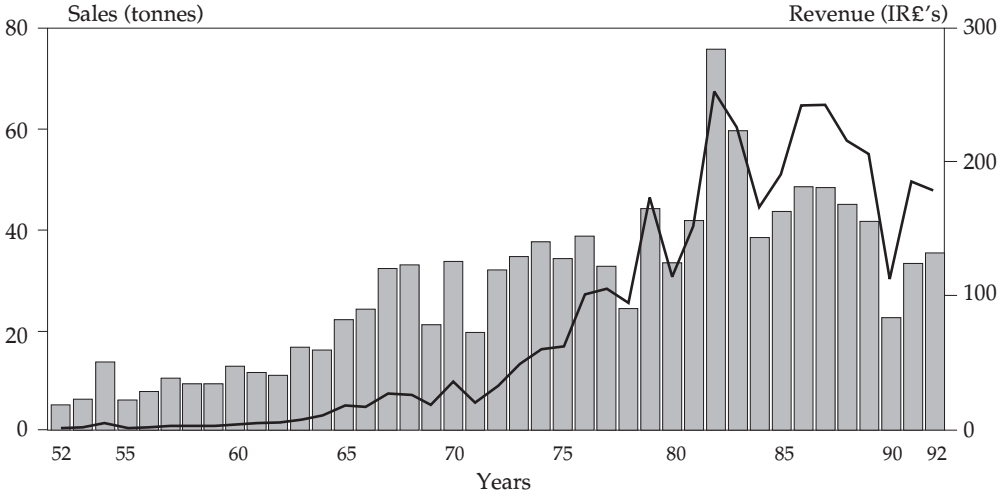

Fig. 7. Silver eel sales and revenue. River Shannon 1952-1992

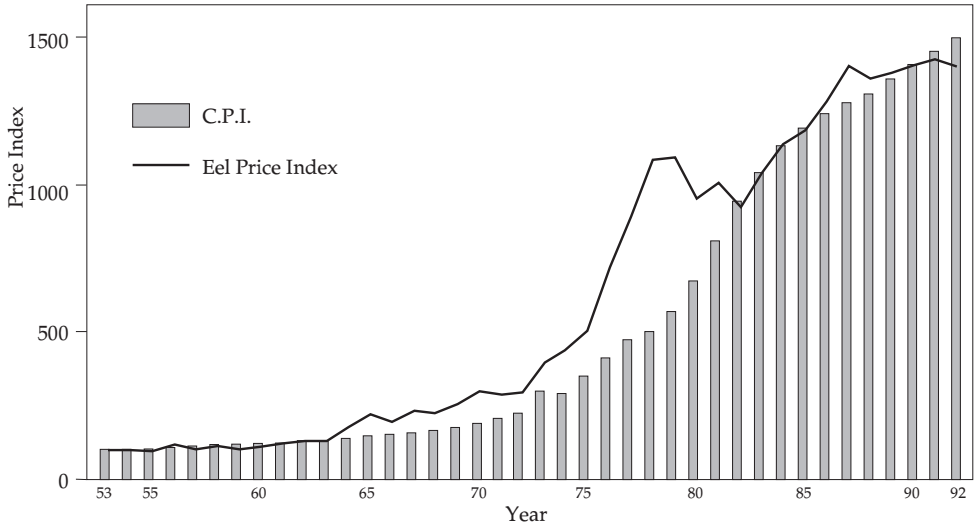

Fig. 8. Irish consumer price index v frozen silver eel price index 1953-1992

increase in their average weight. In fact, males actually increased in length by 16.5% and females by 27.6%. It was suggested that a decrease in elver recruitment into freswater and a change in the environmental status of the system may have been possible reasons for the observed changes (Poole et al. 1990).

It would be ironic if the changes in the size frequency distribution of the commercial silver eel catch were due to over-stocking by elvers. It is possible that the system is

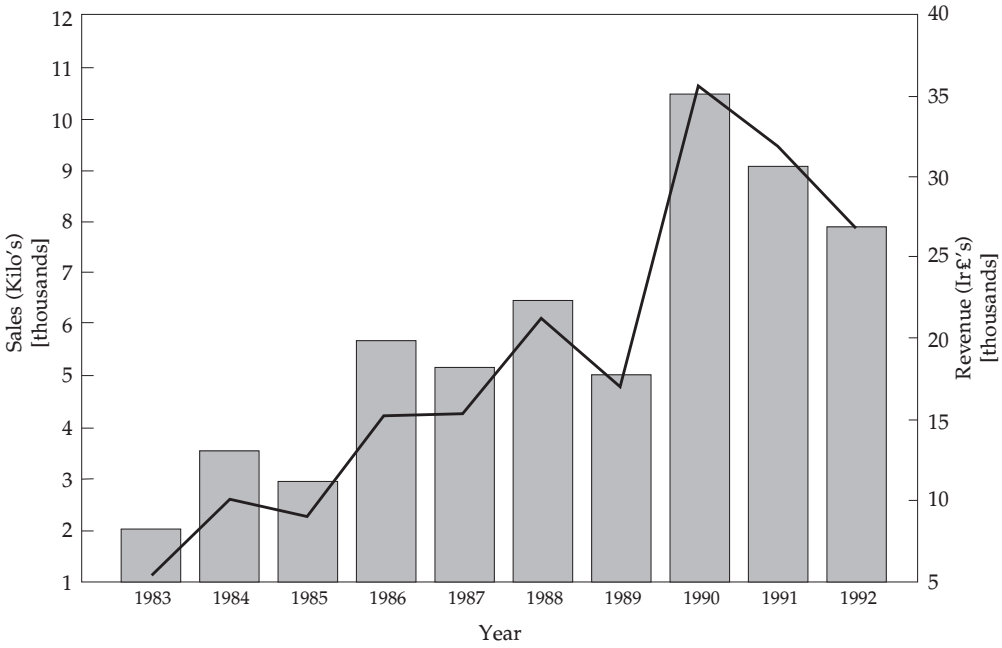

Fig. 9. Yellow eel sales and revenue. River Shannon 1983-1992

already at its maximum carrying capacity. If this hypothesis is correct, it would imply that the current dearth of elvers may give rise to a smaller number of bigger eels in the future.

THE VALUE OF THE SHANNON EEL FISHERY

Figure 7 shows that revenue from the silver eel fishery has fluctuated between £150,000 to £250,000 p.a. in recent years, and has generally increased in line with increasing catches over the last four decades.

However, on closer examination, it is clear that the actual price per kg has varied significantly, and not necessarily in line with annual inflation rates. In Figure 8 a comparison is made between the Irish Consumer Proce Index (Anon 1992a) and an index of frozen silver eel prices from 1953 to 1992. It is clear that eel prices kept very closely in line with annual infation between 1953 and 1963. However, from 1964, eel prices began to increase gradually ahead of inflation rates, and following Ireland's entry into the EC in 1973, eel prices increased at an even greater rate. Excellent prices were obtained up to 1981 but thereafter prices fell back in line with annual inflation rates. A-

part from a slight improvement in prices in 1986, prices in recent years have actually fallen behind inflation rates. Although revenue from live yellow eel sales is substantially smaller, it would appear to have followed a similar pattern to that observed for frozen silver eels (Fig. 9).

In contrast, sea fish price shave tended to rise with or exceeded the rate of inflation. It is interesting to note that the price of eel in Japan (the world's largest eel consumer) over the past 20 years has also remained basically unchanged, and even seems to be dropping slightly in recent years (Anton 1992b). Similarly, the wholesale price of live/fresh eels in the Rungis market in France has remained more or less static since 1985, while the price of smoked eel has actually decreased significantly in recent years (Franssu 1989).

FUTURE OUTLOOK FOR THE SHANNON EEL FISHERY

The Shannon eel fishery contributes very little to the total world production of eels which was recently estimated at 110,000 tonnes p.a. (Franssu 1989). The eel trade in Europe is a very specialised business because of the highly specific requirements of each market regarding product quality and size (Anon 1991). From 1970 onwards, the landings of the wild eel fisheries in Europe declined significantly from about 15,000 tonnes p.a. in the late 1960's to about 9,000 tonnes p.a. around 1984. Overfishing, environmental changes, water pollution, and diminishing recruitment are all believed to be responsible (Belpaire 1990). The demand for eels in Europe is still regarded as high. Indeed, during the 1980's, the total demand for eels in the EEC was estimated at 23,650 tonnes p.a. (Belpaire 1990). However, there is no evidence of a significant increase in eel consumption, at least in the short term, although generally speaking, in the last 10 years the eel market has been rather stable (Anon 1991). A recent survey estimated that European demand could be doubled to 50,000 tonnes p.a. by increased marketing efforts (Houvenaghel 1989).

In 1989, a total of 5,500 tonnes of farmed eels was produced by EEC countries (Anon 1991) which represents about 25% of the total European consumption. Although farmed eel production has been increasing, the rate of increase has undoubtedly been hampered by many technical and disease problems, and the eel industry picture in Europe is still cloudy since eel farming remains a high-risk venture. Nevertheless, it should be noted that farmed eels are generally better accepted than wild eels, especially by the Dutch market, particularly for smoking, because of their consistently

high fat content, homogeneous grading, and better resistance to transportation. In fact, farmed eels command a premium of about 20% over wild eels (Franssu 1989).

There is also evidence that the consumption of smoked eel is likely to continue it's downward trend, particularly where large eels are used; eg. in Germany where about 90% of the demand is for large smoked eels. Due to the declining supply of large eels and the consequent price increases, some customers have diverted to other products. The trend is reinforced by the increasing reluctance of consumers to buy fatty food products, together with the growing availability of cheaper smoked farmed salmon (Franssu 1989). The eel industry obviously needs an intensive marketing programme in order to highlight the nutritional benefits of eel as a food product; eg. eels are very high in Vitamin A. A similar marketing strategy with fresh sea fish has obviously been very successful in increasing both demand and prices.

Although the Shannon, even by European standards, produces a very small quantity of eels, and will always contribute a relatively small amount to European markets, every effort should be made to maintain the high quality image of the product as well as the fact that it is a wild product captured by traditional fishing methods in a pristine environment. However, due to the fishery's relatively high level of fixed overhads, catches must also be increased if prices continue their current downward trend. The value of the product could also be increased by further processing in Ireland, although this would also undoubtedly involve substantial market development costs.

SOCIO-ECONOMIC ASPECTS OF THE SHANNON EEL FISHERY

Salmara currently employs a total of five full-time staff and about six part-time staff on the Shannon Eel Fishery. ESB Fisheries Conservation employ a further five full-time staff on fisheries protection. In addition, there are currently twenty part-time fyke netting crews (40 people) fishing on a contract basis for Salmara. If the fishery was able to support Moriarty's (1984) estimated yield of 590 tonnes p.a., the resource could possibly provide employment for as many as 200 people.

Although the current revenue generated by the fishery is relatively small (£175,000 - £285,000 p.a.), the value of the fishery could be substantially increased if Moriarty's estimated yield of 590 tonnes was attainable. At current market prices the minimum est9imated first sale vaule of eels from the Shannon fishery could be in the region of £2.3 million p.a.).

The development of the full potential of the eel fishing industry in Ireland could have important socio-economic benefits. In 1986, it was estimated that a total of 5,813 people had either full or part-time employment in Irish inland fisheries; including 220 (3.8%) people known to be engaged in eel fishing (Anon 1986). In 1992 it was estimated by the Central Fisheries Board (CFB) that an extra 330 full-time jobs could be created over the next 10-15 years if eel stocks were properly managed (Anon 1992c). Indeed, based on the phenomenal catches of eels obtained each year in the Lough Neagh eel fishery in Northern Ireland (Wood 1989), the CFB estimated that the present harvest of eels in Ireland (about 100 tonnes) could be increased to 1,500 tonnes p.a. by the annual transplantation of 13 tonnes of elvers.

ACKNOWLEDGEMENTS

We would like to express our thanks to Anna, Bella, Miriam, Noreen and Peter in Salmara, and Brendan and Liz in the Central Statistics Office for all their help.

REFERENCES

Anon. 1908 - Report of Sea & Inland Fisheries of Ireland.

Anon. 1928 - Report of Sea & Inland Fisheries of Ireland.

Anon. 1981 - ESB Fisheries Report for the year ended 31st March 1981. Electricity Supply Board, Dublin.

Anon. 1986 - Inland Fisheries: Strategies for Management & Development, Central Fisheries Board, Dublin.

Anon. 1991 - EurAqua '92: Aquaculture in the European Community. EC Publications, 3.

Anon. 1992a - Consumer Price Index: Introduction of Updated Series (Base: Mid November 1989 as 100) Central Statistics Office, Dublin.

Anon. 1992b - Internationalization comes to the Japanese Eel Industry. Yamaha Fishery Journal No 39, 8.

Anon. 1992c - Inland Fisheries - Job Creation: The Central and regional Fisheries Boards. CFB August 1992.

Belpaire C. 1990 - Eel Culture in Europe: Past & Present state.

Franssu Luc de. 1989 - World Eel Market Review. Infofish International, 6, 18-22.

Houvenaghel G. 1989 - Assessment of the needs to culture the eel *Anguilla anguilla* in Europe. In: Aquaculture - A Biotechnology in progress, 1989, 168-178. N. de Pauw, E. Jaspers, W. Ackeford, N. Wilkins (Eds.). European Aquaculture Society, Bredene, Belgium.

Koops. 1971 - Eel Fisheries Development: Report on discussions with Mr. Koops, May 1971. Electricity Supply Board Internal Memorandum.

McGrath C.J., O'Leary D.P., Sharkey P.J. & Murphy D.F. 1976 - Experimental Electrical Guidance System for Eels at Killaloe Eel Weir on the River Shannon. ICES/EIFAC Symposium on Eel Research & Management, No. 66.

Moriarty C. 1974 - Studies of the eel *Anguilla anguilla* in Ireland 3: In the Shannon Catchment. Ir. Fish. Invest. Ser. A, No. 14.

Moriarty C. 1979 - Biological studies of yellow eels in Ireland. Rapp. P.-v. Reun. Cons. int. Explor. Mer. 174, 16-21.

Moriarty C. 1981 - Prospects for the development of the Irish Eel Fishery. Fishery Leaflet, No. 109.

Moriarty C. 1982 - Development of two eel *Anguilla anguilla* fisheries in Ireland. proc. North Am. Eel Con. 1982, Ontario Fisheries Technical Report Series No. 4, 66-69.

Moriarty C. 1983a - A study of ascending eels in the River Shannon, Ireland. EIFAC Working Party on Eel, Drottingholm 1983.

Moriarty C. 1983b - A population study of the eel *Anguilla anguilla* in Meelick Bay, Lough Derg. Fisheries Bulletin No. 7.

Moriarty C. 1984 - Stock enhancement in the Irish eel (*Anguilla anguilla*) fishery. EIFAC Tech. Pap. (42) Suppl. Vol. 1, 50-58.

Moriarty C. 1986 - Riverine migration of young eels *Anguilla anguilla* (L.). Fisheries research, 4, 43-58.

Moriarty C. 1987 - The eel stocks of the Shannon System and prospects for the development of the fishery. Fishery Leaflet No. 139.

Moriarty C. 1988 - The eel in Ireland. Went Memoral Lecture 1987, Royal Dublin Society, Occasional Papers in Science & Technology No. 4.

Moriarty C. 1989 - The silver eel catch on the lower River Shannon, Ireland. EIFAC Working Party on Eel, Porto 1989.

Moriarty C. 1990a - Eel management in three lake systems in Ireland. In: W.L.T. van Densen, B. Steinmetz & R.H. Hughes (Eds.). Management of Freshwater Fisheries. Proc. Sym. EIFAC Goteborg, Sweden, 31st May to 3rd June 1988. Pudoc. Wageningen, 262-269.

Moriarty C. 1990b - Short note on the Silver Eel Catch on the Lower River Shannon. Int. Revue ges. Hydrobiol. 75 (6), 817-818.

O'Leary D.P. 1970 - A low head elver trap; EIFAC Consultation on eel fishing and technologies at the Institute for Fisheries, Hamburg, Germany, 12th-17th Oct. 1970.

O'Leary D.P. 1982 - Clonlara 2nd Fishing Station, EIFAC Report, Electricity Supply Board, Dublin.

Parsons J., Vickers K.U. & Warden Y. 1977 - Relationships between elver recruitment and changes in the sex ratio of silver eels *Anguilla anguilla* L. migrating from Lough Neagh, Northern Ireland. J. Fish Biol., 10, 211-229.

Poole W.R., Reynolds J.D. & Moriarty C. 1990 - Observations on the Silver Eel Migrations of the Burrishoole River System, Ireland, 1959 to 1988. Int. Revue ges. Hydrobiol. 75 (6), 807-815.

Went A.E.J. 1950 - Eel Fishing at Athlone: Past and Present. J. Royal. Soc. Antiquaries of Ireland, 80 (2), 146-154.

Went A.E.J. 1974 - Five eel spears from the Shannon basin. J. Old Athlone Soc. 1 (4), 246-249.

Wood B. 1989 - Lough Neagh: Managing To Stay Resourceful. Went Memorial Lecture 1988, Royal Dublin Society, Occasional Papers in Science & Technology No. 6.

STRESZCZENIE

WĘGORZ W RZECE SHANNON - PRZEGLĄD GOSPODAROWANIA RYBACKIEGO

Węgorz jest gospodarczo cennym gatunkiem w rzece Shannon, poławianym od wielu stuleci. Gospodarka tym gatunkiem została utrudniona po zbudowaniu w 1928 roku serii zapór hydroelektrycznych na dolnym biegu rzeki, które utrudniły wędrówkę węgorzyka szklistego w górę. W 1958 r skonstruowano przepławkę, a w następnych latach opracowano program przerzucania węgorzyka powyżej zapór. W latach czterdziestych średnie roczne odłowy węgorza spływającego (srebrzystego) wynosiły 17.8 ton, lecz w latach pięćdziesiątych spadły one do średnio 9.6 ton rocznie. Po wprowadzeniu programu przerzutów i zarybiania węgorzykiem montee połowy znów podwyższyły się, osiągając średnio rocznie 19.3 tony w latach sześćdziesiątych, 33.0 tony w siedemdziesiątych i 47.3 tony w osiemdziesiątych. Obecnie odłowy ustabilizowały się na wysokim poziomie. Odłowy węgorza żerującego są prowadzone wyłącznie na specjalne zezwolenia. Wzrosły one z 2.9 ton w 1983 r do 10.2 ton w 1992 r. Węgorz jest w znacznej mierze eksportowany; duży srebrzysty głównie do Niemiec, zaś mały i średni srebrzysty oraz żerujący do Holandii. W pracy omówiono program gospodarki węgorzem z uwzględnieniem uwarunkowań społeczno-ekonomicznych.