

# Strategy for the development of the eel fishery in Ireland

by

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## **EXECUTIVE SUMMARY**

(Heading numbers refer to Chapters)

### **1. Basic strategy**

The strategy is based on techniques known to be successful in Northern Ireland and elsewhere in Europe. It will increase the national yield of wild-caught eel by a factor of four, from 250 to 1,000 t/year. A parallel development of intensive culture could yield a further 1,000 t so that, with 1,000 t from Northern Ireland, an annual yield in the order of 3,000 t for the whole of Ireland can be achieved. A supply of this magnitude will provide the basis for a processing industry and bring about substantial cost reduction in handling and marketing, thereby maximising profits.

### **2. Biology**

The unique life cycle of the European eel is outlined, with particular reference to its single oceanic breeding place and the random return to continental waters of the progeny of the spawners.

### **3. The fishery**

Fishing for glass eel and elver is carried out under special authorisation. The catch is used largely for stocking open waters and, to a lesser extent, as seed for aquaculture. Yellow eel are caught mainly in lakes either by fyke net, which is subject to strict regulation, or by long-line which cannot be satisfactorily controlled under present legislation. Silver eel capture, except at designated fisheries operated between 1936 and 1938, is also subject to authorisation. The officially reported catch is in the order of 100 t/year. An estimate of an actual catch of 250 t is widely accepted.

### **4. Management and marketing**

Primary legislation exists which provides for satisfactory control of all eel fishing except the use of the long-line for yellow eel and the erection of fixed engines for silver eel. Marketing, subject to a statutory dealer's licence,

takes place on an *ad hoc* basis and there is great scope for rationalisation and development. Processing is confined to a very small number of cottage-level installations and should be developed.

### **5. Development**

Details of a national development scheme are provided. The scheme envisages State-funded stocking, research and monitoring.

### **6. Regional strategies**

Details of the different approaches recommended for each Fisheries Region are given, together with estimates of the quantities of elver required for each major river basin.

### **7. Aquaculture**

Aquaculture requires the capture of wild glass eel or elver as seed. The techniques are well developed and the demand excellent. The capture fishery would benefit from expansion of intensive culture.

### **8. National strategy**

The calculated cost of operating an initial 10-year research and development plan is equal to the value of a single year's enhanced yield at the end of the 10-year period. Whatever research study may be adopted, the provision of funding for a nationwide programme of elver capture and transfer should be put in hand without delay on the basis of the internationally agreed stocking levels.

### **9. All-Ireland permanent commission**

Expertise on the eel is too limited for the species to be managed effectively on a regional basis. The structure of an all-Ireland Commission to centralise management in both jurisdictions is outlined.

## **RECOMMENDATIONS**

### **1 Glass eel and elver**

Control of glass eel and elver capture should be confined to the Regional Fisheries Boards which would purchase and distribute the catch from authorised fishers. The first priority is for the stocking of natural waters to meet the calculated requirements, the second is for aquaculture and the third for commercial sale.

### **2 Yellow eel**

Legislation is urgently needed to require authorisation for long-line fishing and to designate the eel pot as a scheduled engine. A moratorium should be placed on new authorisations for yellow eel except where positive results of stock enhancement become apparent. Future yellow eel authorisations should be distributed according to designated fishing zones. Waters deemed unlikely to be the basis of profitable eel fisheries should be listed and declared sanctuary areas. A nationwide size limit of 35 cm for yellow eel is recommended.

### **3 Silver eel**

In the interests of conserving spawning stock and of protecting the interests of existing silver eel fishers, a 10-year moratorium on new eel weirs is proposed. Proprietors of existing fisheries should not be permitted to prevent the emplacement of additional weirs for an indefinite period and a maximum of ten years is suggested.

Significant mortality of silver eel in turbines has been observed, but not quantified. Assessment should be made of its intensity and the need for remedial measures.

### **4 Liaison between fishers and Regional Boards**

The formation of eel fishers' associations for each Region would enhance the current unsatisfactory arrangement whereby the inter-

ests of the eel fishing community are represented by a single Board member.

### **5 Five-year plans**

The first five-year plan would include stock enhancement by glass eel and elver transfer, a detailed stock assessment exercise and a moratorium on new fishing authorisations. On the basis of the results of the first quinquennium, modification of the moratorium could be considered. The second 5-year plan would continue stock enhancement and monitoring according to a programme developed under the first plan.

### **6 Designation of fishing and sanctuary waters**

Based on the results of the stock assessments, lakes should be designated as suitable for commercial fishing or be set aside as sanctuaries for spawner development and sport fishing. All rivers except the Barrow should be declared sanctuaries.

### **7 Research and monitoring**

Stock assessment in all lakes with a good potential is a basic requirement and must be followed by a monitoring programme. At least one full-time permanent scientist should be appointed as programme director.

### **8 Aquaculture**

Provided the wild stock is safeguarded the development of eel culture should be encouraged.

### **9 Marketing**

A centralised marketing system with a mechanism for quality control should be established.

### **10 Processing**

The export of live eel should be substituted by the development of a processing industry.

### **11 Permanent Commission**

It is strongly recommended that an all-Ireland authority be established to supervise the implementation of the strategy.

### **12 Funding**

Because of the current poor stocks, the long lead-in period to full production and the problems of ownership, full funding by the Government is envisaged.

## 1 INTRODUCTION

In the course of a reply to a Parliamentary Question on eel in February 1997, the Minister stated that 'there is considerable potential for development of the fishery and an integrated development strategy plan is being formulated'. The Marine Institute and other bodies were asked by the Department of the Marine to prepare a submission. The material which follows is based on the author's work as a biologist, first in the fisheries service of the Government and, subsequently in the Marine Institute. The main sources are:

- research work on eel which has been in progress since 1959
- discussions with the Chief Officers of the Regional Fisheries Boards
- formal meetings with Regional Fisheries Boards
- views of eel fishers gathered in person to person meetings
- reports presented at eel working parties of the International Council for the Exploration of the Sea and the European Inland Fisheries Advisory Commission, 1970 to present date
- reports of the EU Concerted Action A94-1939 *Enhancement of the European eel fishery and conservation of the species* (Moriarty, 1996; Moriarty and Dekker, 1997)
- proceedings of the National Eel Workshop held in 1998 (Watson *et al.*, 1999).

This work is based on a study of the eel in Ireland over a period of 40 years, as the major part of the author's official duties as a scientist in the Fisheries Service. Its views are supported by reference to international work, mainly European but extending to the four other continents. The latter was greatly facilitated by the European Inland Fisheries Advisory Commission and by the International Council for the Exploration of the Sea, in the course of more than 30 years. All the views expressed and conclusions drawn have at one time or another been presented in the international forum and have found acceptance.

The effectiveness of stocking with glass eel and elver as a management tool was first established in Germany in the 1890s. The author's studies in Ireland in the 1960s provided the scientific explanation of this success and demonstrated clearly that it could be effectively applied throughout the greater part of Irish lakes. Subsequent research and study both in Ireland and abroad, by the author and others, have served to increase the precision of the earlier work and to confirm the original conclusions.

The long period and apparently high cost of maximising the resource, together with the likelihood that ownership problems will persist, preclude any possibility of attracting private investment. In such a situation, as with virtually all development of capture fisheries in Ireland, the Exchequer is the only practicable source of funding. An important factor when this is considered is that more than 90% of the cost is manpower-related, involving substantial employment in the development stages. The study has also shown that the development costs over the 10-year non-productive period are little more than the earnings expected from the first year of enhanced operation. Few, if any, undertakings in fisheries' management have ever claimed such a high return on investment.

Lough Neagh has long been known as one of the world's greatest producers of eel. In 1963, an improved management regime was established in Lough Neagh (Kennedy, 1999). By 1982 it was evident that an annual yield in the order of 700 t, or 20 kg/ha, had been achieved and sustained. Over the following 17 years, this sustainability was clearly demonstrated.

In 1959 the Fisheries Division of the Department of Lands initiated a study to discover why eel yield elsewhere in Ireland was very much smaller. This initiative led to a study programme comprising extensive survey work by fyke netting together with silver eel

monitoring. It included observations made in two seasons in Lough Neagh and drew the following conclusions (Moriarty, 1982a, 1988; Moriarty and Reynolds, 1997):

- Growth rates of eel from many Irish waters are similar to those of Lough Neagh.
- Greater population densities have been observed elsewhere in Ireland, therefore, capacity exists for greater productivity than observed in Lough Neagh.
- Greater yields than Lough Neagh's are known in Europe, showing that the value of 20 kg/ha is substantially less than the highest attainable.
- A substantial area of Lough Neagh does not produce good eel stocks because the bed is sandy; the sustained yield of 20 kg/ha calculated for the whole lake, therefore, indicates a greater yield per unit area from muddy regions of the lake.
- Many other species of fish, including trout, perch, pike, roach and pollan, thrive in Lough Neagh; their abundance implies that they are not adversely affected by the dense eel population.
- Bycatch in the fyke nets is so small that it poses no threat to stocks of other fish species.

The studies, therefore, have yielded overwhelming evidence that other lakes can produce equal or greater quantities than Lough Neagh without impinging on other fish species. In the Republic, an area of 500 km<sup>2</sup> of suitable lakes is available, from which a sustainable yield of 1,000 t/year could be established. Employment in the capture fishery alone would be between 500 and 1,000 persons from May to September.

The current value of the fishery in the State, based on officially recorded catches, lies between £250,000 and £500,000. However, it is known that the records of legitimate catches are incomplete and that there is a substantial element of illegal landings. An estimate of a catch of 250 t/year, value £1,250,000, is widely accepted.

The price obtainable for quality eel is £5/kg, making an initial value of £5 million for the yield which can be attained in the Republic. The total achievable yield of the capture fishery for Ireland north and south approaches 2,000 t to which 1,000 t of cultured eel might be added. A supply of this magnitude would be sufficient to establish a processing industry with added value in the order of three times that of the wet weight. The annual value of a developed and properly managed Irish eel industry should, therefore, be taken to lie in the region of £60 million.

Market performance at present may not be encouraging but there are a number of reasons for the expectation that a major improvement is likely in the course of the next 10 years. Above all, the eel is a luxury product with a limited supply base. Increasingly high standards of living are certain to lead to increased demands for top quality food and there is no reason to believe that the eel can fail to hold its place amongst the most highly priced species of fish. It must be remembered that the current high prices are paid in the virtual absence of any marketing effort.

This paper in Chapter 2 gives the essential facts of eel biology on which current management and future development of the fishery depend. Chapters 3 and 4 describe the present state of the fishery, its management and marketing practice. Chapter 5 gives the methodology for development of the fishery and Chapter 6 sets out the potential for each Fishery Region, based on the nature and distribution of eel-fishing waters. Chapter 7 gives an outline of eel culture, which demands a different approach from the capture fishery. Chapter 8 makes an estimate of the costs and benefits of the development and makes recommendations for the National Strategy and Chapter 9 proposes the establishment of an all-Ireland authority. Conclusions based on the foregoing are summarised on page 3.

## 2 BIOLOGY

### 2.1 Distribution

The European eel *Anguilla anguilla* is effectively the only species of freshwater eel found in Europe. Small numbers of American eel *Anguilla rostrata* have been identified in Scandinavian countries but their presence has no impact on management strategies. All scientific evidence supports the theory that the eel has a single breeding place in the Sargasso Sea. The adult breeds only at the end of its life and no previous spawners have ever been identified. There is no evidence whatever that eel home to the watercourses or even the countries in which they developed. The numerous studies made of eel anatomy and genetics support the view that distribution is random. Conservation of the breeding stock, therefore, is a pan-European concern.

In Ireland, eel are found in nearly all watercourses. Except where management schemes are in operation, the greatest numbers are found in the lower reaches of river and lake systems. Growth rate is poor in acid, good in limestone waters.

### 2.2 Life history

The essential phases of the life history of the eel are:

*Glass eel*: the youngest life stage inhabiting inshore and estuarine waters, it has no skin pigment so that the body is transparent and glass-like. The glass eel does not feed. Glass eel begin to enter river estuaries during December with numbers greatly increasing in early spring. The numbers are immense, in the order of many millions in the major estuaries. An unknown proportion of these remain in the estuaries and either die there or grow to adulthood. The remainder migrate towards fresh water.

*Elver*: in plain English there is no distinction between 'glass eel' and 'elver', both referring to the youngest stage. Technically the elver

has developing skin pigment and is beginning to feed. Elver enter fresh water, often in immense numbers in spring, as soon as the temperature reaches 9° or 10°C. The elver stage ends when a length greater than about 9 cm and an age of more than 1 year is attained. Small eel of between 10 cm and 25 cm are known as *bootlace eel*, also as *yellow eel*, though it is better to use the latter term for larger individuals.

Brief definitions of the life stages are given in Table 2.1.

*Yellow (brown) eel*: feeding and growing stage. Males never grow to more than 47 cm and seldom attain more than 40 cm in length. Females can reach 1 m or more, but are usually less than 60 cm. The average growth rate is between 2 cm and 3 cm/year. Yellow eel are active from late March to late November. The majority hibernate in the mud on lake or river beds but some individuals have longer seasons of activity. Yellow eel may be caught in any month, but only in small numbers in winter. The usual habit is to feed at night and the favoured food is small invertebrates. In many, but not all, watercourses, eel of 40 cm and over regularly eat small fish, mostly perch and roach.

*Silver eel*: breeding stage, migrating to sea. When sufficient size and fat content have been attained, the yellow eel metamorphoses to silver eel. The silver eel does not feed but migrates downstream on the first stage of its return journey to the Sargasso Sea. Migration begins in autumn and may continue till late spring. The majority of male silver eel are between 30 and 40 cm long, age 6–10 years. Females are 40–70 cm long, age 10–20 years. Only leptocephalus and silver eel can be clearly defined. The other stages form a continuum with overlapping lengths and pigment stages.

**Table 2.1 Definitions of life stages of the European eel**

Name	Definition and habitat	Appearance
Leptocephalus	Larva. Ocean pelagic.	Deep-bodied, strongly compressed, transparent 'willow-leaf' shape.
Glass eel	Small eel, less than one year post metamorphosis. Continental shelf waters to lower reaches of rivers.	Body form as in adult, largely transparent but with localised pigment.
Elver	Migrating eel to 2 years post metamorphosis. Coastal and freshwater. This term is not strictly defined and is frequently used to include glass eel.	Fully pigmented eel, blackish colour: to length 10 cm.
Bootlace eel, snig	Small growing, sedentary eel. Coastal and freshwater.	Fully pigmented eel, yellow or brown colour: length 9 to 25 cm.
Yellow eel, brown eel	Large growing, sedentary eel. Coastal and freshwater.	Fully pigmented eel, yellow or brown colour: length greater than 20 cm. Eyes small, body soft.
Silver eel, bronze eel	Migrating, non-feeding eel. Freshwater to oceanic.	Silver or bronze colour: length rarely less than 25 cm. Eyes large, body firm.

### 3 THE FISHERY

#### 3.1 Glass eel and elver

Elver fishing is prohibited by the 1959 Fisheries Act, but may be authorised under its Section 14 in the interests of developing the fishery, both for stocking material and as 'seed' for eel culture, since artificial propagation is not possible. Because of high demand from the Far East prices reached extremely high levels in 1997, but declined in 1998. The elver is still a very valuable commodity, worth between £50 and £100/kg alive and in good condition. Section 18 (1, a) of the 1980 Fisheries Act empowers Fisheries Boards to capture glass eel or elver.

Capture of glass eel did not take place in Ireland until the 1990s. On the continent, four methods are in use: anchored tidal net (tela), fyke net, trawl and dip net. Tidal nets, fykes and dip nets are preferred because the trawl exposes the glass eel to considerable pressure and relatively high mortalities. Tidal nets may be large and set by boat in mid-estuary or small and attached to bridges. Trawls are usually between 1 m and 2 m diameter and operated by large or small boats. Dip nets are about 1 m diameter and operated manually from the bank.

Elver, migrating from salt to fresh water, have been captured systematically since 1959 for transfer upstream or between catchments: first on the Shannon and latterly on other rivers. The usual gear is an elver trap, in the form of a catching box installed at the top of an elver pass.

#### 3.2 Yellow eel

Yellow eel are caught by baited long-line or eel pot or by unbaited fyke net. About 200 fishermen were licensed in 1999. It appears that all waters, in which viable eel catches are likely to be made, are exploited. Some may prove to be under-fished and the stocks in all may be enhanced by the application of suitable management measures. Many proposals

for the development of unfished waters have been made and some followed up. Few succeeded. It seems reasonable to believe that, in the course of hundreds of years, eel fishers had established which watercourses could yield good catches and which were not worth the effort.

Returns collected by the Department of the Marine between 1988 and 1996 showed that 19 private eel fishers regularly made catches in excess of 1 t/year. Two of these operated weirs for silver eel, one eel pots in Waterford Harbour, four fyke nets and the remaining 12 were long-liners. The top return, 4.3 t by fyke net, was nearly equalled by a long-line catch of 4.2 t.

The majority of fishers recorded considerably less than 1 t. Catches in the order of 1 t have been regularly observed by scientists working in close association with fishers and the average catch in Lough Neagh is about 1 t. The size of the catch depends to a great extent on the skill of the fisher, but also on the effort expended. It is clear that a substantial income can be made by an exceptionally hard-working fisher, while reasonable supplements to other sources of income are made by the average worker who approaches eel fishing part-time.

#### 3.3 Silver eel

Silver eel are caught at 'eel weirs', in most cases conical *coghill* nets attached to stakes in rivers. The nets intercept the migrating eel. In a few cases, particularly in conjunction with milldams, rigid screens are used. Best catches are made in stormy weather about the time of the new moon from September to December. From 1939 to 1959, legislation banned the installation of fixed engines at sites which had not been used in one or more of the years 1936, 1937 and 1938. These weirs are listed in Table 4.1.

Relatively few applications were made to develop new fisheries when the ban was revoked by the 1959 Act and even fewer of these were successful. The cost of constructing an eel weir capable of fishing on the highest floods has, in most cases, proved prohibitive.

In most cases a 'free gap' of 10% of the width

of the stream is required at an eel weir. This allows the escape of considerably more than one eel in every ten. The yield in a number of river systems is greatly increased by the installation of additional weirs. The installation of a weir upstream of an existing fishery does not necessarily reduce the catch of the latter. However, the development of new weirs in such situations may be highly contentious.

## 4 MANAGEMENT and MARKETING

### 4.1 Legislation

Although angling for eel is increasingly popular, the greater part of the catch is commercial. All commercial fishermen must be licensed. Fixed engines for the capture of eel, including fyke nets and most other gear, require an Authorisation issued by DoMNR in

consultation with relevant Regional Fisheries Board which may not issue a licence until the Authorisation has been granted. Until the 1990s, long-line licences had to be issued on demand. Legislation in preparation at the time of writing aims to bring the long-line under the same control as fyke nets and other gear.

**Table 4.1. Eel weirs which operated in the years 1936–38 and may be licensed without an Authorisation**

Fishery District	Catchment	River	Townland		
<b>Dundalk</b>	Fane	Clarebane	Toome		
		Fane	Corcullioncrew		
<b>Drogheda</b>	Boyne	Blackwater	Martry		
		Blackwater	Castlepole		
		Blackwater	O'Daly's Bridge		
		Blackwater	Lisduff		
		Blackwater	Edenburt		
		Blackwater	Virginia		
		Blackwater	Drumcarrow		
		Blackwater	Billis Bridge		
		Boyne	Rosnaree		
		Boyne	Maudlin		
		Boyne	Newhaggard		
		Galloneura	Greaghduff		
		Mullagh	Mullagh		
		<b>Waterford</b>	Barrow	Barrow	Tinnahinch
Barrow	Ballygreague				
Barrow	Ballyogan				
Barrow	Fishergreague				
Barrow	Moneybeg				
Barrow	Mountjuliet				
Nore	Nore		Mountjuliet		
Suir	Suir		Cabragh		
	Suir		Athassel		
	Suir		Suirville		
<b>Galway</b>	Corrib	Corrib	Ashford		
		Corrib	Townparks		
		Dalgan	Conagher		
		Mask–Corrib	Inishard		
		Mask–Corrib	Dringreen		
		Robe	Castlemagarret Park New		
		Kilcolgan	Dunkellin	Kilcullion	
		Loughrea	Loughrea	Loughrea	
		<b>Ballina</b>	Moy	Manulla	Gortlahan
				Moy	Glebe
Moy	Bellass				
<b>Ballyshannon</b>	Drowes	Drowes	Lareen		
		Drowes	Magheracar		
	Erne	Erne	Woteraghy		
		Erne	Woteraghy		
		Erne	Woteraghy		
		Erne	Corlea		

#### *4.1.1 The 1959 Consolidation Act*

*Section 14* (as amended in the 1962 Act) in effect allows the Minister to issue an Authorisation to catch, attempt to catch and have in possession any specified fish caught by any specified method. It has been used extensively not only for strictly scientific purposes but also to allow commercial fishermen to use methods which have not been covered by the existing legislation. It is also used to permit fishing in particular places, such as narrow estuaries, where fixed engines are normally prohibited. Ultimately, as happened with the fyke net, amending legislation may be enacted to regularise the fishery.

Section 14 has been used since 1959 to permit the capture of glass eel or elver for overland transportation or for intensive culture. It is required in this case because Section 173 prohibits the capture or possession of the 'fry' of eel. A particular advantage of Authorisations under Section 14 is that strict conditions as to date, place and time of capture may be applied together with a requirement for reporting on the catch. This has been of great importance in providing scientific information.

*Section 67* requires a Board to issue an 'ordinary fishing licence'. The majority of such licences are for salmon, but the long-line for eel is included. This gave the Boards no discretion in issuing licences. The 1994 Amendment sought to rectify this by deleting a part of Subsection 4 of Section 100 in accordance with the assumption that the long-line was a 'fixed engine'. This was successfully challenged in the Circuit Court in March 1997 by long-line fishermen, the court holding that the long-line was not a fixed engine. Further amending legislation will be required to put the long-line for eel on the same footing as fixed engines.

*Section 68* provides the regulations for duties on ordinary licences.

*Section 69* makes provision for fixing a duty for an unscheduled engine.

*Sections 70 and 71* deal with the appointment of agents to issue licences. There is no record of their use in the case of eel.

*Section 90* provides for the forfeiture of licences as an optional penalty for offences.

*Section 95* generally forbids the use of nets in fresh water. Subsection 1(d), however, permits the use of a net 'constructed for the capture of eel'.

*Section 99* prohibits the erection of fixed engines in fresh water. Subsection 4, however, excludes the long-line for eel from this prohibition. This is of historical interest in that it seems to infer that the long-line was considered to be a fixed engine. Subsection 5 allows the Minister 'by order' to authorise the erection of a fixed engine in accordance with plans approved by the Minister. Subsection 6 allows the ESB to erect fishing weirs in accordance with Section 101.

*Section 100* permits the use of a fixed engine which was in operation in one or more of the years 1936, 1937 or 1938. These were the years immediately preceding the 1939 Act which prohibited the erection of fixed engines in fresh water. Subsection 4 excluded the long-line from this prohibition and was repealed in the 1994 Amendment – with the intention of equating the long-line with fixed engines and, therefore, requiring that long-lines be operated only when duly authorised.

*Subsection 5* allows the Minister to authorise the use of a fixed engine for eel. An Authorisation under this Subsection is the usual instrument to allow fishing for silver eel.

*Section 101* allows the ESB, with the consent of the Minister, to construct a fishing weir on their own property.

*Section 102* forbids the erection of a fixed engine in an estuary where the breadth of the channel at low water of spring tide is less than three-quarters of a mile. This provision was primarily part of salmon conservation legislation and *Section 14* has been used frequently to allow the operation of small fyke nets in such estuaries.

*Section 103* similarly forbids the erection of a fixed engine within one mile seaward or coastward of the mouth of a river where the breadth of the channel at low water of spring tide is less than half a mile.

*Section 107* requires a free gap in the deepest part of any fishing weir. The gap must be one tenth of the width of the river and not less than 3 feet, but need not be more than 50 feet. The provision for ‘deepest part’ is to ensure that the gap is not made at a point, such as the margin of a river, where the water is usually much shallower and the effect of the gap would be less.

*Section 109* permits the Minister ‘by order’ to allow an eel weir to be used without a free gap. It had been considered, at the time of the legislation, that it would be sensible to close the free gap at the most downstream weir on any river to maximise the catch. This has never been invoked. Current thinking would generally be strongly opposed to closing off a free gap on the grounds that every fishery throughout Europe should make an effort to ensure some escapement of breeding stock.

*Section 110* allows the Minister to require the construction of a free gap in a fishing weir.

*Section 111* prohibits the alteration of the bed of a river in a way that would affect the flow through the free gap.

*Section 112* prohibits the use of any sort of fishing gear within the free gap or within 50 yards upstream or downstream of it.

*Section 114* limits to 20 feet the length of any guiding wall to a fishing weir and forbids the use of a guiding wall to alter the flow of water through the free gap.

*Section 151* provides for close season bye-laws and Subsection 1(b) imposed a general close season from 11 January to 30 June. This subsection was repealed in the 1962 Amendment.

*Section 152* sets out the penalties for infringements of the close season, but excludes fishing by rod and line.

*Section 153* requires the opening of the gaps of an eel weir in the daytime.

*Section 173* prohibits capture, possession of or injury to the ‘fry’ of eel.

#### *4.1.2 The 1962 Amendment*

*Section 11* allows the Minister to authorise by bye-law the erection and use of fixed engines.

*Section 12* allows the Minister to grant exemption from the guiding wall restrictions of *Section 114* of the 1959 Act.

#### *4.1.3 The 1980 Amendment*

*Section 18* allows the Central Board or a Regional Board to ‘take fish from a fishery by any means whatsoever’. This would allow a board’s employees to capture glass eel or elver.

#### *4.1.4 The 1994 Amendment*

*Section 18* amended *Section 95(1)* of the 1959 Act to bring eel nets under the authorisation regulations of its *Section 100*.

*Section 19* increased penalties for existing offences and introduced penalties for failure to comply with the conditions of a *Section 100* Authorisation. By removing Subsection 1 of *Section 100* it simplified the issuing of Authorisations for new fixed engines. The Sec-

tion was intended to bring the long-line under the same regulations as fyke nets and other gear, but was found defective by a Circuit Court judgement in March 1997 which held that the long-line was not a 'fixed engine'.

This led to the re-instatement of the unsatisfactory situation whereby Regional Fisheries Boards were required to issue a long-line licence to any person applying. The intended effect of Section 19 of the Fisheries (Amendment) Act of 1994 was to allow Regional Fisheries Boards to control all forms of eel fishing, including the use of the long-line which was deemed to be a fixed engine. Until a further amendment is made, full control of eel fishing in the interests of stock conservation will not be possible. As a temporary measure a bye-law, capping the number of long-line licences to equal the numbers issued in 1997, was introduced in 1998 and re-issued in 1999. The legality of the 1999 bye-law was challenged by a fisher, who claimed that it interfered with his livelihood.

*Section 20* amended Part X of the 1959 Act by adding eel to the provisions for control of dealing in and possession of salmon. This greatly increases the powers of officers to inspect vehicles suspected of containing eel and places on a person in possession of eel the need to prove that they were lawfully captured. Previously, it was almost impossible to

secure a conviction for an eel fishing offence unless the capture of the eel was actually witnessed.

*Section 21* introduces penalties for unlawful sale or possession of eel.

*Section 22* requires marking of packages containing eel.

#### 4.2 Bye-laws

Close seasons exist under Bye-law in the Districts listed in the text table below.

The following Bye-laws deal with other aspects of the fishery. Enforcement of the half-pound (454 g) minimum size limit for the Limerick District and the Corrib system would cause considerable problems and there are no good scientific grounds for its application to the silver eel fishery.

*Bye-law 253* Drogheda District, dated 23rd August 1906

Prohibits the use of any 'night line' except in Loughs Ramor and Mullagh.

*Bye-law 368* Lamb's Head to Dunmore Head, dated 30th August 1919

Prohibits the use of any long line, night line or spiller in fresh water.

Limerick	River Shannon (except with lines and hooks)	1 February–30 June
	River Shannon, lakes and tributaries, with lines and hooks (other than single rod and line)	1 February–30 April
		1 January–30 June
	Rest of District	
Kerry	Between Dunmore Head and Kerry Head	1 January–30 June
Galway	Corrib or Galway River	11 February–30 June
Connemara	Whole District, with lines and hooks (other than single rod and line)	11 January–9 April
Drogheda	Any river in the District	1 December–30 June

*Bye-law 399* River Corrib, its lakes and tributaries, dated 4th February 1930

Prohibits the use of a long-line with more than 1,000 hooks and imposes a minimum size of half a pound (227 g). Also prohibits the use of a hook with gape less than three-eighths of an inch (9.5 mm)

*Bye-law 220* Lough Derg, dated 9th January 1896

Prohibiting to use for the capture of fish of any kind, in the said Lough Derg, lines commonly called and known as “Tram Lines” or “Long Lines”, baited with the fry or young of fish.

*Bye-law 130* Westmeath and Cavan Lakes, dated 4th January 1890

Prohibiting to use for the capture of fish of any kind, in any of the lakes situated in the Counties of Westmeath and Cavan, lines commonly called and known as “Tram Lines” baited with fry or the young of fish.

*Bye-law 386* Limerick Whole District, dated 14th January 1929

Prohibiting to kill, take, or have in possession, in or near the banks of the rivers, lakes and tributaries in the Limerick District, any freshwater eel of less than one half of a pound weight.

Any such eel, if taken, must be forthwith returned to the water.

Prohibiting to use for the capture of eel, or for any method of fishing by which eel are commonly captured in the Limerick District, any hook of less than three-eighths of an inch (9.5 mm) gape, measured from the point to the shank thereof.

*Bye-laws 745 and 752* Management of eel fishing, dated 26th March and 15th December 1998

Cap the number of long-line licences that may be issued in any Fishery District, on the basis of the numbers issued in 1997.

### **4.3 Enforcement**

Enforcement is difficult and costly, mainly because fishing can be carried out effectively between sunset and dawn. Serious problems in bringing prosecutions have been largely met by provisions of the 1994 Amendment.

### **4.4 Current management measures**

#### *4.4.1 Elver capture and transfer*

Mortality of the elver and young yellow eel is extremely high, estimated at 90% or more. By capturing them in the lower reaches of rivers and transporting to the upper waters, or catching in unproductive waters and transfer to richer habitats, survival can be greatly enhanced and stocks of marketable eel increased accordingly. Such measures have been in use in Germany since the 19th century, in Lough Neagh since the 1930s, in the Shannon since 1959 and the Erne since 1962. Some transfers take place in the Corrib and Moy.

An alternative measure, now well established in Sweden, is intensive rearing to bootlace stage followed by release in autumn. Experiments in this technique were begun in 1997 by the ESB and in 1998 by the Erne Eel Enhancement Programme.

#### *4.4.2 Close seasons*

Close seasons exist in a number of Fishery Districts and proposals have been made both for country-wide and for local restrictions. The behaviour of the eel, as in seasonal migration of elver and silver eel and hibernation of the yellow eel between October and April, effectively restricts the fishing seasons. The usual argument in favour of imposing close seasons is to protect other species, such as salmon. A good case can be made to prohibit silver eel fishing during the smolt run, but other restrictions are less soundly based.

Statutory close seasons were abolished in the 1959 Fisheries Act and in 1960 an attempt was made to repeal those that remained in

force under bye-law. The relevant Boards of Conservators objected to repeal of the bye-laws listed in 4.2 above. Existing and proposed close seasons for yellow eel in late spring and summer actually prevent the full exploitation of the fishery and need careful consideration in consultation with the fishing community. A fixed close season takes no account of such variable conditions as water temperature and is a crude method of stock conservation. Measures such as limits on minimum size or on fishing effort are preferable.

In combination with strict control of fishing effort, a close season is an effective means of limiting total catch. It is, however, a very crude measure which takes no account of such important factors as the age distribution of the stock. Furthermore, it may adversely affect marketing by rendering eel unobtainable at times of high demand.

#### *4.4.3 Size limits*

Besides the prohibition of the capture of the undefined young or 'fry' of eel (1959 Act, Section 173), the only size limit in the State is one half pound (227 g) in the Limerick and Galway Districts (Bye-law 386 of 1929). It is likely that, at the time of its introduction, the majority of silver eel caught on the River Shannon were females and greater than 227 g weight. Enforcement of the Bye-law would have greatly restricted the yellow eel catch and confined the silver eel catch to females. If enforced at present, such a size limit would effectively prohibit the yellow eel fishery and require the release of a substantial proportion of the silver eel catches.

Because of the great variation of weight for any given length, limitation of size on a weight basis is unsatisfactory. A length limit for yellow eel is desirable and should operate throughout the State to facilitate enforcement. Besides its value as a management measure, observation of a size limit for yellow eel results in a more marketable product,

since there is little or no demand for small yellow eel in northern Europe.

On the other hand, small silver eel are acceptable and any reasonable size limit does nothing more than ensure the release of all males without having any effect on the females.

A limit of 35 cm for yellow eel is proposed. This would allow retention of the greater part of the catch of a standard fyke net, while prohibiting deliberate capture of bootlace eel for aquaculture. Silver eel should be exempt from size limit and capture of small eel for stocking may continue to be controlled by Section 14 Authorisations.

#### *4.4.4 Free gap*

The law requires a 'free gap' of 10% of the width of the river in connection with any fixed engine for the capture of silver eel. This measure aims both to provide downstream fishers with a viable supply and to ensure the survival of breeding adults.

### **4.5 Views of Central and Regional Fisheries Boards**

Discussions were held with senior officials and members of the Fisheries Boards during 1997 and 1998. Written observations were collected from the Boards by the Central Fisheries Board in 1997 and a workshop of officers of the main eel-producing Regions took place in January 1998.

Broadly speaking, all Regional Fisheries Boards are in favour of the development of eel fishing. With the exception of the Barrow, south and southwest coast river systems have no reasonable prospects for the development of commercial fisheries for yellow or silver eel in fresh water. Many experiments have been made, but it is now widely accepted that the stocks are too small to allow the development of a fishery which could repay the very high capital cost of effective fixed engines. The Regional Fisheries Boards in these cases,

therefore, favour planned exploitation of elvers. East coast rivers such as the Boyne and Fane, together with the major west coast rivers, have lake systems and are the basis for important commercial eel fisheries. The Regional Fisheries Boards aim to exploit these fisheries rationally.

A summary of the views of the Boards is included in the Central Fisheries Board's Policy Document (Gargan, 1999). The following section is based on this document with some additional material derived directly from officers and members of the Boards.

#### 4.5.1 Eastern Region

The Board favours long-term development, including stock enhancement. Control of long-lining should be centralised by appropriate amending legislation. Eel fishing on the River Liffey in breach of the terms of the Authorisation has caused considerable problems in enforcement.

#### 4.5.2 Southern Region

Both stocks and sizes of the eel have been seriously reduced since the early 1990s.

The principal eel gear in the Region is the baited eel pot used in Waterford Harbour. While licenses are issued, their legal validity is doubtful and there is a clear need to designate them as scheduled engines. A Board's power to control the types of gear used in a broad estuary is not clear and a possibility exists for potentially damaging methods to be introduced.

When the eel pots are brought under legislation the precautionary principle should be applied by having a maximum of 20 pots per license and a maximum number of 30 licenses for the Waterford Fishery District (effectively the combined estuary of the Barrow, Nore and Suir). The number of fyke net licenses should not be increased. Numbered plastic tags should be issued to license hold-

ers to mark pots and fyke nets. Long-lines and eel trawls should be prohibited throughout the Region.

The following close seasons are proposed:

Fykes in tidal water	1 December–31 April
Fykes in non-tidal water	1 November–31 April
Sprat weirs	1 April–15 June

A minimum length of 30 cm eel for sale should be introduced and rings to allow the escape of eels less than 120 g should be fitted to fykes and pots.

A population survey should be carried out, in close connection with fishers and dealers, in the large river catchments to guide future developments and an improved method of catch reporting should be introduced. Priority should be given to the Barrow. Sources of eel bait, other than small fish captured at sprat weirs should be sought.

#### 4.5.3 Southwestern Region

The Board was greatly concerned over the failure of the measure to control long-line fishing and recommended either that the long-line be banned throughout the country or that legislation to control it be introduced.

With the exception of the Lee reservoirs, and possibly some estuaries, no waters in the Region are suitable for development as eel fisheries. The thrust, therefore, should be towards developing elver fishing and some brief studies have been made. Suitable locations for elver traps have been identified and there is likely to be a good potential for dip net or fixed net fishing in long, narrow estuaries such as those of the Laune and Maine.

#### 4.5.4 Shannon Region

The Board considered that legislation to control long-lines was an urgent necessity. The numbers of long-line licenses should be

capped at its present level of eight and these should be confined to the Clare lakes. Controlling legislation should enable conditions to be attached to the license. Bye-law 752, 1998 capped the number of licenses.

A continuing shortfall in the quantities of elver reaching the Shannon lakes needed to be rectified. A joint Shannon Regional Fisheries Board/ESB 2-year project to assess the availability of elvers within the Region was set up in 1998. This is based on operation by crews employed by the Board and the ESB. In view of the high prices paid for elver on the open market, problems are likely to arise unless measures are put in place to prevent unauthorised movement of elvers.

In the case of the ESB-owned fishery on the Shannon, the Board would like to be in a position to comment on the suitability of prospective netmen who currently work as nominees on licences held by the ESB.

The Board considers that, until a comprehensive stock survey has been carried out, expansion of the fishery should be curtailed. Only traditionally used eel weirs, those that have been in place for the past 10 years, should be licensed. Fyke nets should not be permitted in rivers and the present number of licenses should not be exceeded. There is little or no demand for estuary licenses, but not more than ten should be issued.

The Board accepts that eel poaching is widespread throughout the Region and requires greater resources to deal with the problem.

#### *4.5.5 Western Region*

The Western Regional Fisheries Board, having held a public meeting in November 1997 with the fishers and other interests and having hosted a workshop in January 1998, put forward a management strategy for the Region.

The Board has proposed a two-tier approach to the management strategy.

The first phase requires a bye-law to allow restriction of the fishery to licensees from previous years. Their results would be made available for analysis to a research team based at NUI Galway. The larger lakes would be divided into zones, based on the parts of the lakes traditionally fished. A survey of elver passes and obstructions to their ascent would be made while established elver trapping and transfer would continue.

The second phase would be to devise a long-term management strategy based on the findings of the survey. Measures would be taken to assist elver passage and the possibility of importation of elvers would be considered.

The Board agrees with the views of Shannon and Northern Boards that elver fishing should be carried out only by persons acting on behalf of the Boards.

#### *4.5.6 Northwestern Region*

The Board had operated a policy of prohibiting fyke nets and restricting the numbers of long-lines permitted. Following the judgement in favour of Christopher Hughes and Charles Stewart in the Circuit Court on 4th March 1997, the Board was required to issue long-line licenses to all who applied. In effect this prevents the Board from exercising any control over the eel stocks.

In 1998 the Board embarked on a stock survey exercise on which future development could be based.

#### *4.5.7 Northern Region*

The Board has established the Erne Eel Enhancement Programme, a major cross-border eel research and development project co-funded by the Peace and Reconciliation Measure and the governments of Northern Ireland and the Republic. This includes an innovative scheme for the capture of glass eel in the estuary, with the aim of providing suffi-

cient elver for stocking the entire catchment at 0.1 kg/ha and a possibility of generating a surplus for use in eel culture. Other sources of elver are being explored.

At present there is very little incentive for the Northern or any Regional Board to make a major effort to develop the eel fishery. Enforcement staff are few and adequate policing is beyond their resources. Should the eel fishery develop with the introduction of a zoning system, there will be an element of self-policing amongst the licensed fishers who will not welcome potentially damaging competition.

A significant incentive to managers to become deeply involved in the fishery could be brought about by giving the Boards complete control over capture and sale of elvers at authorised elver traps. Revenue generated thereby could be directed towards improving the management system. Such control of the elver fishery is considered essential. The capture and transfer of elvers must begin as soon as possible and cannot wait until scientific surveys have been completed.

The Board supports the use of fyke nets in the lakes of County Cavan, accepting that they do not threaten the stocks of other species.

The Board is seriously concerned by the mortality of silver eel caused by turbines at power stations. It considers that the extent of the damage needs to be quantified with a view to assessing the need for introducing remedial measures

#### 4.5.8 *Foyle Fisheries Commission*

The Foyle catchment, with its scarcity of rich lakes, does not appear to offer scope for the development of a viable fishery for yellow or silver eel. However, the configuration of Lough Foyle and the large extent of the catchment give reason to believe that substantial stocks of glass eel may be available. The commission is to take part in a joint exploratory glass eel fishing operation with the Erne

Eel Enhancement Programme. The Commission is in favour of the exploitation of glass eel for export to other catchments or for intensive culture.

#### 4.5.9 *Central Fisheries Board*

The Central Board's policy is set out in detail by Gargan (1999). The Board agrees that proper management can lead to increased employment and revenue generation. The first requirement is to establish management on a catchment basis and then to assess the stocks. Following the assessment, a total allowable catch must be determined. This will be the basis for decisions on the number and type of eel fishing licenses to be issued. All catchments below a certain productivity level should be designated as eel sanctuary areas to produce breeding adults.

For a 5-year period capture and distribution of elvers should be undertaken by the Regional Fisheries Boards or by persons working under their direct supervision.

Eel fishing in estuaries by fyke net or eel pot should be developed.

A policy on harvesting elvers for eel culture will have to be considered in the overall context of elver stock management.

At a meeting in September 1998, the Board proposed increases in licence fees as follows:

	Current	Proposed
Gap eye (one coghill net)	£40	£50
Long-line	£40	£50
Eel trap	£65	£81
Fyke (train of 20)	£40	£50

## 4.6 **Marketing**

### 4.6.1 *Current marketing*

The ESB is probably the biggest marketing group, handling the eel from the Shannon

lakes. Otherwise eel fishermen sell to itinerant specialist merchants. The 1994 Act requires all eel dealers to possess a license.

Traditionally, the large-scale eel fisher, in particular the proprietors of silver eel fisheries, kept their catch alive in slatted boxes held in the river in the vicinity of the trap. When large enough quantities for export had accumulated, they were packed on trays in wooden boxes. The top tray was filled with ice which served both to keep the eels cool and, as the ice melted, moist. High survival for as much as 48 h was achieved. The boxes were sent to England, mainly to Billingsgate in London, by rail and ferry. Lough Neagh eels continue to be live-packed in boxes but are flown to the Netherlands and to Germany. They reach the continental airports on the evening of capture and are processed and sold the following day.

Outside Lough Neagh, the trend since the 1950s has been for an increasing proportion of the marketing to be handled by itinerant dealers equipped with aerated water tanks. The usual practice is local live-storage by the fishers and collection of the catch once a week. Some Dutch merchants deal directly with the fishers, others buy from Irish middlemen. The ESB established an export trade in frozen eel.

Importers have naturally been greatly concerned over the freshness of the eel and have, therefore, favoured systems which delivered the living product.

In 1999, the ESB, Lough Neagh Co-operative and BIM engaged a marketing consultancy group to make a study of the subject in northern Europe, with particular reference to Germany and the Netherlands. The group provided details of the importing firms and their requirements.

#### *4.6.2 Market development*

The Lough Neagh Co-operative has achieved

a high reputation for consistently high-quality eel and its system of daily local collection and export by air-freight operates with great efficiency. This depends partly on a good centralised management system and partly on the relatively large quantities of eel provided daily. In spite of this, prices offered fluctuate and fishing from time to time is suspended when prices on offer are unacceptably low.

Live storage entails a degree of loss of weight and condition, but the fisheries in the Republic at present are too small to support daily collection. Furthermore, the costs of transport are relatively high and this is reflected in the price paid to the fisher. Live transport in tanker-trucks is beneficial in delivering eel in good condition to the processor, but adds significantly to the marketing costs because much of the bulk carried is water rather than eel.

From the standpoint of the Irish eel industry, these factors minimise its value since a large proportion is absorbed in transport costs. As long as the industry remains small and confined to live export, these problems will persist.

The objection of eel importers to dead eel is very long established and can be overcome only by a concerted effort. It will be necessary first to establish the feasibility of local slaughter and cold storage and subsequently of a range of processing. The minimum is gutting and de-sliming, the maximum is production of a pre-packed item for supply to the retailer. This will require close liaison with established importing firms, probably in the first instance under franchise. The ultimate goal should be the establishment of a market for Irish eel. Any progress in this direction will depend on the imposition of rigorous quality control.

#### *4.6.3 Market prospects*

There is general agreement that the market for wild eel is not expanding. It is evident that

the farmed eel, thanks to its uniform size and year-round availability, is more popular amongst dealers. Prices offered for wild eel, even to such major producers as the Lough Neagh Co-operative, have frequently been unacceptably low. This poses the serious question of the desirability of increasing the quantities offered for sale.

It must be emphasised that the development plan given in this document will require 10 years to come to fruition and that nobody can forecast a situation in the food market over so long a period. Increasing the Irish output from 1,000 to 3,000 t would add merely 6% to the current European supply and, therefore, could not be expected to result in any significant lowering of the price even in a static situation.

Furthermore, the prospects for an increase in demand are good. The eel is a luxury product and the increasing standards of living throughout Europe are certain to lead to greater demands for such top quality food. It is also likely that the 'green' market will become more and more significant and the disadvantage of seasonality and unpredictability of the wild eel will be offset by its attraction as a 'natural' product.

At present the eel market is fragmented and Irish suppliers are very much at the mercy of continental importers. Increased output, involving co-operation North and South, will greatly strengthen the position of the Irish producer.

Finally, little or no attention is given to the promotion of the eel, sales being largely directed to a highly localised traditional clientele. There is clearly scope for a national or international marketing campaign to increase demand. The usual reaction of a person eating

eel for the first time is to enquire as to where more may be obtained.

#### **4.7 Processing**

Virtually no processing takes place: eel are exported either alive or frozen. In the countries where eel are consumed, nearly all are processed before retailing. Eel of all sizes and life stages are acceptable in the market. Glass eel are canned in Spain and sold as extremely highly-priced luxury items. Bootlace eel are canned in Portugal or sold live in the south of France for export for on-growing in Italy. German smokers prefer large silver eel, Dutch smokers small silver and so on. Eel of all sizes are good to eat but the market for any given size range is very localised. Processes, besides smoking, include jellying, pickling and the very elaborately prepared 'kabyaki' for the Japanese market.

The practicality of the development of an indigenous processing industry is too remote to merit consideration at this stage. The obvious approach is to prepare established products in association with more than one foreign processor. Past attempts to process eel in Ireland have failed and it appears that the usual cause was the processor's unwillingness or inability to pay the fisher a price equal to or greater than that offered by the itinerant dealer. This cannot be a logical situation since local processing does away with the high transport costs.

A study of the quantities of eel of various grades available will be required as a first step in determining the feasibility of developing a processing industry. It may reveal that quantities are insufficient at present but will give important indications of future possibilities when the enhanced production is attained.

## **5 DEVELOPMENT**

The basis of the management programme is the capture and distribution of glass eel at a rate of 0.1 kg/ha/year. This requires an annual capture and distribution of 5 t to yield 1,000 t of wild eel from 500 km<sup>2</sup> of lake surface. An additional 5 t would be needed to produce 1,000 t of cultured eel. Captures in the order of 5 t per season from Ardnacrusha and Ballyshannon combined have been made from time to time in recent years and were regularly obtained in the 1960s and 1970s when glass eel were very much more plentiful. There are theoretical reasons for predicting that intensified and improved fishing could yield as much as 20 t of glass eel/year.

### **5.1 National and Regional Development**

Development of the fishery requires in the first place a major research programme, co-ordinated by a central authority. The Marine Institute would be appropriate as it currently employs an eel specialist, but the Central Fisheries Board could be an equally suitable headquarters in view of its position with regard to the Regional Fisheries Boards.

### **5.2 Personnel**

The scientific personnel would be full-time appointments since the initial steps outlined in this paper will, in addition to solving the most immediate problems, constantly bring forward new ideas which will need to be scientifically tested. Moreover, as the fishery develops and fishing pressure on the stocks rises, increasingly sophisticated monitoring techniques will need to be applied to ensure that the fishery is managed to attain maximum efficiency and yield.

The central authority team would comprise one scientist as project leader, with appropriate clerical support, to co-ordinate national effort. After an initial 3-year phase he would require a full-time technician.

Six regional teams would engage in research,

development and management work, each to comprise a scientist as project leader, a technician and two fishery officers. The fishery officers would not work full time on eel since the capture fishery for market eel will operate mainly from May to October and the elver transportation project will take place from late February to late April. The elver project will require intensive work only for a few days every 2 weeks since elver movement is strongly influenced by tides.

### **5.3 Glass eel and elver development**

All the teams would concentrate in early spring on elver capture and transportation. While the capture of elvers ascending into fresh water is well established on the Erne and Shannon, extremely little is known about the behaviour and capture of estuarine glass eel. This problem is complex and will require a serious research effort over many years. It has not been adequately approached anywhere in the world.

Apart from the fact that all Irish river systems are significantly different from each other, conditions in all other European waters are different from those in Ireland. Therefore, extrapolation from the few scientific studies that exist already cannot provide the detail required for a management plan in Ireland. Furthermore, only a very small number of studies have been conducted over a sufficiently long time-scale to explain variations caused by temperature, water levels and flood conditions which change from year to year. Elver exploration and capture will need the support of a substantial number of fishers, working under contract to the Regional Fisheries Boards and being paid for their catches.

### **5.4 Yellow eel fishery**

The scope for development varies greatly between Regions. The most important eel habitats are listed in Table 5.1. Five Regions contain a number of substantial lakes and es-

tuaries but the Southern has no lakes big enough for eel development while the lakes of the Southwestern are in general too acid to support a profitable fishery. Many of its estuaries, however, appear to present very prom-

ising glass eel habitats. It is, therefore, suggested that eel development in the Southern and Southwestern Regions be managed in a joint programme between the two Boards.

**Table 5.1. Major productive eel habitats in Fisheries Regions**

Eastern	Ramor, Monaghan lakes, Wexford Harbour
Southern / Southwestern	Waterford Harbour, Barrow
Shannon	Shannon lakes, Clare lakes, Shannon Estuary
Western	Corrib catchment lakes, Lough Rea
Northwestern	Conn, Gill, Arrow and smaller lakes
Northern	Cavan lakes in Erne catchment

### 5.5 Silver eel fishery

A number of profitable fisheries for silver eel exist. While measures to increase the efficiency of any of these may be justified on economic grounds, the need to introduce new operations is open to question. Because normal migration of the silver eel takes place in flood conditions, the capital cost of effective barriers is extremely high. This probably explains the fact that very few have been erected in the course of the 20th century and many have been abandoned.

Silver eel represent potential spawning stock and have traditionally been protected, usually by the requirement for a 'free gap' in catching engines. Enhancement of yellow eel stock, provided the resulting fisheries are adequately controlled, will lead to increases in survival to the silver stage and thereby increase the spawning stock. Such a development could justify an increase in the silver eel fishery, especially since the product is more valuable than the yellow eel. Because of Europe-wide concern about spawning escapement, the approach in the short to medium term should be to take no active steps to encourage silver eel fishing developments. Sampling of silver eel is an important factor in stock assessment and should be a regular feature of all scientific studies.

### 5.6 Major studies

Major studies have been made recently of the eel in the Shannon catchment and are in progress on the Erne. The Southern Regional Fisheries Board has begun studies in Waterford Harbour and the Northwestern Regional Fisheries Board is to begin a survey of its most productive eel waters. To carry out such studies with existing staff is a very significant step forward and will yield important results. It must, however, be stressed that the problem is too large and complex to be satisfactorily approached on a part-time basis. Serious progress in eel development demands a long-term commitment to full-time work.

The extensive study conducted on the Shannon (McCarthy *et al.*, 1994a,b; Reynolds *et al.*, 1994) and that in progress on the Erne provide or will provide essential base-line data. These will need to be updated by monitoring teams. In addition, both Shannon and Northern Regions have other lakes, such as those on the Fergus and Lough Melvin, which need attention by the proposed teams.

### 5.7 Development and maintenance programme

The programme envisages an initial 3-year phase during which research and development on a regional basis will be undertaken by teams in parallel, co-ordinated by the cen-

tral team (5.2). The work programme for the regional scientific teams is summarised in Table 5.2 and for the fishery officers in Table 5.3.

A glass eel-based enhancement project in Ireland requires a lead-in time of 10 years on account of the slow growth rate of the species. The first results of increased yield become apparent 10 years after the first stocking sea-

son and the yield will continue to rise for the following 5 years after which it will stabilise if properly managed. The development scheme will take place in two phases: (i) 3 years basic research with contract scientists and technicians, (ii) annual stocking, management and scientific monitoring operation by Regional Board officers, with central co-ordination by a permanent eel expert.

**Table 5.2. Work outline for regional scientific teams**

February–May	1. Exploratory glass eel fishing 2. Glass eel sampling
May–September	1. Exploratory fishing 2. Catch sampling 3. Silver eel sampling
October–December	Silver eel sampling
January–February	Data analysis

Glass eel fishing, initiated in the 1990s in the estuaries of the Shannon and Erne, resulted in the capture and transfer of significant numbers to the lakes of the two systems. Increased fishing effort in these catchments and development of fishing in others detailed in Chapter 6 will result in greater catches. Scientific sampling is required to develop the cost-effectiveness of the operation, to monitor long-term changes and to gather information on the desirability of developing an export fishery.

The exploratory fishing for yellow and silver eel will, in the first place, be needed to establish base-line data to be used in monitoring and assessing the effectiveness of the development of the fishery as a whole. Catch sampling will provide the basis for management measures. Silver eel sampling is an important part of the basic management studies but, more importantly, is a requirement in determining spawner escapement for the European eel population.

**Table 5.3. Work outline for regional fishery officers**

Mid-February–May	Operate/patrol glass eel fishery 10 nights/month
May–September	Patrol yellow eel fishing 3–7 days/week
October–December	Patrol silver eel fishery 6 nights/month

Capture of glass eel depends largely on tidal conditions and experiments in progress are showing that the operation is part-time, requiring generally a few hours of a limited number of nights. The scientific studies will

enable the requirements to be more closely defined. To ensure that the glass eel are delivered to their legitimate destinations will require a measure of patrolling. Situations have already been identified in which Regional

Board officers are able to engage in glass eel capture without interfering with their regular duties. Such an arrangement has the advantage of ensuring full control of the transfer of the glass eel and also of ensuring a presence of officers in the fishery.

Control of the fishery for yellow and silver eel is essential in the optimal management of the stock. The scientific studies will determine optimal fishing effort and size limits. Enforcement of these requirements will need dedicated eel work in all Regions. Because of

the seasonal and tidal behaviour patterns of the eel, none of the enforcement work will be full-time and officers will be free to engage in other duties for much of the time. It is very desirable, however, that at least one officer in each Region be assigned primarily to eel work so that appropriate expertise is developed.

Estimates of the costs of the development and maintenance programme are given in Chapter 8 and detailed in Moriarty (1999).

## **6 REGIONAL STRATEGIES**

In this section the extent of major catchments, their stocking requirements and potential yield are quantified. The basis for the calculation relates to the sustained yield of Lough Neagh at 20 kg/ha with a stocking rate of 250 or 0.1 kg elver/ha. The estimate of the Lough Neagh yield is probably the most accurate in the entire eel fisheries of Europe. Since the Co-operative enforces a maximum daily quota, it is believed that the actual yield is higher. Moreover, substantial areas of the bed of Lough Neagh are sandy, unproductive of eel, and therefore, rarely fished. It appears, therefore, that the yield per productive hectare of the lake must be considerably greater than 20 kg/ha.

The stocking rate of 250 glass eel/ha is also accurately known. In this, and all other Irish fisheries except the Erne, there is an unquantified natural recruitment. The requirement of 250 glass eel to yield 20 kg market could be an over-estimate. On the other hand there is no reason to believe that the yield of Lough Neagh would not be greater if more glass eel were supplied – there is no evidence whatever of over-stocking. In spite of the present impossibility of an exact calculation of yield per recruit, the target of 250 glass eel/ha is strongly recommended. It has been accepted as the best available by the EU Concerted Action on Eel (Moriarty and Dekker, 1997). Scientific monitoring of stock and yield on a permanent basis will ultimately yield a more precise estimate. It is certain that each catchment will eventually be shown to have a different requirement, but the Lough Neagh figure is undoubtedly the best working estimate available.

The possibility of significant yields of elver or market eel in rivers of less than 25 km length and 'acid' lakes of conductivity less than 125 meq/l is not considered. Good catches of eel in such conditions are not unknown, but priority at least for the first 10 years of a development exercise must be given to the

most productive systems. However, these lakes and rivers yield very substantial numbers of spawners and may make an important contribution to the eel stock as a whole. Their output in this regard should be assessed.

Elver capture will take place in river catchments such as the Shannon, Corrib and Erne which are currently exploited for yellow and silver eel and in which stocks may be enhanced. The first priority is to transfer a minimum quantity of 0.1 kg elver/ha to the lakes within the system every year. Thereafter transfer outside the catchment may take place.

In catchments in which exploitation of yellow and silver eel is unlikely ever to take place the aim should be to maintain the wild population upstream in the interests of contributing to the breeding stock. A figure of 1 kg/10 km of main channel stream was adopted by the Concerted Action. This is applied to the tables in the following section and it is proposed that authorisations for elver capture include a condition that the given quantity of elvers must be released before removal of any from the catchment may be permitted.

### **6.1 Eastern Region**

The Eastern Region has a long tradition of fishing for yellow eel in Loughs Muckno and Ramor and some smaller lakes and of a very substantial number of eel weirs and 'fishing milldams', particularly on the Fane and Blackwater rivers. Wexford Harbour, the large and partly enclosed estuary of the River Slaney, has supported a fyke net fishery since the 1970s.

#### *6.1.1 Elver*

The upper estuaries of the Castletown River, the Boyne and the Slaney appear to be promising sites for trawl or fixed netting. In the case of the Slaney, elver capture upstream of the yellow eel fishery should have no nega-

tive impact whatever. Trapping at the most downstream weirs of the Boyne and the Liffey should be given first priority, but the weirs on the smaller rivers in the catchment should all be investigated.

### 6.1.2 Yellow eel

The Boyne catchment contains Lough Ramor which has good population potential, and therefore, first priority must be given to stocking it with glass eel, likewise the Fane stocks need to be directed to Lough Muckno.

Boyne, Broadmeadow and Liffey estuaries are fished from time to time. The effort probably leads to stock depletion taking some years to recover. Potential yield will never be large and it is unlikely that management measures could be cost-effective. One crew should be the maximum in any season in any one estuary. The same applies to the freshwater fishery on the Liffey. The fyke net yields on any of the other rivers are unlikely to be significant.

Fishing rights on both Lough Ramor and Lough Muckno are privately owned. Long-lining is prohibited in the latter. Because of its small size and the existence of a

number of traditional eel weirs downstream of Lough Muckno, there is no good reason to encourage fishing for yellow eel. The owner of the Ramor rights issues permits to long-line or fyke net fishermen. When developed, up to four crews could be accommodated.

Lough Lene has no tradition of eel fishing and, because of its position at the headwaters of effluent rivers (Boyne and Shannon catchments), is unlikely to hold good eel stocks. It would be an extremely interesting lake for experimental development.

The privately-owned South Sloblands Channel, having been shown to have an unusually dense population of eel in 1970 was fished successfully the following year. Recovery after heavy fishing required a period of 5 years, as had been predicted by age and growth studies (Moriarty, 1982b). Management advice to the owner was to fish at 5-year intervals rather than attempt to maintain an annual catch. Poor recruitment since the 1970s, however, led to the abandonment of the fishery.

Lady's Island Lake provided worthwhile catches in the 1960s. Its irregular connection with the sea, however, reduces the chances of

**Table 6.1.1. Annual glass eel requirements and potential yield of yellow and silver eel in the Eastern Region**

	Length (km)	Glass eel (kg)	Elver potential	Elver gear	Area (ha)	Glass eel (kg)	Potential yield (t)
<i>Rivers</i>				<i>Lakes</i>			
Castletown	45	5	**	fixed	Muckno	33	3
Fane	61	6	*	trap	Lene	430	43
Glyde	55	5	*	trap	Ramor	800	80
Dee	60	6	*	trap	South Sloblands	50	5
Boyne	113	11	**	trawl, fixed, trap	Lady's Island	300	30
Nanny	39	4	*	trap			
Broadmeadow	34	3	*	trap			
Tolka	32	3	-				
Liffey	132	13	**	fixed, trap			
Vartry	32	3	*	fixed			
Owenavorrhagh	29	3	*	fixed			
Slaney	118	12	**	trawl, fixed			
<b>Total elver requirement (kg)</b>						161	
<b>Total potential yield (t)</b>							33

recruitment. A small sustainable fishery could be created by standard management and would allow operation by two crews.

The most important eel fishery in the Region takes place in the Slaney Estuary where some 20 licensed fishermen make an estimated catch of 10 t. It is assumed that this and other estuaries are well stocked by glass eel, though this has never been the subject of investigation. No eel fishing takes place in the fresh-water portion of the Slaney.

### 6.1.3 Silver eel

Six eel weirs have been operated on the River Fane, depending largely on the eel of Lough Muckno. Before the Boyne drainage, six eel

weirs operated on the Blackwater and there were 20 in total on the Boyne and its tributaries, though several were derelict by the time the drainage began. The Central Fisheries Board has been given estimated annual catches of 5 t and 7 t in the Fane/Glyde/Dee and Blackwater, respectively. Returns supplied by the fishermen are incomplete and suggest that the catches are smaller. An annual yield of 5 t from the Fane, Glyde and Dee with their small lakes would imply an exceptional biomass and highly efficient fishery. Catches of more than 1 t were made at some of these and could be repeated when eel stocks increase. However, the capital cost of building an efficient eel weir could be unrealistic, even if a catch of 1 t/year could be realised.

**Table 6.1.2. Eel fisheries in the Eastern Region (s, silver eel; y, yellow eel)**

	Catchment (km <sup>2</sup> )	Fisheries	Number of fishers	Catch (t)	Catch potential (t)	Glass eel priority	Notes
Fane	350	s & y	6	5	7	1	
Boyne	2,694	s & y	5	7	26	1	includes estuary
Liffey	1,368	y	1	1		2	
Slaney	1,761	y	20	10	10	3	estuary only
<b>Total</b>			32	23	43		

## 6.2 Southern Region

The most successful fishery in the Region takes place in Waterford Harbour. Until the 1960s, the gear used was a wicker basket about 1 m long and 50 cm in diameter. These were made in Carrick-on-Suir. Partly due to the absence of substantial lakes from the catchments, there are only minor fisheries for yellow and silver eel in fresh water. In the late 1960s a visiting Dutch fisherman introduced gear known locally as the 'beck', a trap made from nylon mesh supported on plastic hoops. These must be baited with freshly-caught small estuarine fish such as herring. Lock-keepers on the Barrow placed small nets for silver eel in the sluices of the lock gates and small numbers of eel weirs were operated on the three rivers. Fyke nets were

used in the 1970s on the Barrow and on the Blackwater and are still operated in the Suir estuary.

### 6.2.1 Elver

Trials of elver fishing by ladder-trap at St. Mullins for transport upstream were made by local eel fishermen but did not develop. In view of the size of the catchments of the main rivers and the length of their estuaries, it is possible that substantial numbers of glass eel enter the tidal water and that development of a fishery is feasible. Experiments could be made at a number of bridges and at downstream weirs. Priority in stocking should be given to the Barrow which, unlike the majority of rivers without lakes in Ireland, has been fished cost-effectively.

**Table 6.2.1 Annual glass eel requirements and potential yield of yellow and silver eel in the Southern Region**

	Length (km)	Glass eel (kg)	Elver potential	Elver gear	Potential yield (t)
<i>Rivers</i>					
Barrow	192	19	***	trawl, fixed trap	2
Nore	140	14	**	trawl, fixed trap	2
Suir	184	18	**	trawl, fixed trap	15
Blackwater	167	17	**	trawl, fixed trap	2
<b>Total elver requirements (kg)</b>		68			
<b>Total potential yield (t)</b>					21

### 6.2.2 Yellow eel

Fyke net fishing took place on the Barrow in the 1970s with some success, but was abandoned and a strong and reasonable case against its development has been made by the existing silver eel fishermen. Fyke net fishing has also been successful on the Blackwater where there are no silver eel fisheries, and therefore, no conflict of interests. Because of the limited area of water in rivers – in contrast to the situation in lakes – there are no prospects for the development of major fisheries in the Region, but small-scale fishing as a sideline in the Blackwater, Suir and Nore could be tolerated – bycatch of salmonids has usually been insignificant.

The eel pot fishery for yellow eel in Waterford Harbour has been successful, but fishermen are making a plausible claim that quantities and sizes of the eel are falling. The Board has proposed that not more than 30 licenses be issued for the time being and that the maximum number of pots per license be

20. On the same basis of reduction of size and stocks, the Board has also recommended that the maximum number of fyke net licences for the Waterford Fishery District be nine and that not more than 20 nets be allowed per licence.

In view of strong rumours of export of small eel from the Region, the Board has also recommended setting a minimum length limit of 30 cm.

The yellow eel population in the Blackwater estuary was studied in 1965 and 1966 and in the river between Banteer and Fermoy in 1972 and 1973 by Moriarty (1975a). Sufficient stocks were present to sustain a small fishery but there are no serious prospects for commercial development and the river would best be conserved as a source of spawning stock.

### 6.2.3 Silver eel

Silver eel fishing has been tried at many

**Table 6.2.2. Eel fisheries in the Southern Region (s, silver eel; y, yellow eel)**

	Catchment (km <sup>2</sup> )	Fisheries	Number of fishers	Catch (t)	Catch potential (t)	Glass eel priority	Notes
Barrow	3,067	s	6	<1	2	***	
Nore	2,530	s	1	<1	2	**	mainly in river
Suir	3,603	y	19	15	30	**	
Blackwater	3,326	y	2	<1	2	**	mainly in estuary
<b>Total</b>			28	23	36		

points on the rivers and has been abandoned in most cases. Because of the propensity for flooding, effective gear would usually be uneconomical to construct. An important exception is on the Barrow where lock keepers have operated a fishery. Effort in this fishery has been greatly reduced, probably because of falling stocks. It is a small but potentially significant operation which could be revived by a stocking programme.

### 6.3 Southwestern Region

The relatively acidic waters throughout the Region support a population of slow-growing eel. A fishery has, however, been established in Lough Allua and there are possibilities for worthwhile catches in the Lee reservoirs. There is potential for yellow eel fishing in Lough Leane and reasonably successful trials were made there in the 1960s. However, the National Parks authorities decided to forbid any commercial fishing and the lake, therefore, constitutes an effective sanctuary area. While there is no reason to prohibit individuals from fishing in the Southwestern Region, the Regional Fisheries Board decided against taking active steps to develop yellow and sil-

ver eel. There is, however, considerable potential for elver fishery development.

#### 6.3.1 Elver

In spite of the Lee's large catchment and extensive estuary, the persistent failure of efforts to establish fyke net fisheries in the tidal waters suggests that the supply of elvers is limited. For this reason it might be given low priority for experimental fishing. The other substantial rivers may have considerable potential and top priority is recommended for the Bandon, Laune and Maine. The smaller Kerry rivers are known to have conspicuous elver runs from time to time and could be suitable sites for trapping.

#### 6.3.2 Yellow eel

A fyke-net fishery has been operated successfully for some years in Lough Allua and should be continued. The stocks are unlikely to be sufficient for more than one crew. The Lee Reservoirs have some potential but should be limited to a single crew until stocking increases the population.

**Table 6.3.1 Annual glass eel requirements and potential yield of yellow and silver eel in the Southwestern Region**

	Length (km)	Glass eel (kg)	Elver potential	Elver gear		Area (ha)	Glass eel (kg)	Potential yield (t)
<i>Rivers</i>					<i>Lakes</i>			
Lee	87	9	**	trawl, trap	Allua	200	20	4
Bandon	72	7	***	trawl	Lee Reservoirs	400	40	8
Argideen	27	3	**	fixed				
Ilen	32	3	**	fixed				
Sheen	22	2	*	trap				
Roughy	27	3	*	trap				
Blackwater	16	2	*	trap				
Cummeragh	24	2	*	trap				
Inny	25	3	*	fixed				
Laune	75	8	***	fixed				
Maine	72	7	***	fixed				
<b>Total</b>		<b>49</b>					<b>60</b>	<b>12</b>

### 6.3.3 Silver eel

No silver eel fishing takes place in the Region. Possibilities for small-scale developments at milldams exist and should not be discouraged. The economics of such an operation depend entirely on a no-wage situation.

## 6.4 Shannon Region

Returns provided by the railways early in the 20th century suggested that the eel yield from the Shannon lakes was greater than from Lough Neagh. However, the Lough Neagh management team began active development work in the 1930s while, about the same time, the Ardnacrusha dam was installed with minimal knowledge of the requirements of ascending elvers. The Shannon eel fishery declined but remedial steps, including an elver transport scheme together with curtailment of public fishing, were initiated by the ESB in 1959.

The first scientific study of eel in the Shannon began in 1969 and the results were published by Moriarty (1974). In 1981 a long-term study was begun in Meelick Bay in Lough Derg and is still in progress. A number of scientific papers giving results from this project have been published. The main management conclusions of these studies were brought together in a *Fishery Leaflet* entitled *The eel stocks of the Shannon system and prospects for the development of the fishery* (Moriarty, 1987). This suggested that a yield of 1,000 t/year could be attained from the Shannon lakes.

Subsequently the ESB funded greatly enhanced surveys which were undertaken by research workers from University College, Galway and Trinity College, Dublin. (McCarthy *et al.*, 1994a, b; Reynolds *et al.*, 1994). These reports in general confirmed and developed the earlier conclusions and led to major advances in fishing both for elvers and for yellow and silver eel.

### 6.4.1 Elver

Elver fishing on the Shannon was established in 1959 acting on the advice of a consultant Harold Koops of the German Coastal and Inland Fisheries Institute. Capture and transportation of elver and bootlace eel from Ardnacrusha and Parteen Weir, respectively, have been carried out annually ever since. The elver catch at Ardnacrusha is believed to be influenced mainly by the quantities of glass eel actually reaching the Shannon Estuary from the open sea. It was large, varying between 1 and 7 t up to 1982 when it fell to very low levels, rarely exceeding 1 t until the 1990s when better techniques and, probably, more abundant stocks, led to an increase. However, the minimum requirement of 3.5 t was not attained over a period of 15 years from 1981 until 1997. Fishing for elver on the Rivers Maigue and Feale had also been successfully operated by the ESB and was improved in the 1990s, when the Bunratty and other untapped rivers began to be exploited.

By comparing the Shannon Estuary with estuaries elsewhere in Europe it appears that the Shannon is seriously under-exploited and that many tonnes of elver could be captured. It is well within the bounds of possibility that the Shannon Estuary alone could provide all the elver required to stock Irish waters, to supply aquaculture and to have a surplus for the very lucrative export market. Experimental fishing to develop the catch is in progress.

Top priority for elver capture is proposed for the Feale, Maigue, Shannon, Bunratty and Fergus on the grounds that they are already being exploited and have potential for greater development. The Deel, Mulkear, Doonbeg and Inagh are all likely to have good potential. Other coastal streams in the Shannon Region should be considered in due course.

### 6.4.2 Yellow eel

On the basis of sampling undertaken in 1985 and 1986 (Moriarty, 1987), it was concluded

**Table 6.4.1 Annual glass eel requirements and potential yield of yellow and silver eel in the Shannon Region**

	Length (km)	Glass eel (kg)	Elver potential	Elver gear		Area (ha)	Glass eel (kg)	Potential yield (t)
<i>Rivers</i>					<i>Lakes</i>			
Feale	74	7	***	trap, fixed	Allen	3,500	350	70
Deel	19	2	**	fixed	Boderg	430	43	9
Maigue	61	6	***	trap, fixed	Bofin	408	41	8
Mulkear	31	3	**	trap	Derg	11,635	1,163	233
Shannon	290	29	***	trap, fixed	Derravaragh	1,100	110	22
Bunratty	42	4	***	fixed	Ennell	1,400	140	28
Fergus	58	6	***	trap, fixed	Gara	1,100	110	22
Doonbeg	24	2	**	fixed	Graney	370	37	7
Annageerah	21	2	*	fixed	Inchiquin	110	11	2
Inagh	35	4	**	fixed, trap	Key	900	90	18
					Owel	950	95	19
					Ree	10,500	1,050	210
					Sheelin	1,900	190	38
<b>Total</b>	655	65					3,430	686

that the eel population density in the Shannon lakes was greater than that of Lough Neagh. This led to the conclusion that the known fishing effort applied in the catchment, concentrating almost entirely on silver eel and usually yielding less than 50 t of eel/year, was inadequate to harvest the stocks effectively. At the same time there was evidence of extensive illegal fishing with an unknown yield.

The survey commissioned by the ESB in 1992 and 1993 involved extensive fyke net fishing by supervised fyke net crews in Loughs Derg, Ree, Ennell, Sheelin and Allen (McCarthy *et al.*, 1994a). Moriarty's observations in 1986 took place in Zone 3 of Lough Derg as defined by McCarthy and fished under his supervision in 1992 and 1993. The catch per ten nets fished overnight was 12 kg in 1986, falling to 8 in 1992 and 5 in 1993. The values are not directly comparable because in 1986 fishing sites were selected at random while in 1992 and 1993 different crews were selecting the most promising sites in the interests of maximising their catches. However, the decline in catch may very well be the result of the poor recruitment observed

in the 1980s and 1990s.

The majority of eel caught in the fyke nets are between 10 and 15 years old and, in very broad terms, the average age of silver eel may be taken as 15 years. Recruitment had been reasonably strong at least from the 1960s up to 1982 so that the survey in 1986, undertaken before any substantial fishing for yellow eel was taking place in Lough Derg, would have coincided with maximum population. By 1992 the years of poor recruitment should have begun to be apparent and so the smaller catch per unit effort is not surprising.

The current level of exploitation allowed by the ESB is reasonably low and should probably remain so until the effect of the improved rate of stocking becomes apparent.

#### 6.4.3 Silver eel

From the 1950s until the 1990s, commercial fishing for yellow eel was prohibited on the Shannon and all effort was directed towards the silver eel. The original management theory and proposal was that the entire catch

**Table 6.4.2. Eel fisheries in the Shannon Region (s, silver eel; y, yellow eel)**

	Catchment (km <sup>2</sup> )	Fisheries	Number of fishers	Catch (t)	Catch potential (t)	Glass eel priority	Lakes
Shannon	12,050	s & y	70	70	700	***	Shannon lakes
Fergus	1,040	s & y	5	5	10	***	Fergus lakes
<b>Total</b>			75	75	710		

could be made at the eel weir in Killaloe. Even after very considerable and innovative improvements had been made to the gear there, it was evident that catches were unduly low and a number of other installations were used. These included revival of the silver eel weir at Athlone and the construction of a series of three barrages of nets on the headrace canal at Clonlara.

Two traditional eel weirs had been operated on the Fergus and a third was added, downstream of the others, in the 1980s. All three make a moderate catch. An estimate of 5 t has been made for the total catch, silver and yellow eel, on the Fergus.

### 6.5 Western Region

Management of the Corrib eel fisheries, apart from structural improvements to existing eel weirs and restrictions to yellow eel fishing, has been minimal. Elver passes were incorporated in the barrage constructed in the 1960s to control water levels. Although elvers from time to time used the passes, they were frequently inaccessible because of flood or low-water conditions and the necessary annu-

al servicing was abandoned.

The first fyke net study of eel in fresh water in Ireland took place from 1967 to 1969 (Moriarty, 1972) and in 1970 commercial fyke net fishing for yellow eel began. The results of the study led to a recommendation that a maximum of 20 fyke nets per person be allowed. This was based on the observation that a fishing effort of this magnitude would allow a lakeside resident to make a modest return from a small expenditure of time and effort. Minimising the effort per person would allow the involvement of maximum numbers of fishermen.

Eel migration in the River Corrib was studied between 1980 and 1982 (McGovern and McCarthy, 1992) and established that the catching power of traps placed in the elver passes was not more than 3 kg/night.

The results of a small sampling survey undertaken in 1990 indicated that the stocks were considerably reduced and concluded that poor recruitment rather than intensity of fishing could explain the decline. A precautionary approach of maintaining the fishing effort

**Table 6.5.1. Annual glass eel requirements and potential yield of yellow and silver eel in the Western Region**

	Length (km)	Glass eel (kg)	Elver potential	Elver gear		Area (ha)	Glass eel (kg)	Potential yield (t)
<i>Rivers</i>					<i>Lakes</i>			
Kilcolgan	61	6	**	trap	Carra	1,500	150	30
Corrib	77	8	***	trap	Corrib	17,000	1,700	340
Ballynahinch	29	3	**	trap	Mask	8,000	800	160
Erriff	32	3	***	trap	Rea	260	3	5
<b>Total</b>	199	20				26,760	2,653	535

at its current level was recommended. Since then, stock enhancement by transferring glass eel from the neighbouring Erriff catchment has been carried out.

### 6.5.1 Elver

Anecdotal reports of extremely large numbers of elver visible in daylight in the canals of the city of Galway may be accepted as indicating that from time to time very substantial catches could be made. Barriers to their ascent to fresh water exist on all branches of the river and the only factual information available (McGovern and McCarthy, 1992) suggests that relatively small proportions of the stock succeed in entering the lake system. It seems possible that mortalities are high and that there is considerable scope for the development of the dip net fishery operated from time to time, together with the installation of improved traps.

Observations over many years indicate that the Erriff frequently has a large elver run and that a significant fishery can be developed. The river is relatively small and it is likely that a catch of many times the required escapement (3 kg) may be made, for example 32 kg in 1997.

The elver potential of the Kilcolgan or Dunkellin River system has not been examined. The presence of substantial stocks of eel as far upstream as Lough Rea suggests that significant numbers may enter the river. If exploited for elver, the first requirement should be the transfer of 3 kg/year to the potentially valuable Lough Rea fishery.

A survey of eel in Ballynahinch Lake in the 1980s indicated substantial stocks and in earlier years some observations had been made of plentiful elvers under stones at migration time in the Ballynahinch River. As the biggest of a number of small catchments in the region, it is the most likely to attract a substantial run of elvers. It is possible that all of the smaller rivers of Connemara could yield several kg of elvers each.

Top priority for elver fishery development is recommended for the Corrib and the Erriff. Kilcolgan and Ballynahinch are certainly worth investigating, after which the smaller rivers could be considered.

### 6.5.2 Yellow eel

The long-line has a very long tradition of use on the lakes of the Corrib system by both resident and itinerant fishermen. The fyke net was introduced in 1970 and adopted by some 40 crews. Catch per unit effort appeared to fall in Lough Corrib in the late 1980s, but anecdotal information suggested that the stocks in Lough Mask were excellent in the 1990s. The eel of Lough Corrib are notably small, maturing at a relatively young age, with females of less than 39 cm being caught from time to time and an unusual degree of overlap in lengths between male and female. The eel of Loughs Mask and Carra appear to be larger.

### 6.5.3 Silver eel

Major silver eel fisheries are situated in Galway City and at Inishard at the outflow of Lough Mask. Smaller fisheries are operated

**Table 6.5.2. Eel fisheries in the Western Region**

	Catchment (km <sup>2</sup> )	Fisheries	Number of fishers	Catch (t)	Catch potential (t)	Glass eel priority	Lakes
Kilcolgan	383	s	2	n.a.	5	***	Rea
Corrib	3,152	s & y	40	40	520	***	Corrib, Mask, Carra
Ballynahinch	173	s	2	1	1	**	Ballynahinch
<b>Total</b>			44	41	526		

at other points on Lough Mask and one at Lough Carra. A remarkable indoor trap for silver eel was operated in the town of Loughrea where the Dunkellin River flows through a former watermill. A second eel weir exists farther downstream on the same river. Substantial catches are made on the Mask–Corrib system. A silver eel fishery has been operated from time to time on the Ballynahinch River. It is unusual in depending on the output from an acid-water lake.

## 6.6 Northwestern Region

The Moy catchment has a long history of eel fishing, for yellow eel on Loughs Conn and Cullin and for silver eel at Foxford and Ballina. Lough Arrow and Lough Gill have also been fished regularly or at frequent intervals. Carrowmore Lake has not been surveyed and, assuming that long-liners make occasional trials there, the fact that there is neither a fishery nor any tradition of one suggests that the stocks may be poor. Good runs of elvers have long been known in the Moy and Ballisodare. It is possible, indeed likely, that western rivers, such as the Owenmore, have exploitable elver stocks.

### 6.6.1 Elver

Substantial numbers of elvers are visible from time to time at the salmon weir on the Moy at Ballina where they have been netted and transferred to Lough Conn. The site is

highly suitable for the construction of elver traps. A successful fishery was operated on the Burrishoole at the Salmon Leap in the 1960s, the elvers being transferred to the Shannon. In the 1980s a simple trap made from local materials was placed in the Ballisodare fish pass and proved very effective. A stipulation was made that 50% of the catch be released in Lough Arrow, the remainder being made available for an eel culture project.

The configuration of the Owenmore, at the head of a substantial inlet, with a large lake upstream, suggests that it could support a good elver run. The Cloonaghmore, on a large estuary with a waterfall close to the tidal boundary, also looks promising. Owenduff, Newport and Burrishoole are possible elver sources.

### 6.6.2 Yellow eel

Lough Conn has traditionally been fished successfully by long-liners. The eel population was studied in August 1972 (Moriarty, 1973) and a more recent follow-up survey indicated that reasonable stocks were still present. The eels were small and the growth-rate relatively slow. Eutrophication of the lakes could have improved the eel habitat and are unlikely to have damaged it. Lough Conn is unusual amongst large Irish lakes in lying on a tributary rather than on the

**Table 6.6.1 Annual glass eel requirements and potential yield of yellow and silver eel in the Northwestern Region**

	Length (km)	Glass eel (kg)	Elver potential	Elver gear		Area (ha)	Glass eel (kg)	Potential yield (t)
<i>Rivers</i>					<i>Lakes</i>			
Owenmore	48	5	**	trap	Carrowmore	960	96	18
Owenduff	29	3	*	trap	Conn	5,000	500	100
Newport	29	3	*	trap				
Burrishoole	23	2	*	trap				
Moy	100	10	***	trap				
Cloonaghmore	32	3	**	trap				
<b>Total</b>	<b>261</b>	<b>26</b>				<b>5,960</b>	<b>596</b>	<b>118</b>

**Table 6.6.2. Eel fisheries in the Northwestern Region (s, silver eel; y, yellow eel)**

	Catchment (km <sup>2</sup> )	Fisheries	Number of fishers	Catch (t)	Catch potential (t)	Glass eel priority	Lakes
Burrishoole	258	s	2	1	8	**	Feeagh, Furnace
Moy	2,337	s & y	36	2	120	***	Conn, Cullin
Ballasadare	757	s & y	4	1	25	***	Arrow
Garavogue	403	s & y	4	1	28	***	Gill
<b>Total</b>	<b>3,755</b>		<b>46</b>	<b>5</b>	<b>181</b>		

main river Moy. The presence of good eel habitats in the Castlebar lakes on the main river makes it likely that a high proportion of the ascending elvers pass by Lough Conn rather than entering it. This might make little difference to the silver eel fisheries but would seriously affect the stocks of Loughs Conn and Cullin.

Lough Arrow was also a popular long-line fishery. A study of the long-liners was conducted by the Inland Fisheries Trust in 1955 leading to the conclusion that the method posed no hazard to trout stocks (Anonymous, 1956). A stock survey in 1974 (Moriarty 1975b) indicated a well-fed and fast-growing population, but with relatively small numbers. The small numbers could be ascribed both to fishing intensity and to the probable negative effect of the Ballisodare falls on ascending elvers. This makes a very clear case for capture and transfer of elvers.

Lough Gill in recent years has yielded a reasonable long-line catch, but has never been as popular as Arrow. The eels studied in 1974 (Moriarty, 1975b) were found to be less plentiful, smaller and slower-growing than those of Lough Arrow in the same year.

### 6.6.3 Silver eel

Silver eel from Lough Feeagh are caught in the downstream traps of the Salmon Research Agency. They have been quantified over many years and were studied intensively between 1990 and 1994 by Russell Poole (1994). Monitoring continues, placing the Burrishoole and its lakes amongst the most

thoroughly studied eel populations in the world. While the catch is reasonable, it would be unlikely to be economical in terms of the capital and maintenance costs of the fishing gear.

On the Moy, the Foxford eel weir was demolished in the course of the arterial drainage works in the 1960s and was not replaced. The more downstream of two eel weirs in Ballina operated at the salmon weir and was abandoned, partly because the catch was scarcely viable in terms of manpower required and partly because the nets caught substantial numbers of salmon smolt. The upstream weir on the right bank continues to operate.

One or two silver eel fisheries on the Garvogue have yielded modest catches. The Unshin River, draining Lough Arrow, has rarely been fished legitimately for silver eel. Strong rumours persist of its yielding good catches to poachers.

## 6.7 Northern Region

The Northern Fisheries Region contains the River Erne, with its estuary and two hydro dams, plus the extensive Erne lakes of County Cavan. The greater part of the area of Lough Erne is in County Fermanagh. Co-operation between jurisdictions has been the rule for many years. A number of Cavan lakes were studied in the 1970s (Moriarty, 1973). Austin Duke of Forbairt initiated a cross-border study which was followed by a wide-ranging report on elvers (McCarthy *et al.*, 1994c). In 1997 an Erne eel development project, instigated by Mr. Harry Lloyd, Northern Regional

Fisheries Board and funded jointly by both Governments and the Peace and Reconciliation Measure, began a major study of the entire catchment and adjoining waters. The aim is to manage the fishery and bring about a sustainable yield of 200 t of eel/year (Matthews, 1999).

Elsewhere in the region, eel fishing has taken place but rarely for any long period. All the substantial lakes are acid. While one-off catches involving many year classes may be profitable, there is little prospect of developing sustainable fisheries capable of a significant annual yield. A number of rivers, besides the Erne, may have potential for elver capture.

#### 6.7.1 *Elver*

Since 1962 ascending elvers have been

caught at the base of the Cathleen's Falls hydro dam and released in Lower Lough Erne by the Northern Ireland authorities. In 1993 agreement was reached whereby a proportion of these elvers would be transported to the Cavan lakes. Catches of up to 4 t have been made.

The nearby Abbey River has yielded worthwhile catches, but the fishery was abandoned due to excessive vandalism of the trap. A privately-funded experiment has been in progress for some years on some rivers to the north. Rivers listed in Table 6.7.1 have been selected because of the presence of lakes and large estuaries within their catchments. Anecdotal information refers to substantial runs of elver on the Leannan.

**Table 6.7.1. Annual glass eel requirements and potential yield of yellow and silver eel in the Northern Region**

	Length (km)	Glass eel (kg)	Elver potential	Elver gear		Area (ha)	Glass eel (kg)	Potential yield (t)
<i>Rivers</i>					<i>Lakes</i>			
Drowes	39	4	**	fixed	Melvin	2,100	210	44
Erne	216		***	trap, tela	Erne lakes (including NI)	33,000	3,300	660
Abbey	13	1	***	trap				
Eske	39	4	*	trap				
Clady	31	3	**	trap				
Lackagh	24	2	*	trap				
Leannan	45	5	**	trap				
<b>Total</b>	<b>407</b>	<b>19</b>				<b>35,100</b>	<b>3,510</b>	<b>704</b>

#### 6.7.2 *Yellow eel*

The Erne lakes have traditionally yielded large catches of yellow eel to long-liners. Studies in the 1970s (Moriarty, 1973) indicated relatively large stocks of large and exceptionally fast-growing eel in the Cavan lakes. These observations have been supported by work in progress in 1998 in the Erne project.

#### 6.7.3 *Silver eel*

Fisheries on the River Drowes, fed by Lough

Melvin, have been abandoned since the 1960s. Small fisheries operate on Erne tributaries in County Cavan. A major silver eel fishery in the Erne between Belleek and Ballyshannon was abandoned following the construction of the hydro-power dams and reservoir. This was replaced by a barrage of nets upstream at Belleek and between the islands at the lower end of Lower Lough Erne. In terms of the area of eel habitat upstream, returns have been extremely low.

**Table 6.7.2. Eel fisheries in the Northern Region (s, silver eel; y, yellow eel)**

	Catchment (km <sup>2</sup> )	Fisheries	Number of fishers	Catch (t)	Catch potential (t)	Glass eel priority	Lakes
Erne	4,372	s & y	50	100	660	***	Fermanagh & Cavan
<b>Total</b>	4,372		50	100	660		

### 6.8 The Foyle

From time to time experiments in fyke-netting and in elver capture have been carried out in the Foyle catchment. The fyke-netting did not yield encouraging results and elver capture was not pursued. The generally low-lying nature of the inflowing streams do not provide attractive sites for elver traps. The introduction of the *tela*, a large floating net, to

Ireland in 1998 provides a possibility for successful elver fishing in the tidal water. The size of the catchment and the shape of the estuary give reason to believe that very substantial numbers of glass eel may enter the Foyle and experimental netting was to begin in 1999.

## 7 AQUACULTURE

The eel cannot be spawned artificially, and therefore, all the seed for eel culture must be wild-caught. At present, the shortage of glass eel presents a serious problem for the aquaculture industry. There is reason to believe that sufficient glass eel enter Irish coastal waters. Therefore, although the main thrust of this document has been directed towards the development of the capture fishery, it indicates that the proposed exploratory and experimental fishing for glass eel should yield adequate supplies to develop the culture industry. Eel culture in effect depends on the existence of a glass eel fishery and cannot develop without a major input in this field. The culture industry could have a negative impact on the spawning stock since the entire production is consumed and no breeding adults return to the wild. The situation here is different from aquaculture of all other species, which includes maintenance of brood stock and production of eggs.

The optimum temperature for eel growth is 24°C. This temperature is rarely attained in the open in Ireland, and therefore, eel culture is carried out indoors with artificially heated water. To economise on fuel, the water is pu-

rified and re-circulated. This requires advanced technology and a high degree of sophistication on the part of the operator. A major environmental advantage of the system is that the quantity of liquid effluent is minimal and is discharged to the public sewer rather than to open waters. This in turn minimises the risk of introduction of pathogens to the wild populations.

Eel culture has been successfully used to contribute to stock enhancement (Rossi et al, 1988; Wickström, 1986) and experiments in this direction are in progress in Ireland. The production of 'bootlace' eel for ranching could reduce the lead-in time for the development of the capture fishery from ten years to five. Promotion of eel culture is currently being undertaken by BIM.

A further benefit of eel culture is that any increase in eel production in Ireland gives Irish producers a stronger hold over the market and reduces many of the overheads – such as the cost of transport – of the finished product. The culture industry, although different in many ways from the capture fishery, should, therefore, be promoted concurrently.

## **8 NATIONAL STRATEGY**

### **8.1 Costs and benefits**

A calculation of the costs and benefits of the development programme described in Chapter 5 was presented to the national workshop on eel held in Dublin in 1998 (Moriarty, 1999). The essential conclusion is that the value of a single year's enhanced catch would equal the total expenditure of the 10-year lead-in period. Thereafter, the fishery, in terms of maintenance of the stocking, monitoring and protection scheme, would be worth approximately ten times the input costs. This figure, based on the value of first sales of the eel, would be the minimum obtainable. It is assumed that the enhanced catch would support a highly profitable processing industry.

### **8.2 Glass eel and elver**

#### *8.2.1 Legal situation*

Section 173 of the 1959 Act prohibits the capture, possession of or injury to the 'fry' of eel. Although fishing for elver as an item of food did take place on the River Feale within living memory and the elver is widely used as a bait for trout, there is no traditional right to fish for it.

Section 14 of the same Act has been used as a matter of course to permit the capture of elver for transfer within or between catchments and, to a lesser degree, for intensive culture. Section 18 (1, a) of the 1980 Fisheries Act empowers Fisheries Boards to capture glass eel or elver.

The usual conditions in a Section 14 Authorisation, requiring the holder to provide the Regional Board with advance notice of the time and place of fishing and to inform the Department of the destination of the catch, have rarely been observed.

The legal situation, therefore, means that few members of the public have any claim to elver fishing rights. Authorisation under Section 14 provides the authorities with the opportunity

for almost unlimited control of the fishery. It is, therefore, possible to require the fisher to give an exact specification of place of capture and gear used and incorporate a requirement that a proportion of the catch be released at specified places within the catchment of capture.

#### *8.2.2 Personnel*

Several Boards agree that elver fishing should be confined to their own personnel. This is sound in principle, since creating a public right to fish could lead to serious problems in the essential matter of providing stock for Irish waters. If members of the public were to acquire a right to fish for elvers, they could reasonably demand freedom to seek the best markets. Two practical difficulties need to be faced. Firstly, a small number of individuals have held Section 14 Authorisations for some years and it would be unfair to terminate the arrangement. Secondly, effective exploratory fishing and, in due course, establishment of a regular fishery are likely to require many more hands than are employed by any Board. An arrangement such as fishing under contract to a Board would appear to be the best solution.

#### *8.2.3 Catch distribution*

The over-riding principle must be that in every river in which elver fishing takes place, the first requirement is to release upstream a designated quota. This is to ensure that Ireland's obligation to the international community in conserving breeding stock is observed. Based on the recommendations in the Concerted Action (Moriarty and Dekker, 1997) this requirement has been calculated as 1 kg/10 km of main channel stream. It can be included as a condition of any authorisation issued.

In the river-and-lake catchments where fishing for yellow or silver eel takes place, or may reasonably be expected to develop, the elver requirement will be greater. The grounds for

this approach are that, since the fishery for wild eel is based on a no-cost feeding regime and minimal capital investment, it is in the long term the most economic means of production. An added benefit from the national point of view is that the wild eel fishery is labour-intensive. Both these factors, together with the necessity to ensure escapement of spawners, demand that supply to natural waters takes precedence over supply to intensive culture. The recommended rate is 0.1 kg/ha.

The next outlet for elver is as 'seed' for intensive culture within Ireland. The quota to develop and then maintain the wild stocks has been calculated as 5 t. This is greater than the current production, but it is anticipated that development of the elver fishery will yield a catch substantially greater than this quota. Some flexibility in this respect could be tolerated in the short term in the interests of maintaining existing intensive culture.

Finally, any surplus to the requirements of the wild eel stocks and the Irish intensive culture industry should be exported.

Estimates of the quantities of elver required for the catchment quotas are given in Tables 6.1.1 through 6.7.1. These are derived from the best data currently available but could be revised upwards or downwards in the light of monitoring results.

Funding of the operation should be provided by the State throughout the 10-year development period. Thereafter, the fishers benefiting from this initial stocking could be expected to contribute by substantially increased license fees.

### **8.3 Yellow eel**

All the authorities and a majority of the fishers agree that the fishery must be controlled in the interests of a sustainable yield. Quotas and zonation of public and private fisheries are the means to the end. These may be fixed in the first place by reference to practice in

other jurisdictions. But it is essential that every fishery in Ireland be surveyed and subsequently monitored with a view to adjusting quotas and zones. Priority would be given to the larger fisheries, such as those on the Shannon, Corrib and Erne systems, but the long-term aim should be to survey every lake in which eel fishing is known to take place. It is not possible to base meaningful long-term regulations on a one-off survey since the development of the fishery is itself an input into the dynamics of each population. Regulations must embody provision for frequent revision in the light of the analysis of monitoring.

In Lough Neagh there is no zoning, but quotas are strictly enforced by the Co-operative. Because of the existing freedom in the majority of eel fisheries for fishers to operate at random, imposition of zones will not be easy. A gradual process, whereby existing fishers may continue to enjoy their freedom, but in which new entrants are restricted from the start is likely to be the most effective. There is a limit to the amount of ground that a fisher can cover, caused by the time and effort taken to set a given length of line or train of nets. In round figures, each Lough Neagh fisher covers an average of 1 square km/year. When stocks have built up, this could be taken as an initial guideline.

### **8.4 Silver eel**

Silver eel fishing has been abandoned in many cases due to problems in maintaining gear and in recruiting manpower. There is scope for making serious improvements in the methods currently in use. In particular, the traditional fishing by barrages of coghill nets in the narrowest parts of rivers is known to be inefficient and systems such as large fyke nets in slower flows may be better. In view of the decrease in recruitment throughout Europe, the best plan for the next 10 years could be simply to maintain the existing methods, in spite of their inefficiency, in the interests of maximising escapement.

Damage, frequently fatal, to silver eel takes place during their passage through turbines. This has not been quantified and needs to be examined. Should it prove to be small-scale, it would be difficult to make a case for action since any remedial measures are likely to be costly. If there is evidence of large-scale damage, methods of minimising it need to be developed. It would be preferable to maximise catch rather than simply leave such a valuable resource to be wasted.

When stocks are restored, the case for re-establishing abandoned silver eel fisheries and for introduction of new ones should be considered in view of the high value of the silver eel. A measure of protection of the interests of the occupiers of silver eel fisheries is needed. However, the current situation, whereby objections are made and sustained against any new operation upstream of existing fisheries, needs examination. In effect, the proprietor of a fixed engine is able to embargo any future development. A 10-year moratorium is proposed, after which proposals for new fixed engines should be considered on their merits. Any person who then installs a new fishery would have the right of 10 years' operation before any additional weirs are placed upstream. Exceptions could be permitted in cases where substantial lakes lie upstream of any weir.

## **8.5 Management proposals**

Management will be the responsibility of the Regional Fisheries Boards, working in co-operation with the national authorities and with the fishery owners and fishers. Some improvement in relationships between the authorities and the fishers will be an essential feature. Two 5-year plans for management are then envisaged.

### *8.5.1 Liaison between fishers and Boards*

A partnership arrangement between fishers and the Board in each Region must be established. At present a single eel licensee repre-

sents all the eel fishers in the Region. This representative is likely to be experienced in only one phase of eel fishing and may have a vested interest in his own fishery. In cases where there is a perceived conflict of interests between eel and sport fishers, the eel representative can be outvoted. Alternatively, all other members of a Board may go along with the personal views of one eel representative who may not have the interests of all the fishers in his constituency at heart. Progress in developing eel fisheries has from time to time been blocked by problems arising from such situations. Any development plan will need to establish a system for consultation, such as the establishment of an eel fishers' organisation in each Fishery Region and a requirement for open dealings between the organisation and the eel representative on the Board.

### *8.5.2 First 5-year plan*

Enhancement by elver transport is likely to require a period of 10 years before any substantial improvement in the stocks may take place. In the meantime, it is recommended that the recommendations of the EIFAC/ICES Working Party on Eel be accepted. They include the view that fishing effort should not be increased in the absence of enhancement measures.

An approach, which agrees with this, is to impose a moratorium at present levels. In the first place, no new licences should be issued for yellow eel fishing in the established fisheries, nor should any licensee be permitted to increase the number of nets currently allotted. An exception to this might be made so that one licensee could operate the nets of another who wished to cease fishing.

Monitoring, by sampling the commercial catch, should take place in all the existing fisheries. If necessary, legislation should be brought in requiring all licensed fishers to co-operate with designated officials in providing samples and permitting observation.

No steps to alter the intensity of fishing should be taken until the end of the 5-year period so that a proper analysis of the results may be achieved. This procedure introduces a risk of allowing particular fisheries to collapse, but restrictions introduced in any shorter period would make it almost impossible to draw firm conclusions about the performance of the fishery.

#### *8.5.3 Second 5-year plan*

This plan will be based on the analysis of the results of monitoring in the course of the first 5 years. These results are not predictable and could equally well provide evidence of under- or over-fishing. The most important principle to adopt is to avoid interference with the progress of the fishery as established for the first 5 years. Because of the slow growth rate of the eel and the fact that the fishery captures a number of year classes, it is not possible to base predictions on observations made over a period of less than 5 years. The longer-term welfare of the fishery will depend on the ability to make sound predictions.

#### *8.5.4 Designation of waters for fishery development and for spawning stock*

The results of the nationwide studies carried out by the Department's scientific staff have indicated that eel productivity is high in the lime-rich lakes, but in acid lakes eel growth is slow and productivity low. With the exception of rare cases, such as the Burrishoole River in which efficient downstream traps are installed and used for research purposes, the potential for developing any acid lakes for eel fishing must be questioned. As mentioned earlier, these lakes yield substantial numbers of spawners, and therefore, potentially contribute to the eel resource as a whole. In view of current concern amongst international authorities that spawner escapement should be enhanced, serious consideration should be given to declaring all such lakes eel sanctuaries – except for fishing by single rod and line which is highly unlikely to have any negative

impact on the eel population.

River-based eel fishing, in particular for silver eel at weirs, has been widespread but is now confined to a small number of long-established installations. Fyke net fishing in rivers is effective, but, because of the very small area of water involved, is likely to be destructive in the sense of removing within a single season five or more year classes from any stretch of water. It is unlikely that an annual sustainable fishery could be developed in any river other than the Shannon. Existing fisheries, such as those on the Barrow, should be supported but serious consideration should be given to maintaining rivers as eel sanctuaries, again with the exception of angling.

The primary argument against developing eel fishing in rivers and in acid lakes is economic. An important positive aspect of the ideal of eel sanctuaries is that although production is low, the extent of the unfished rivers and lakes is so large that they make a substantial contribution to the spawning escapement.

Although there have been many anecdotal accounts of a negative impact of commercial eel fishing on other species, widespread observations by scientists have failed to come up with any evidence of risk to other fish populations caused by eel fishing. The relatively high value of the eel compared to most other species and the absence of a legitimate market for them is an added inducement to the eel fisher to confine himself to his chosen species. In spite of these facts, strong objections are made in places to any use of nets to catch fish. In the absence of any sound evidence of incompatibility between sport fishers and commercial eel fishing, objections by local interests should be met by an information campaign rather than by restriction of eel netting.

#### *8.5.5 Research and monitoring requirements*

Maximisation of the sustainable catch re-

quires sophisticated monitoring throughout the eel's habitat. It is envisaged that the first 3 years of the development scheme will require an intensive scientific input. Following

this, monitoring may be carried out effectively by a small team. This must be continued as a permanent exercise after the initial 10-year lead-in period.

## 9 ALL-IRELAND PERMANENT COMMISSION

It is abundantly clear from the foregoing pages that the eel, in terms of fishery management, is a unique entity. In summary, the following factors contribute to this status:

- Extra-territorial breeding with random return of elver
- Stocks depending entirely on breeding in the wild
- A suitable species for intensive culture, but demanding wild stocks for seed
- Extremely slow growth rate in the wild, requiring more than 10 years to reach consumer market size
- The greater part of the population inhabiting fresh water
- High demand and high prices offered for juveniles
- High value for consumer market-size fish
- The only freshwater fish for which nation-wide commercial fishing is permitted

Expert scientific knowledge of the species is limited and highly centralised and does not extend throughout the regional authorities. Eel representatives on the Regional Boards either have no first-hand knowledge of the species or are specialist fishers concerned with only one phase of the eel's complex life

history.

There is accordingly a strong case to be made in favour of pooling the expertise in the form of a statutory commission or authority. In view of the common interests of eel development workers North and South, this authority could usefully be composed of representatives from both jurisdictions. The following composition, with North and South representatives for each category, is proposed:

Senior administrator  
Representative of Fisheries Boards  
Scientific expert  
Manager of major eel fishery  
Yellow eel fisher  
Silver eel fisher  
Eel culturist

The authority would:

- supervise the scientific programme
- advise both governments on the progress of the development scheme and
- assume responsibility for the drafting of regulations based on the scientific information and input from the trade and fishers.