Shannon International River Basin District Eel Management Plan

Introduction

This chapter has been prepared in accordance with Council Regulation (EC) No. 1100/2007 to describe measures to be carried out within Ireland's Shannon International River Basin District (SHIRBD) eel management unit for the recovery of the stock of European eel. The chapter will give an overview of the physical characteristics of the SHIRBD. The state of the current eel stock and the eel fishery will be described and analysed for the SHIRBD. Local stocks and fisheries will be analysed to estimate the current level of escapement at the catchment level. The quality of the eel habitat will be assessed and pressures or risk factors will be identified. Drainage, water abstraction and climate change are reducing available wet habitat which has an effect on eel populations. Finally, we will describe current and future monitoring and management actions that will ensure that target levels of escapement will be achieved.

The Department of Communications Energy and Natural Resources, Inland Fisheries Division, (DCENR) and the Department of Culture, Arts and Leisure Northern Ireland (DCAL), Inland Waterways and Inland Fisheries, convened a meeting on the 11th March 2008 in Dublin and subsequently exchanged written agreements (13th March and 20th March 2008 (ref:C17/9/161)) on the transboundary EMPs and agreed full co-operation in this regard. Scientists from the Marine Institute, Central Fisheries Board and DCAL – AFBINI have also agreed co-operation. One eel management plan will be submitted in respect of the SHIRBD and this will be prepared by the Shannon Regional Fisheries Board and submitted by DCENR.

The SHIRBD is managed by the Shannon Regional Fisheries Board (SHRFB) whose operational area largely constitutes the SHIRBD. Small parts of the SHIRBD are managed by the Western Regional Fisheries Board (WRFB) and the South Western Regional Fisheries Board (SWRFB). The RFBs are statutory bodies, established under the Fisheries Act 1980, operating under the aegis of the Department of Communications, Energy and Natural Resources. The RFBs are responsible for maintaining and improving environmental quality and developing and protecting the fisheries resource within their regions. Eel fishing licences and authorizations are issued on a Regional basis.

The Electricity Supply Board (ESB) nominates fishermen to fish on its behalf in the Shannon Catchment as part of a research programme and for experimental purposes.

Lead organisation: Shannon Regional Fisheries Board
Area Covered: Shannon International River Basin District

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Eamon Cusack, Chief Executive Officer, Shannon Regional Fisheries Board, Ashbourne Business Park, Dock Road, Limerick

1. Description of Management Unit

The Shannon RBD (SHIRBD) is the largest river basin district in Ireland, comprising a land area of 17,963 km^2 and 1,487 km^2 of coastal and transitional waters (Fig. 1.1). A small portion of County Fermanagh in Northern Ireland contributes to groundwater flow in the headwaters of the Shannon catchment, therefore the SHIRBD is classified as an International RBD. The RBD includes an extensive area of central Ireland, from its source in County Cavan to the mouth of the Shannon estuary draining significant portions of counties Cavan, Clare, Galway, Kerry, Leitrim, Limerick, Longford, Offaly, Roscommon, Tipperary and Westmeath and lesser areas of counties Cork, Laois, Mayo, Meath and Sligo. The SHIRBD contains 7,666 km of rivers, 1,220 km of coastline including estuaries, and 113 lakes including 53 over 50 ha in size. The SHIRBD is dominated by the R. Shannon with L. Derg and L. Ree as the major lakes along the Shannon River. The Rivers Suck, Inny and Brosna are among the principle tributaries of the upper Shannon and the Rivers Fergus, Maigue, Deel and Mulkear are among the principle tributaries of the lower Shannon region. Agriculture is the predominant land use throughout the SHIRBD (70.7%), although there are also significant areas of peatlands (11.1%) and forestry (3.2%). The population of the SHIRBD is 618,884 or 34 people/km2 (Census data 2002).

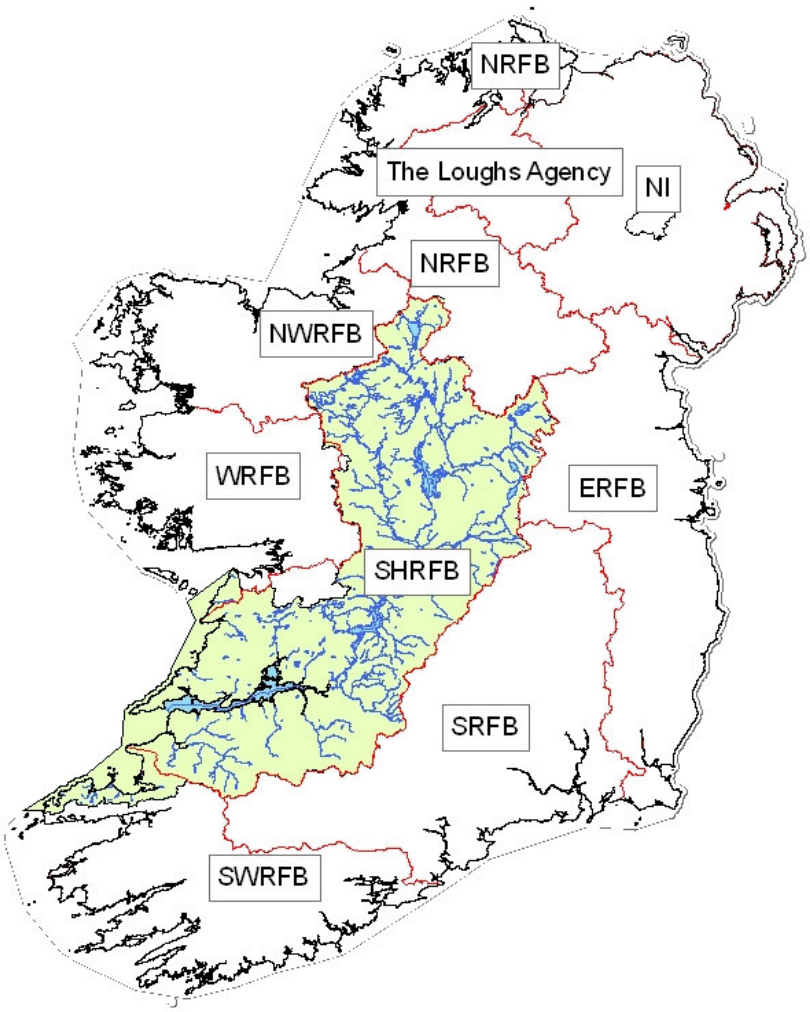

Figure 1.1. The Shannon River Basin District (green) and the boundaries of the regional fisheries boards jurisdictions (red).

1.1. List of Catchments

The SHIRBD eel stock is managed within the fisheries districts of Limerick, Galway and Kerry although the Limerick district, managed by the Shannon Regional Fisheries Board, covers over 98% of the RBD's surface area (Fig. 1.2). There are only very minor portions of the Kerry and Galway districts within the SHIRBD.

Within the Limerick District the dominant catchment is that of the Shannon, Ireland's largest river, which includes over 3,695 ha of fluvial habitat and 38,770 ha of lacustrine habitat. Lough Derg and Lough Ree are the principal lakes on the Shannon. The Rivers Suck, Inny and Brosna are among the principal tributaries of the upper Shannon. The river becomes tidal a short distance upstream of Limerick City. The estuary of the Shannon extends from Limerick westwards towards the Atlantic Ocean. Other rivers containing significant proportions of the district's fluvial habitat include the Maigue (286 ha), the Feale (251 ha), the Deel (174 ha) and the Fergus (149 ha). The Fergus and the Inagh are the also important in terms of lake area at 601 ha and 112 ha respectively.

There are just 240 ha of riverine and lacustrine habitat contained within the combined portions of the Galway and Kerry districts included in the SHIRBD. The principle relevant catchments in the Kerry district are the Lee, Feoghanagh and Owenmore while that in the Galway district the only catchment is the Aille.

See Appendix 1 for a full list of the catchments within each Fisheries District.

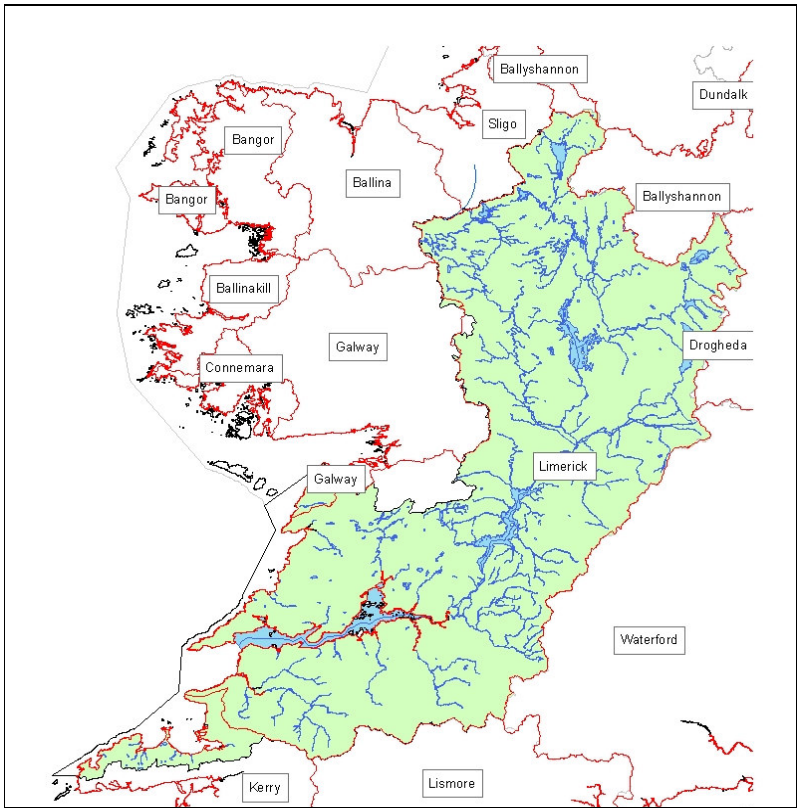

Figure 1.2. Fisheries districts (red and labelled) and the Shannon International River Basin District (green).

1.2. Habitat breakdown within Catchments

Quantification and classification of the available freshwaters within each RBD were calculated with a GIS based on 1:50,000 Ordnance Survey of Ireland mapping. A statistical model relating river reach characteristics (catchment area upstream and the stream link magnitude) to river width measurements from a large number of sites across Ireland was used to estimate fluvial wetted areas. Finally, the Geological Survey of Ireland related the water chemistry of ground-waters to bedrock type so that the nature of waters could be estimated based on the underlying bedrock. See section 3.2 of the national report for details.

The part of the Galway district contained within the SHIRBD is relatively tiny, containing just 20 ha of fluvial habitat within the Calcareous Aille river. The district also contains the Aille estuary that holds 10 ha of water.

The SHIRBD is dominated by the Limerick fishery district,that contains 99.5% of the RBD's freshwater wetted area (table 1.1, figure 1.3). The Shannon contains 74% of the district's fluvial waters and 97% of its Lake water i.e. 42,500 ha of water, or 94% of the RBD's waters. The R. Shannon is Ireland's largest river system. The river becomes tidal a short distance upstream of Limerick City and the estuary of the Shannon extends from Limerick westwards to the Atlantic Ocean. It drains an area of 11,700 km^2 upstream of its estuary. The gradient is extremely low along its main channel length. The Shannon catchment is generally low lying and much of it is underlain by Carboniferous limestone. The waters of the Limerick district are almost exclusively Calcareous (93%) and naturally mesotrophic or eutrophic in character. The largest lakes in the system are Loughs Derg (11,635 ha), Ree (10,500 ha), Allen (3,500 ha), and Sheelin (1,900 ha). These 4 lakes alone make up over 60% of the aquatic area within the

SHIRBD, while all lakes combined comprise about 87%. Significant transitional water bodies include the Shannon Estuary (16,300 ha) and the Fergus Estuary (6,500 ha).

The part of the Kerry district contained within the SHIRBD corresponds to 0.5% of the RBD's freshwater wetted area. Its waters are predominantly siliceous (63%). Its largest rivers include the Lee and the Feohanagh that contain 35 ha and 11 ha of fluvial water surface respectively. Lakes are concentrated within the Owenmore (77 ha), Scorid (43 ha) and Owencahsla (28 ha) rivers.

Table 1.1. Summary statistics for the wetted area within the Fisheries Districts of the SHIRBD.

	Surface-area		Wetted area (ha)		
	Catchment (ha)	Non calcareous (%)	Lacustrine	> 1st order fluvial	1st order fluvial
Galway	66	0	0	17	3
Kerry	206	88	151	56	13
Limerick	15687	8	40089	4414	574
SHIRBD	15959	9	40241	4487	590

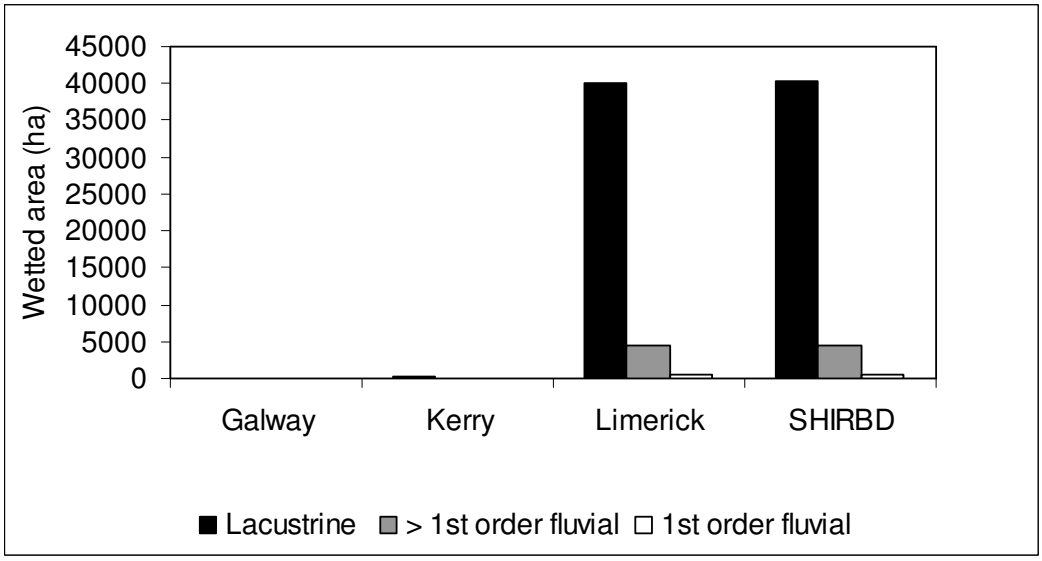

Figure 1.3. The distribution of the wetted area between the relevant Fisheries Districts and habitats of the SHIRBD

2. Description & Analysis of Present Eel stocks

Data within the RBD as a whole is not sufficient for any firm conclusions regarding the status of the stock to be drawn at this time. The status of the stock is estimated using a national model as outlined in Section 5 of the National Report. The results of this analysis are shown in section 4 of this chapter.

Historical data collection is ongoing in the NDP Project (section 1.1 of National Report) and this may facilitate some assessment of the stock to be made. It is intended to undertake eel specific surveys in the first 3 years of the plan (section 7 of National Report).

Eels can be found throughout the SHIRBD. The eel population of L. Derg has declined over recent years. Lough Derg brown eel stock has declined considerably from the mid 1990s to 2001 and in contrast with the catch, no upward trend has occurred in recent years (Dekker et al. 2006). Preliminary analysis suggests that at present only 10% of male and 13% of female

pristine silver-eel escapement is occurring (not including the effect of hydroelectric turbines) (Dekker et al. 2006). Overall, catches within the Shannon system have declined up to 2001 and remained roughly static thereafter. Some reasons for the decline of the fishery could be due to low recruitment, migration obstructions, fisheries, habitat loss, parasite infestation and effects of pollution.

2.1. Stock: Glass eel and elvers

Figure 2.1. Glass eel, early stage in eel life cycle before pigmentation occurs

Figure 2.2. Ardnacrusha hydro-electric dam on the lowerShannon.

Since 1959 eel fishery management on the Shannon has involved measures to facilitate elver ascent at the Ardnacrusha dam. Since that time, a cumulative total of 88 tonnes of juvenile eels has been transferred upstream into the River Shannon trapped at elver traps at Ardnacrusha as well as stocked from various other sites within the SHIRBD (Fig. 2.1 and 2.2). Increased productivity in the eel fishery, noticeably in records of silver eel catches at Killaloe and Clonlara in the late 1980's is attributable to these stock enhancement measures.

Juvenile eel recruitment to the River Shannon is monitored by recording catches of elvers and fingerlings at traps located at the hydroelectric dams. In addition, information on stocking of juvenile eels, obtained in the Shannon estuary and other adjacent rivers is recorded annually. The R. Shannon eel stock has experienced a steady decline in natural recruitment over the past three decades similar to the reductions noted in other Irish rivers and in Europe. An experimental glass eel fishery was initiated in the Shannon estuary in 1997. Summary details of the recruitment pattern from 1959 for the Shannon are presented in figures 2.3 to 2.6.

Since 1977, the number of elvers recorded has only exceeded the optimum level (~4t) required to stock the whole Shannon at 0.1kg/ha on two occasions. It is not known what the level of recruitment was before the hydropower installations were erected and it is also not known what proportion of elvers arriving in the Shannon make it into the traps for transport upstream.

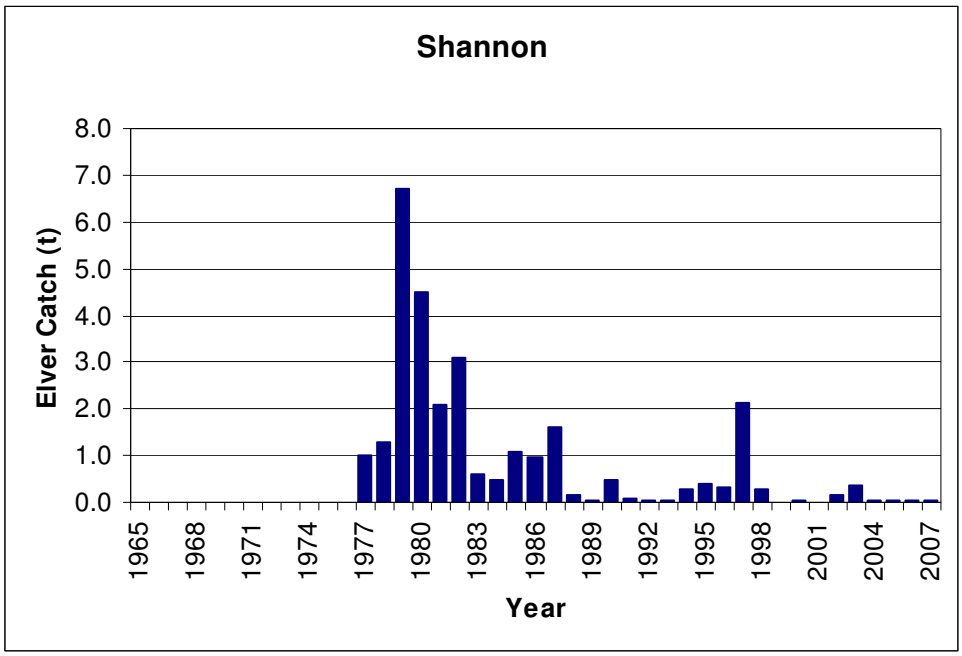

Figure 2.3. Elver catches at Ardnacrusha on the Shannon.

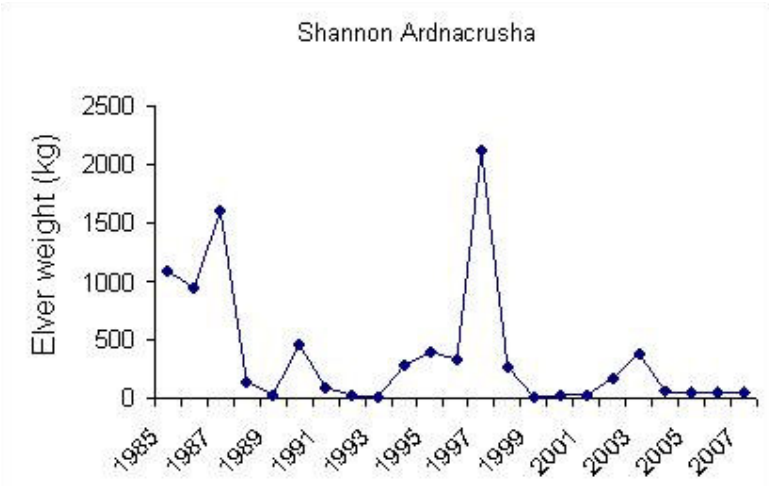

Figure 2.4. Elver catches at Ardnacrusha on the Shannon.

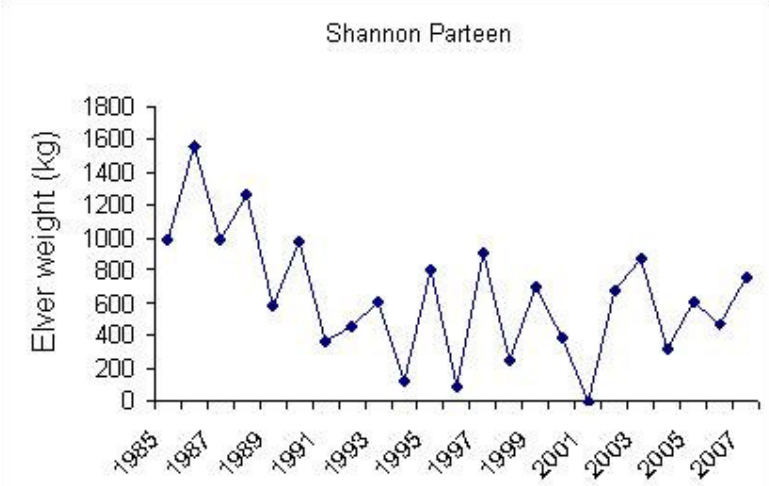

Figure 2.5. Juvenile eel catches at Parteen Weir on the Shannon.

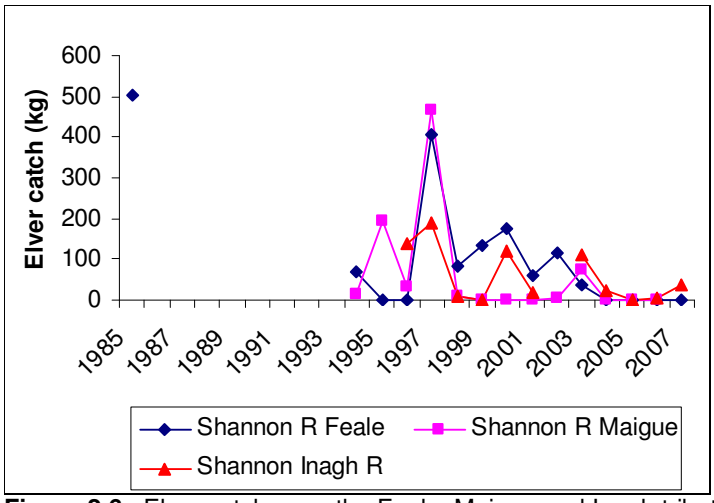

Figure 2.6. Elver catches on the Feale, Maigue and Inagh tributaries of the Shannon.

2.2. Stock: Brown eel

The 1992-1999 brown eel surveys have provided evidence of changes in the Shannon stock of brown eels that reflects variation in previous natural recruitment and stocking levels (McCarthy and Cullen 2000). Steadily declining yields from Lough Derg can largely be attributed to this phenomenon, as evidenced by catch per unit effort data (CPUE) from both Fyke net catches and longline surveys. Overall the brown eel catch from the Shannon has declined considerably pre 2001and appears to have stabilised at this reduced level over the period 2001-2007. This data highlights the importance of long-term data-series in avoiding the false conclusions on the status of the fishery. Length Virtual Population Analysis of the Lough Derg fishery ((Dekker et al. 2006) found restricted selectivity of the fishery for the larger size classes, low overall fishing mortality resulting in gradual depletion of the stock and continued decline of the stock, despite rising catches in most recent years.

2.3. Stock: Silver eel

Silver eel catch statistics are monitored each year at a series of locations in the River Shannon catchment area. Authorised crews and operators of ESB owned fishing weirs are required to keep daily records of catches and fishing conditions. In the upper catchment silver eel movements, and capture rates, reflect the underlying lunar periodicity to a greater extent than at sites such as the Killaloe eel weir. In the lower Shannon the regulation of the river for hydroelectricity generation strongly influences patterns of eel movement, as reflected in Killaloe weir catches.

There have been steadily declining eel catches at Killaloe/ Clonlara but relatively steady catches at Athlone, mirroring the trend in brown eel CPUE within the catchment. Concerns about the declining stock are reinforced by the silver eel population studies (Dekker *et al.* 2006). The high overall predominance of female eels reflects on a low population density throughout the lakes.

Previously published preliminary analysis of Length Based Virtual Population Analysis of Lough Derg data (Dekker *et al.* 2006) has indicated that the fishery takes about 36 % of the presently possible male spawner escapement and about 51 % of the presently possible female spawner escapement. Today there is about 13 % of pristine male escapement from Lough Derg, and about 10 % of pristine female escapement.

3. The SHIRBD Commercial Eel Fishery

3.1. Commercial capacity and effort

Within the SHIRBD there are two main areas in which commercial eel fishing takes place (Fig. 3.1). The River Shannon catchment above Limerick, on which the ESB have the sole eel

fishing rights and the rivers Feale, Deel, Maigue and most of the rivers of Co Clare where ownership is in the control of the State or in private hands. Since the building of the hydroelectric power station at Ardnacrusha in 1935 the Electricity Supply Board have controlled the enforcement and commercial harvesting of eels in the Shannon catchment. In the ESB controlled waters of the Shannon catchment the ESB have operated a programme to monitor the status of brown and silver eels by commercial fishermen through research and experimental fishing. The biggest eel fishery in the Republic of Ireland is based in Lough Derg.

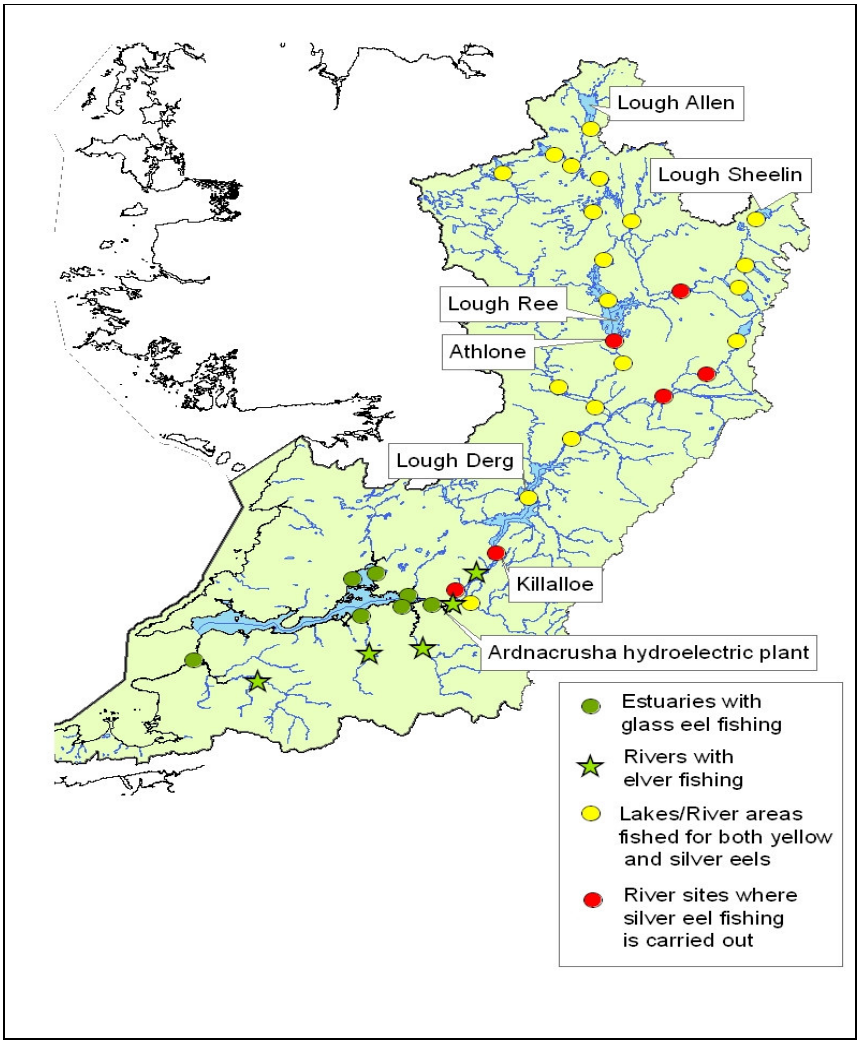

Figure 3.1. Detail of the Shannon catchment indicating the location of the major eel fishing activities

3.2. Capacity/effort: Glass eel and elver

There is no commercial fishery in the region. The Shannon Regional Fisheries Board, in conjunction with the ESB, have been undertaking a pilot glass eel harvesting programme. Glass eel, elver and eel fingerlings are captured on the lower Shannon and in estuarine tributaries for stocking in River Shannon lakes

3.3. Capacity/effort: brown eel

Brown eels are exploited throughout the River Shannon and are fished between June and August in the Shannon river, but in the Fergus and lakes of east Clare previously fishing took place between May and September. Brown eel fishing effort has varied from 1992-2007 (Fig. 3.2, 3.3). In 1992-1994 a small number of monitored crews operated on Loughs Derg and Ree but since 1995 the number of crews was increased and fishing was extended to include most of the river's lake habitats. The maximum number of crews (N=47) was authorised in 1997 and all fishing was then done using fyke-nets. Within the Shannon Regional Fisheries board, there is legislation stating that any fyke net placed in running water should be set parallel to the banks

of the river. Fyke nets are the predominant method used to fish brown eels in the Shannon Lakes between June and August.

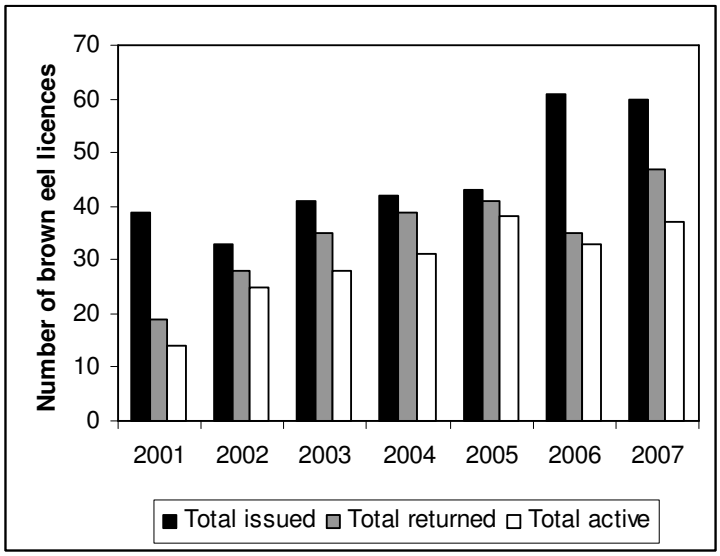

Figure 3.2. Capacity and effort of the SHIRBD brown eel fishery.

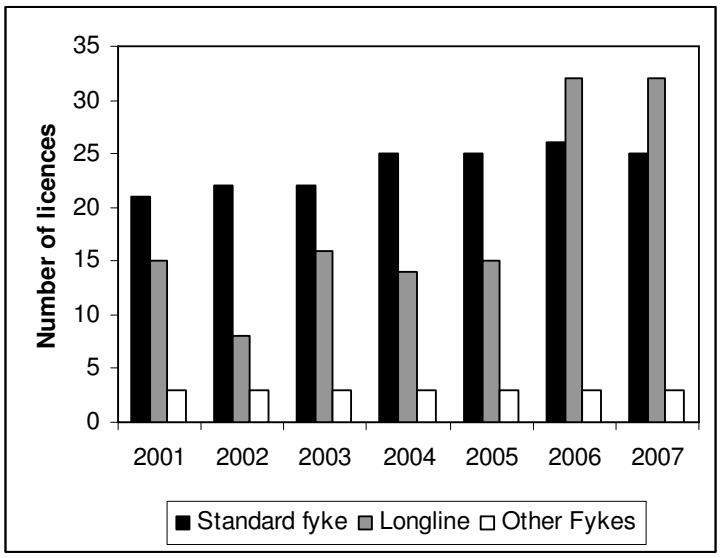

Figure 3.3. Capacity of the SHIRBD brown eel fishery.

In 1998 under the Management of Eel Fishing Byelaw 752 of 1998 the number of licences which may be issued for longlining in the Limerick fishery district was set at 10 but the number of licences issued has fallen below this. Longlines are a non selective method of fishing and can be used to catch a wide range of fish species. The length of the longline can vary. Attached to these lines at intervals of about 2m are snoods. Snoods consist of a short length of line about 2m in length, to which earthworm baited hooks are attached. Types of hooks vary in accordance to type of fish species being caught. Each end of the line may be attached to a light anchor which is fastened to a buoy on the surface. An advantage of this method would be low capital outflow. Within the Shannon Regional Fisheries Board, there is a limit of 1000 hooks on any 1 longline. Freshwater fish are prohibited for use as bait on longlines and that fishing is limited to the hours of darkness. The longline method is used to fish brown eels on the major River Shannon lakes between June and September.

Brown eel fishing in the ESB controlled freshwater parts of the Shannon system involves a series of authorised (2 person) crews who are assigned to specific fishing zones. They typically use 5-6m open boats, equipped with outboard engines, and are permitted to fish either with fyke nets (maximum 50 nets) or longlines (maximum 1000 earthworm baited hooks per night). In 2005 there were 15 fyke-net crews and 15 longline crews. The between year variation in fishing effort in the Shannon catchment is summarised in figure 3.4. In 2001 the fishery management decided to restrict fishing on Lough Derg, as a stock conservation measure, other than for experimental purposes. In addition there is close monitoring of the fishermen, with weekly reports submitted to the National University of Galway. Information is also obtained on the biology and ecology of the eels (e.g. length frequency, parasitology, sexing, age, habitat type etc.).

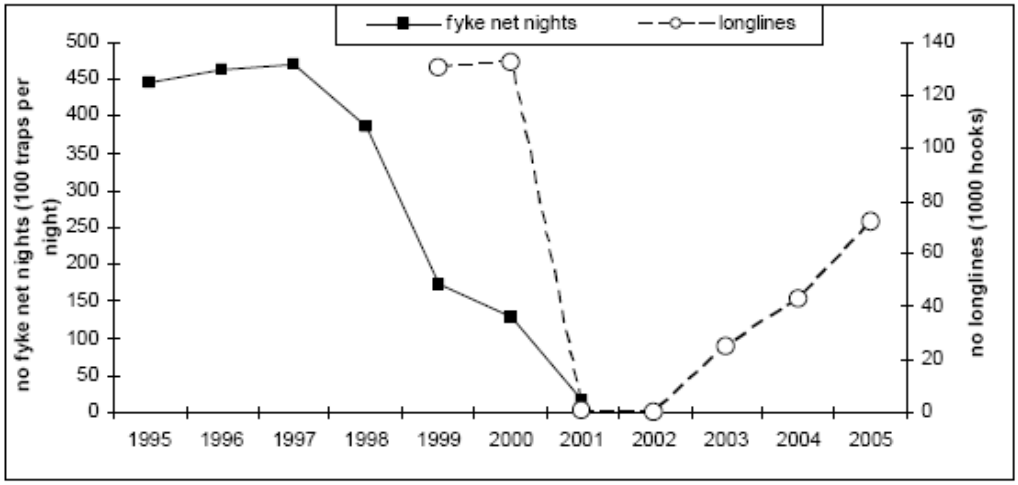

Figure 3.4. Fishing effort on Lough Derg 1995-2005 given as an equivalent of 100 fyke net traps or one longline with 1000 baited hooks set over the 1 night.

3.4. Capacity/effort: Silver eel

Silver eel fishing effort has also varied over the 1992-2005 period (Fig. 3.5, 3.6), with some fishing weirs (e.g. at Athlone and Clonlara) ceasing to function. A progressive shift in fishing effort to the middle and upper parts of the catchment has also occurred (consistent with the trends in brown eel CPUE above) (Fig. 3.4). The silver eel fishery is also now primarily undertaken as part of an extensive eel stock monitoring programme. Fishing occurs either at specially constructed eel weirs, of varying sizes, or using winged-coghill nets set at lake-outlets and various other locations throughout the catchment.

Within the Shannon Regional Fisheries board, the Coghill net may operate only during the hours of darkness and provision must be made for rendering the fishing engine ineffective during the hours of daylight. Coghill nets must be serviced daily and any fish caught, other than eels, carefully handled and returned immediately to the waters from which they were taken. Prior to the introduction of the new byelaws in 2008, silver eels were fished between September and March in the Shannon Region using this method.

Prior to 1992, though good records are available for silver eel fishing at the major weirs, it is known that extensive illegal eel fishing occurred, and this involved fishing methods similar to those used in present day surveys. However, no reliable quantitative information on the fishing capacity or catches of unauthorised fishermen is available.

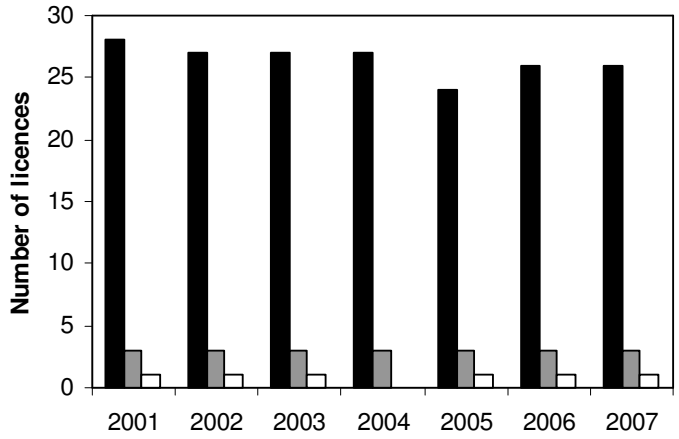

Figure 3.5. The capacity of the silver eel fishery in the SHIRBD. Coghill (black), Large Fykes (grey) and Fixed traps (white).

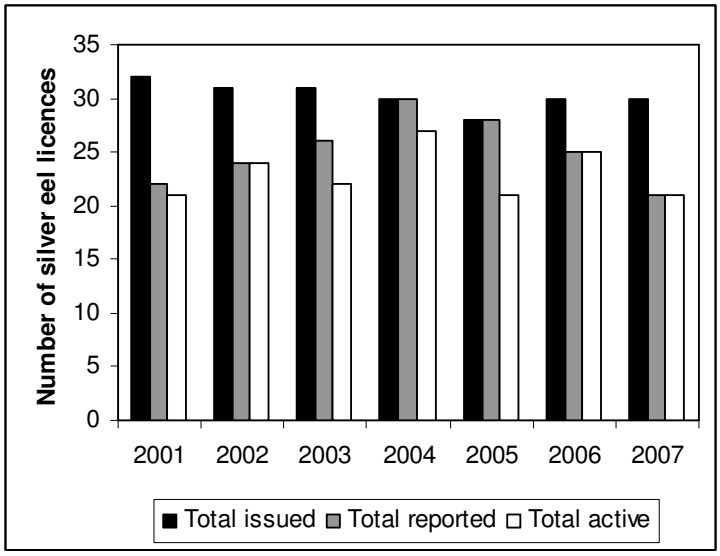

Figure 3.6. Capacity and effort of the SHIRBD silver eel fishery.

3.5. Commercial Catch

3.6. Catch: glass eel/elver

There is no commercial glass eel or elver fishery.

3.7. Catch: brown eel

In line with an increasing capacity and effort, the overall reported brown eel catch within the SHIRBD has increased slightly (Fig. 3.7). Between 2001 and 2007 the SHIRBD accounted for 30-40% of the national brown eel catch (Fig. 3.8). In fact its importance as a fishery in the Irish context has increased slightly over these years. The annual reported yield of the brown eel fishery has been between 15-25 tonnes.

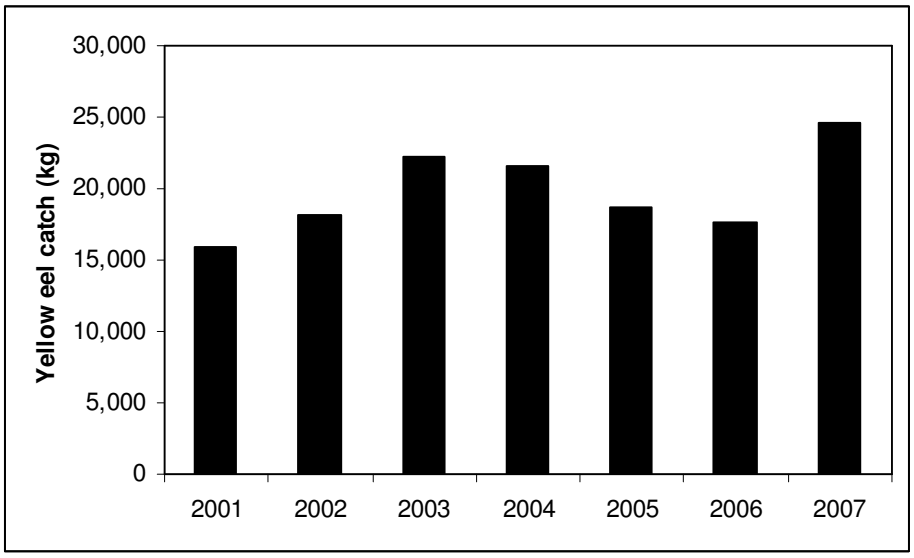

Figure 3.7. Reported brown eel catch in the SHIRBD 2001-2007.

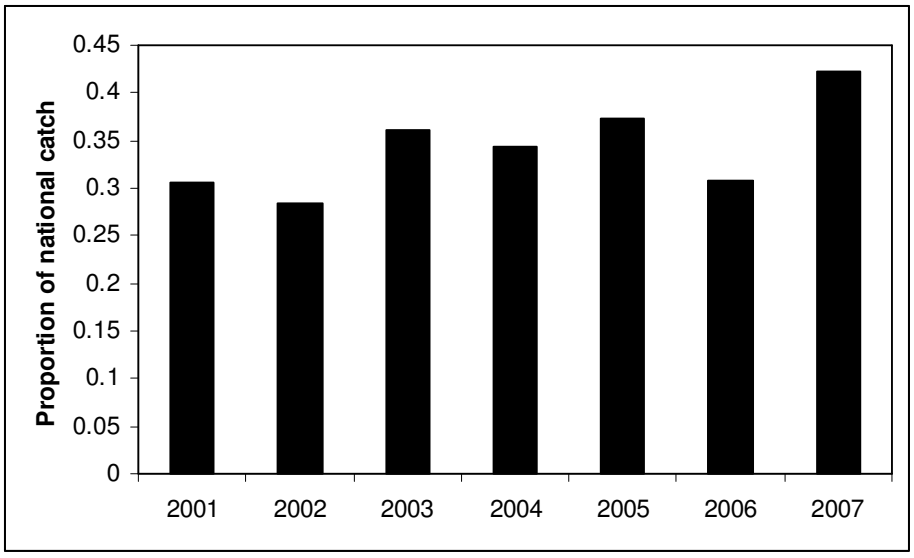

Figure 3.8. Proportion of national brown eel catch taken in the SHIRBD.

3.8. Catch: silver eel

Historic data on silver eel catch show a dramatic decline in the lower Shannon (Fig. 3.9, 3.10). Overall, the reported catch has declined steadily from the late 1980s. In contrast with the brown eel fishery, the silver eel fisheries' capacity and effort have remained unchanged over the period 2001-2007 (Fig. 3.11, 3.12). The yield is highly variable between years but there does not appear to be any discernible trend over this short period. The SHIRBD silver eel fishery yields a reported catch of approximately 15-37 tonnes, accounting for at least 50% of the contemporary national take over the years 2001-2007.

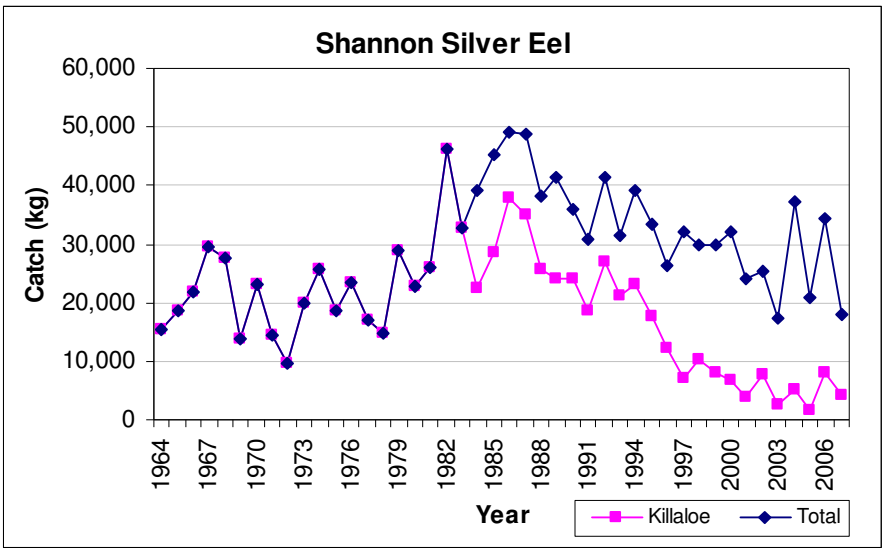

Figure 3.9. Decline in silver eel populations, as indicated by the annual catches for the entire fishery.

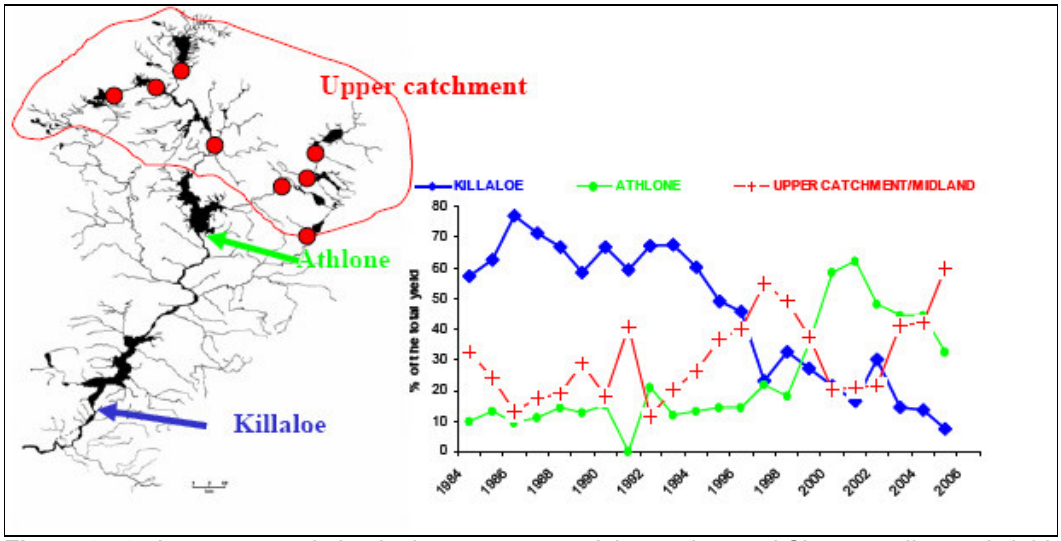

Figure 3.10. Long term variation in the percentage of the total annual Shannon silver eel yield captured at the Killaloe weir, Athlone and upper catchment 1984-2006.

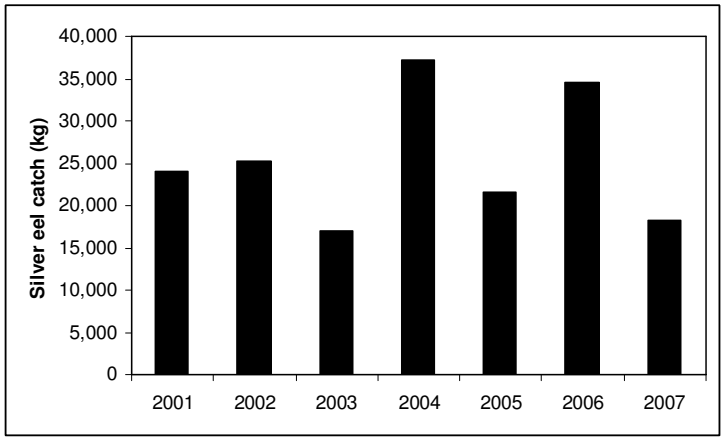

Figure 3.11. Reported silver eel catch in the SHIRBD.

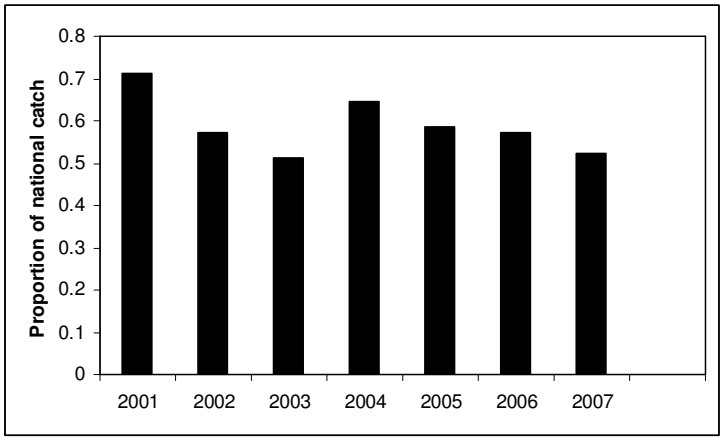

Figure 3.12. Proportion of national silver eel catch taken in SHIRBD.

3.9. Recreational Fishery

There is no targeted recreational fishery for eel in the Shannon catchment. Recreational eel fishing is only carried out by a minority of anglers and there is no legal, or voluntary, declaration of catch which is probably small. Some "recreational" fishing using fyke nets takes place and this is authorized and reported under the commercial legislation. There is very little interest from local anglers with eel being discarded in Ballycullinan lake when fishing for bream.

4. Escapement - local stock modeling

The Eel Regulation requires that each Eel Management Plan reduce anthropogenic mortalities so as to permit with high probability the escapement to the sea of at least 40 % of the silver eel biomass relative to the best estimate of escapement that would have existed if no anthropogenic influences had impacted the stock. Thus, the potential production of silver eels (in biomass terms) for the SHIRBD prior to the decline in recruitment following 1982 was estimated. The biomass of silver eels currently escaping from the RBD was also estimated. Both of these estimates required a habitat based extrapolation of productivity information from index catchments not necessarily within the RBD. RBD specific impacts were then imposed on this potential productivity to derive an approximate estimate of current escapement. See sections 5 and 9 of the National Report for details.

Pristine escapement for the SHIRBD is estimated at 214 tonnes, whereas current escapement is estimated to be approximately 18 tonnes i.e. 8% of pristine (Fig. 4.1). The ShIRBD is not currently achieving the 40% escapement target. If no management action is taken, escapement will steadily fall until 2020, dropping to approximately 2%. A complete closure of the fishery or a complete reduction of hydropower mortality alone will not achieve target. If both fishing and hydropower mortality are completely avoided the SHIRBD is expected to briefly achieve approximately 26% before falling steadily to 11% in 2020.

Achievement of the 40% target in the long term will require a recovery of recruitment, which in turn requires concerted action across Europe through the implementation of the Eel Regulation. It will not be possible for the SHIRBD to define realistic management measures that will achieve and maintain 40% escapement in the long term. Instead, interim measures are required, aiming at recovering recruitment sufficiently so that management measures can be defined that achieve 40% escapement. These interim measures involve setting target levels of anthropogenic mortality that would achieve recovery of the stock within a given time frame provided the same low level of pressure was achieved across Europe (see Section 5.3 of the National Report).

The impact of the proposed management measures on anthropogenic mortality and the timeframe for recovery of the recruitment are presented in Chapter 8 (i.e. the Management Measures section).

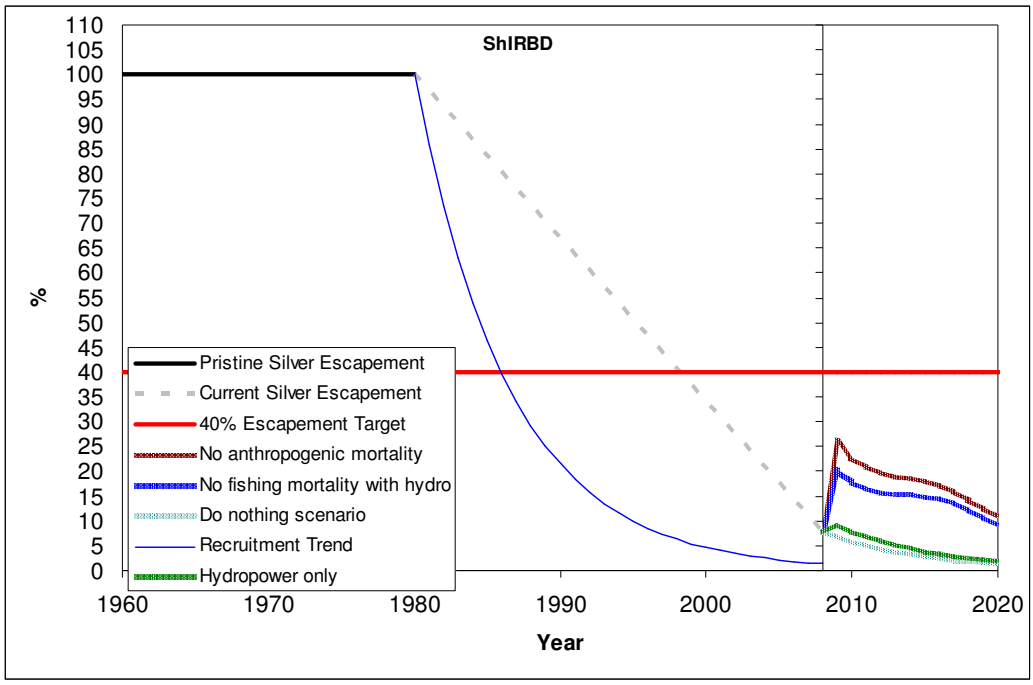

Figure 4.1. The proportion of pristine escapement estimated to leave Irish waters currently and in the future under various management scenarios.

5. Environmental quality assessment

The Characterisation Report for the Water Framework Directive found that 84% of river water bodies are at risk or probably at risk in the SHIRBD. Morphological alterations (mainly historical drainage works) and diffuse pollution are the dominant pressures on SHIRBD rivers. For lakes, 96.4% of lakes water bodies are at risk or probably at risk. Impact data and abstraction pressures accounted for the highest number of at risk water bodies (13 and 11 respectively), while the dominant pressures on probably at risk water bodies were diffuse source pollution and morphological pressures. 99% of the transitional water body area was found to be at risk or probably at risk. Morphological pressures (55% of water bodies) and point pressures (60% of water bodies) had the most significant influence on overall results for transitional water bodies. Morphological pressures (9% of water bodies) accounted for all at risk and probably at risk coastal water bodies. 9% of the coastal water bodies and 1.3% of water body area was found to be at risk or probably at risk. Overall, compared with other RBD's in Ireland (7 in total), the SHIRBD has the fourth highest proportion of water bodies across all water categories at risk or probably at risk. Other assessments included those related to the impact of alien species, fisheries activities, and the quality of our bathing waters.

The Quality of the Region's water has been a major concern over some 30 years and while some progress has been made in recent years Eutrophication from agriculture and effluent from Waste Water Treatment Plans is an ongoing concern for the Shannon Regional Fisheries Board. The introduction of new Regulations associated with the Water Framework Directive and Phosphates and Nitrates Directives will minimise their effects on rivers and lakes with a view to achieving good quality water by 2015. The damage to the quality of the Regions waters has impacted negatively on fish stocks in general causing fish kills and reducing stocks.

Habitat damage in the streams, rivers and lakes through drainage, gravel removal, construction, removal of wetlands, etc has caused the loss of eel habitat or reduction in productivity. Work has been undertaken in recent years to counter this issue through stream rehabilitation works and working with the stakeholders to implement best practice.

River Glasha before works

River Glasha after works

Contaminants
There is no information on PCB levels in the SHIRBD.

Parasites
Data for the Shannon on *Anguillicola* presence has been reported in National Report section 3.4.

Hydropower
Silver eel escapement in approximately 94% of the wetted area of the SHIRBD is impacted by the Ardnacrusha hydroelectric power station (Fig. 5.1). A commercial silver eel fishery operates in the upper catchment and in recent years, approximately 30% of the silver eels departing from L. Derg towards Ardnacrusha are caught at the Killaloe eel weir.. A Contractor has been engaged by ESB who is responsible for catching the eels in Coghill nets and transporting them safely and without delay to a location as designated. Once captured the eels are then transferred to holding tanks at Killaloe weir for a 24 hour period where any damaged eels and mortalities are removed and disposed. Silver eels are then taken from the holding tanks and loaded into plastic barrels, weighed and then transported to release site below Parteen Weir to allow escapement to the sea, as a conservation measure by ESB Fisheries Conservation (Fig. 5.2).

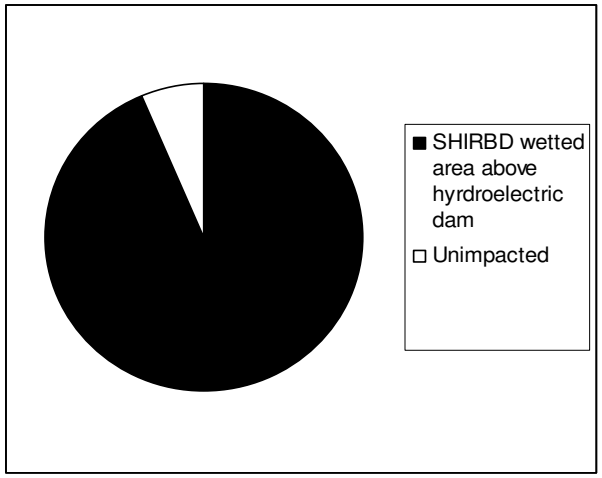

Figure 5.1. The proportion of the SHIRBD's wetted area that is above the Ardnacrusha hydroelectric dam.

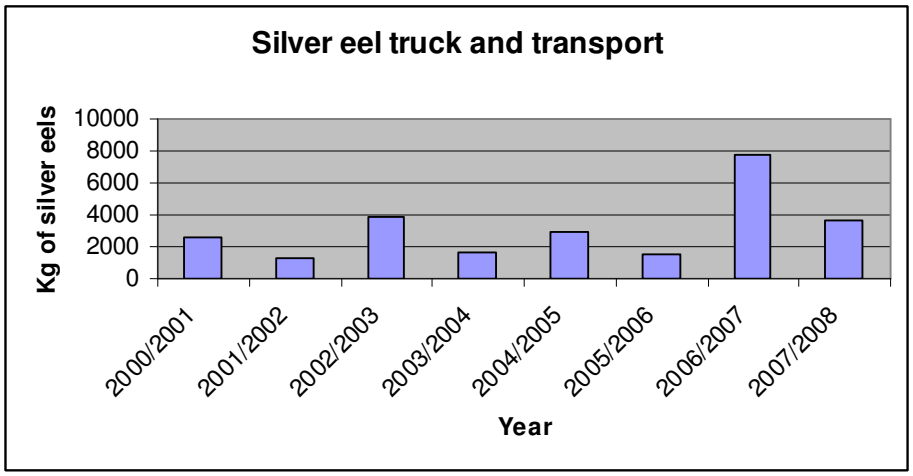

Figure 5.2. Weight of silver eels transported around Ardnacrusha hydroelectric plant.

6. Stocking

6.1. Previous Stocking

Historically, large numbers of elvers and glass eels were transferred and stocked above the hydroelectric dam, however, the level of stocking has collapsed following the reduction in the elver run in the mid 1980s (Fig. 6.1). Levels of stocking are currently extremely low.

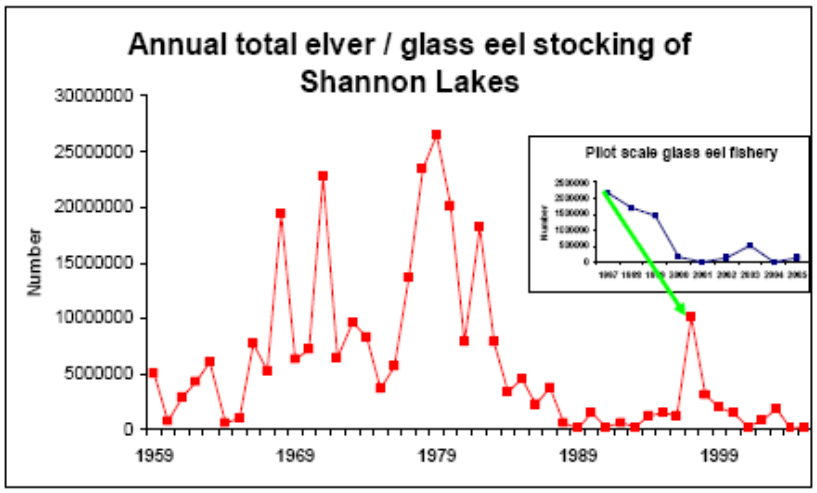

Figure 6.1. Long term data series for eels stocked into the River Shannon expressed in terms of numbers of elver equivalents stocked per annum (number of glass eels captured since 1997 when pilot glass eel fishery started).

In 1993 and 1994 ESB carried out a glass eel programme which investigated sampling techniques, biological observations and discussed results in an international context. This was an intensive survey into glass eels and elvers in the Shannon estuary. Shore surveys and trawls showed that the glass eels arrived into the Shannon estuary in October/ November and then to the Limerick area during February where they become concentrated at the head of the tide until the middle of May. After this period they pass up as elvers. The survey also showed that the eels are not evenly distributed but move in one large grouping with smaller numbers moving at various points behind the main group. From the experimental fishing it appears that the majority of glass eels move at night when the tidal range at Limerick is greater than 4.7m.

In 2002 a partnership was established between the Shannon Regional Fisheries Board and the ESB to catch glass eels in the Shannon Estuary and transport them upstream for restocking in

Lough Derg. One commercial fisherman was sub-contracted by the ShRFB to carry out fishing using conical nets while the ShRFB undertook some trials with other equipment. A total of 18 sites were fished and monitored throughout the estuary (Fig. 6.2).

In 2003 158kg of glass eels were caught due to a more intensive programme being undertaken (Table 6.1, 6.2). Over 80% of these eels were caught in the months of February and March. In subsequent years three main rivers have been targeted the Rine, Feale and Bunratty rivers.

When the glass eels are caught, they may be held for several hours and/or transported on mesh trays. They can be placed directly into freshwater even after capture in seawater. If they are to be held in an oxygenated tank then the maximum time allowable for this is 3-4 days. It is best to carry out the stocking at night and in a gentle flow of water to avoid stress and minimise predation.

Elvers are caught using traps on a number of rivers (Table 6.2). These are non-commercial activities, with all juvenile eels being transported upstream of the hydroelectric power station. They are caught using automatic eel traps and checked regularly and the eels removed and stocked in a number of locations on the Shannon (Fig. 6.3).

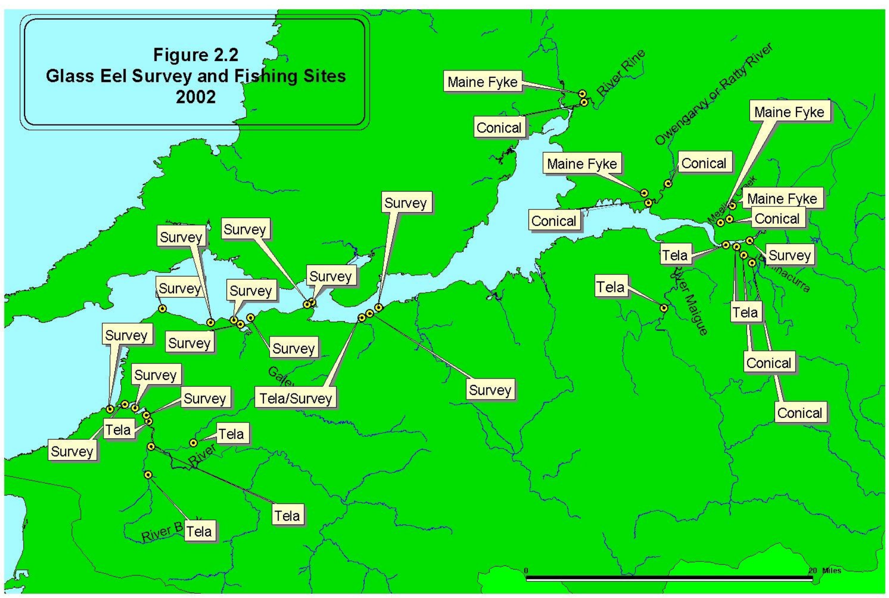

Figure 6.2. Location of glass eel surveys and fishing sites (for stocking).

Table 6.1. Glass eels catch (kg)

	Catch by river														
Year	Ballinacurra	Brick	Bunratty	Cashen	Cloon	Feale	Galey	Maigue	Meelick Creek	Mwevue	Rine	Robertstown	Shannon	Total	Recepient location
2002	1	0.86	21.92	x	x	0.04	0	0	0	x	17.76	x	0	41.68	Lough Derg
2003	1	63.8	13.11	0.118	0	0	1.3	x	x	0.005	78.44	0	0	158.13	Lough Derg
2004	x	0	0	x	x	0	x	x	x	x	1.000	x	x	1.000	Lough Derg
2005	x	0	1.263	x	x	7.64	x	x	x	x	32.258	x	x	41.165	Lough Derg
2006	x	0	1.939	x	x	1.11	x	x	x	x	1.12	x	x	4.164	Lough Derg
2007	x	x	2	x	x	0	x	x	x	x	9.5	x	x	11.5	Lough Derg

Table 6.2. Elver catch (kg)

	Maigue	Ardnacrusha	Parteen	Inagh	Feale	Electrofishing	Total	Recipent Location
2002	5.01	179.987	682	0	116	0	146311	Lough Derg
2003	72.339	378.217	873	110.45	35.66	0	1469.666	Lough Derg
2004	0	58.126	256	23.5	0	0	337.626	Lough Derg
2005	0.000	41.363	612.000	0.000	0.000	42.000	695.363	Lough Derg
2006	0.000	41.530	467.000	4.227	1.105	0.000	513.862	Lough Derg
2007	0	45.372	789	38.5	0	0	872.872	Lough Derg

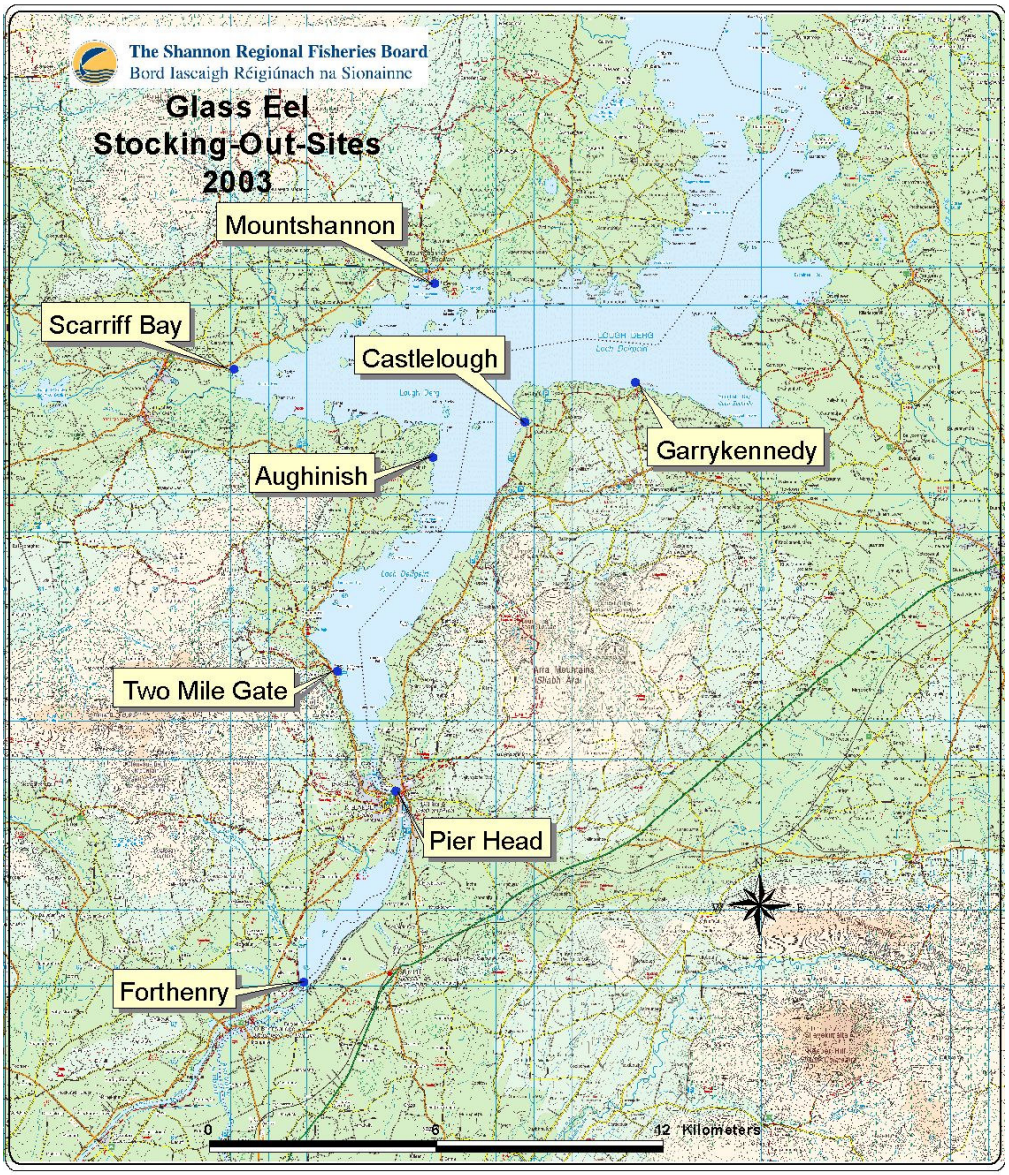

Figure 6.3. Location of stocking sites in the Shannon IRBD.

6.2. Stocking as Part of the EMP

Upstream transfer of elvers caught at Ardnacrusha and Parteen will continue as part of the EMP. However, stocking from other catchments or the estuary is not currently considered as a management option in the short term (see Section 6.1 National Report). Stocking is currently being considered as a potential management option (see Section 7.5 in the National Report). However, this option requires further investigation and feasibility assessment, which will be guided by the Eel Scientific Committee (see chapter 6 National Report).

7. Monitoring

7.1. Escapement Monitoring

The national approach to escapement monitoring has been outlined in chapter 7 of the National Report. There is a particular requirement to quantify the silver eel run on the Erne/Shannon so that the quantities required for trap and transport can be estimated.

7.2. Sampling of Catch & Effort, present & future

Given the proposed closure of the fishery, sampling of catch and effort will not be required.

7.3. Catch Sales/Dealers/Export

This section is dealt with in the National Report under Section 4.3.

8. Management Measures

8.1. Management actions

Scientific advice has indicated that the SHIRBD silver eel escapement is currently approximately 8% of pristine production (EU target = 40%) and will decline as a consequence of poor and declining recruitment over the last 18+ years. This estimate is similar to the LVPA results for Lough Derg (Dekker et al. 2006). International stock assessment has related the likelihood and time-frame of recovering recruitment to levels of anthropogenic mortality. Recovering recruitment will allow Ireland to define management measures that ensure 40% escapement. In the interim, recovery of recruitment is an appropriate alternative target that can be directly linked to management actions (see section 5.3 of the National Plan). Anthropogenic (human) mortality must be reduced across Europe by 85%, on average, just to halt the decline in the extremely low level of current recruitment.

Reductions of anthropogenic mortality are required merely to contribute to halting the decline in recruitment. It should be noted that current recruitment is expected to lead to much lower levels of silver eel escapement than currently observed. Merely halting the decline is scientifically unacceptable and management actions must aim above this level. The closer to zero that mortality is reduced, the more assured we are of achieving a recovery and the quicker the recovery will occur (see Fig. 8.1).

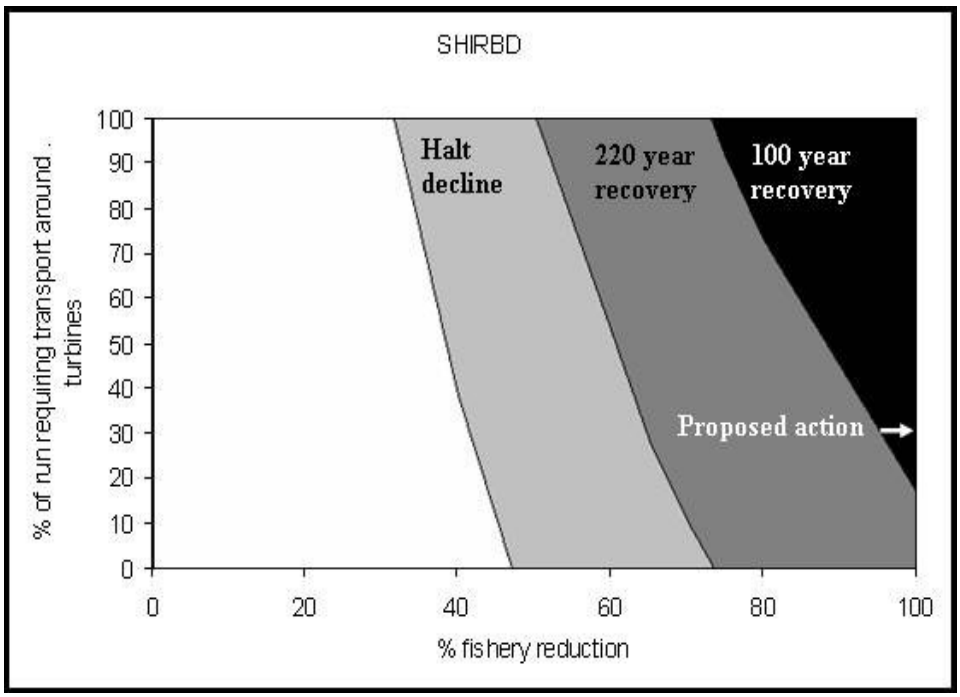

Figure 8.1. The relationship between time-frame to recovery and the level of anthropogenic mortality for the SHIRBD resulting from combinations of fishery reduction and trap and transport of the Shannon silver eels around the Ardnacrusha hydropower station. The darker the shade the faster the recovery and the safer the action. White does not stop the decline in recruitment.

Management Action No. 1. Reduction of fishery to achieve EU target

Action 1a: Cease fishery and close eel market

Timescale: 2009
Review: 2012, 2015, 2018

Given the implications of the scientific advice, the consideration of practical management implications and the need to conserve and recover the stock in the shortest possible timeframe (contingent upon equivalent actions across Europe), the precautionary approach is being adopted in accordance with the recommendations of the National Eel Working Group and the eel fishery will be ceased and the market closed. Consequently, there will be a need for an increase in targeted eel protection and patrols for eels.

Action 1b: Recreational fishery
The proposed legislation will prohibit the possession of eels and this will therefore prohibit angler anthropogenic impact.

Action 1c: Diversification of fishery
CFB and eel fishermen will be engaged in investigating possible diversification for the former commercial fishermen. Former eel fishermen and other service providers who meet the tender criteria will be eligible to compete for the "trap and transport" operations which ESB has committed to undertake under the plan.

Management Action No. 2. *Mitigation of hydropower*

Develop best practice document on the safe passage of eels through hydro-electric power stations and other barriers including water abstraction points.

Action 2a*: Trap & Transport - 30% of the Shannon silver eel run around the Ardnacrusha hydropower turbine*

Timescale: 2009-2011
Review: 2012, 2015, 2018 and annual review of quantity trapped & transported v escapement estimate

Table 8.1. Trap and transport target levels for the Shannon catchment within the SHIRBD.

	catch target (t)	% of expected silver eel run	Proportion of EU H achieved – fishery closed	Approx. timeframe to recovery (y)
2009	not defined	30	0.045	95
2010	not defined	30	0.045	95
2011	not defined	30	0.045	95

The survey plan for monitoring the proportion of the silver eel run transported around turbines will be reviewed by the Eel Scientific Committee. The Committee will also review the trap and transport protocol.

Action 2b*: Quantify Turbine Mortality and morbidity*

Timescale: 2009 with precision estimate
Review: 2012, 2015, 2018

Almost half of the wetted area of Ireland is behind hydropower barriers that are known to impact on eel. The average reported mortality for turbine passage is 28.5% (ICES estimate). Mortality rates are highly variable and there is inevitable size selectivity. Empirical data is currently lacking for Ireland. Such barriers impact significantly on Ireland's ability to meet eel escapement targets and Ireland's ability to produce large female eels needed to support a stock recovery. It is essential that estimates of mortality and morbidity are undertaken for the Ardnacrusha hydropower facility.

A standard methodology will be developed by the Eel Scientific Committee to enable reasonably precise estimates of turbine mortality and morbidity to be calculated. This information will allow an estimate of the requirement of trap and transport to be calculated.

Action 2c*: Engineered solutions*

A long term strategy involving turbine design and modification. Trap and transport will be employed until the efficacy of engineered solutions has been demonstrated (see section 3.5.1 of the National Report).

Action 2d: *Other solutions (e.g. Migromat ™)*
Aids to increase the efficiency of mitigation measures will be evaluated on an on-going basis as appropriate.

Action 2e: *New turbine Installations*
Ensure that all new installations should include an evaluation of all direct and indirect impacts on eels and that measures are undertaken so as to minimise these impacts. The efficacy of screens should be monitored for at least the first 3 years following installation (see section 3.5.2.2 of the National Report).

Management Action No. 3. *Ensure upstream migration at barriers*

Action 3a*: Existing barriers (including small weirs etc.)*
It is not currently known to what extent existing barriers impede upstream migration of eels in Ireland. This will be dealt with through the monitoring programme described in Chapter 7 of the National Report. Following this evaluation, management measures will be considered as appropriate with a view to improving accessibility and negating any current impact. In particular, carry out study of the impact of high velocity levels on the upstream passage of juvenile eels in the river Shannon.

Action 3b: *New potential barriers*
Ensure that all new installations should include an evaluation of all direct and indirect impacts on eels and that measures are undertaken so as to minimise these impacts (see section 3.5.2.2 of the National Report).

Action 3c: *Assisted migration and stocking*
The existing policy for redistribution and stocking out of elver gathered from the elver traps at Ardnacrusha and Parteen upstream of the hydropower turbine will continue and improved efficiency of capture will be pursued

In the event of a stocking programme being shown to be likely to yield a net benefit to the stock, this will be carried out in accordance with Chapter 6 of the National Report.

Management Action No. 4. *Improve water quality*

Action 4a: *Ensure compliance with the Water Framework Directive*
Timescale: 2015
Review: 2012, 2015, 2018

Action 4b: *Fish health and bio-security issues*
Timescale 2009
Review: continuous
Refer to Chapter 8 of the National Report.

8.2. Projected impact of management actions

The management actions proposed for the SHIRBD will result in no fishing and limited turbine related mortality. According to the stock assessment of Astrom and Dekker (2007), the levels of anthropogenic mortality are consistent with a recovery time of 95 years (assuming equivalent EU wide action).

8.3. Raising awareness of the state of the stock

Raising public awareness among the wider public on eels as a species in serious decline through educational and awareness raising programmes.

Ensure that consideration of eels is included in Environmental Impact Assessment, Water Framework Directive Programme of Measures, and relevant land and foreshore management (e.g. drainage and dredging operations.

9. Post EMP monitoring

The national approach to post EMP monitoring has been outlined in chapter 7 of the National Report.

Appendix I – Water bodies in the SHIRBD and their estimated productivity

Catchment surface area (km2)	Cat. (km2)
Fluvial wetted area (ha)	Fluv. (ha)
Lake wetted area (ha)	Lake (ha)
Non-calcareous geology (%)	N.-calc. (%)
Estimated pristine production (kg)	Prist. Pot. (kg)
Estimated current potential production (kg)	Curr. Pot. (kg)
Estimated current escapement (kg)	Curr. Esc. (kg)

		Cat. (km2)	Fluv. (ha)	Lake (ha)	N.-calc. (%)	Prist. Pot. (kg)	Curr. Pot. (kg)	Curr. Esc. (kg)
Aille (River)	Galway	66	20	0	0	99	66	-
Feohanagh (River)	Kerry	30	11	2	100	25	15	-
Lee (River)	Kerry	99	35	0	23	150	97	-
Owencashla (River)	Kerry	17	6	28	100	66	38	-
Owenmore (River)	Kerry	30	8	77	100	164	93	-
Owennafeana (River)	Kerry	15	5	0	100	10	6	-
Scorid (River)	Kerry	16	4	43	100	91	52	-
Ahacronane (River)	Limerick	23	7	0	0	35	24	-
Annageeragh (River)	Limerick	66	19	150	0	840	553	-
Annagh (River)	Limerick	45	13	1	0	70	48	-
Aughaveema	Limerick	16	4	1	0	25	19	-
Aughyvackeen (River)	Limerick	55	14	9	0	114	74	-
Ballincurra (Creek)	Limerick	32	5	0	0	25	18	-
Ballyline (River)	Limerick	43	8	0	0	40	26	-
Ballyvaskin (River)	Limerick	2	0	0	0	0	1	-
Brick (River)	Limerick	178	55	0	10	257	168	-
Cloon (River)	Limerick	59	14	0	0	70	47	-
Cloonbony (River)	Limerick	12	4	0	0	20	13	-
Crompaun (River)	Limerick	18	5	0	21	22	14	-
Deel (River)	Limerick	488	174	12	1	919	607	-
Doonbeg (River)	Limerick	113	32	49	0	403	266	-
Feale (River)	Limerick	659	251	0	0	1248	825	-
Fergus (River)	Limerick	626	149	602	6	3597	2370	-
Freagh (River)	Limerick	4	1	0	0	5	3	-
Galey (River)	Limerick	203	79	0	0	393	261	-
Glencorbly (River)	Limerick	27	6	0	0	30	19	-
Inagh (River)	Limerick	170	61	112	0	860	569	-
Maigue (River)	Limerick	840	286	6	5	1408	929	-
Moy (River)	Limerick	16	4	4	0	40	28	-
Owenagarney [Ratty] (Riv	Limerick	186	50	327	27	1565	1018	-
Shannon (River)	Limerick	11644	3695	38771	8	200839	**85659**	**11000**
Skivileen (River)	Limerick	89	27	44	0	353	231	-
White (River)	Limerick	75	23	0	0	114	76	-
SHIRBD		15959	5076	40241	9	213895	94233	17629

Text in bold represents a figure based wholly on data specific to the catchment. Other figures are based on the national model output as described in the National Report.

Transitional waters	DISTRICT	Fishery	Brown	Silver	Glass	Elver	Area (ha)
Aille Clare Estuary	Galway	n	n	n	n	N	10
Lee K Estuary	Kerry	n	n	n	n	n	307
Upper Feale Estuary	Limerick	y	n	n	y	y	38
Cashen	Limerick	y	n	n	y	n	267
Deel Estuary	Limerick	n	n	n	n	n	302
Fergus Estuary	Limerick	y	y	y	y	y	6475
Clonderalaw Bay	Limerick	n	n	n	n	n	381
Doonbeg Estuary	Limerick	n	n	n	n	n	89
Inagh Estuary	Limerick	y	n	n	n	y	63
Limerick Dock	Limerick	n	n	n	n	n	249
Maigue Estuary	Limerick	y	n	n	y	y	321
Upper Shannon Estuary	Limerick	y	n	n	y	y	3951
Lough Donnell	Limerick	n	n	n	n	y	15
Blennerville Lake East	Kerry	n	n	n	n	n	1
Blennerville Lake West	Kerry	n	n	n	n	n	1
Lough Gill	Kerry	n	n	n	n	n	140
Poulaweala Lough / Quayfield Lough	Limerick	n	n	n	n	n	1
Shannon Airport Lagoon	Limerick	n	n	n	n	n	19
Lower Shannon Estuary	Limerick	n	n	n	n	n	12308
Foynes Harbour	Limerick	n	n	n	n	n	75