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Eel Monitoring Programme

2009 - 2011

Iascach Intíre Éireann
Inland Fisheries Ireland

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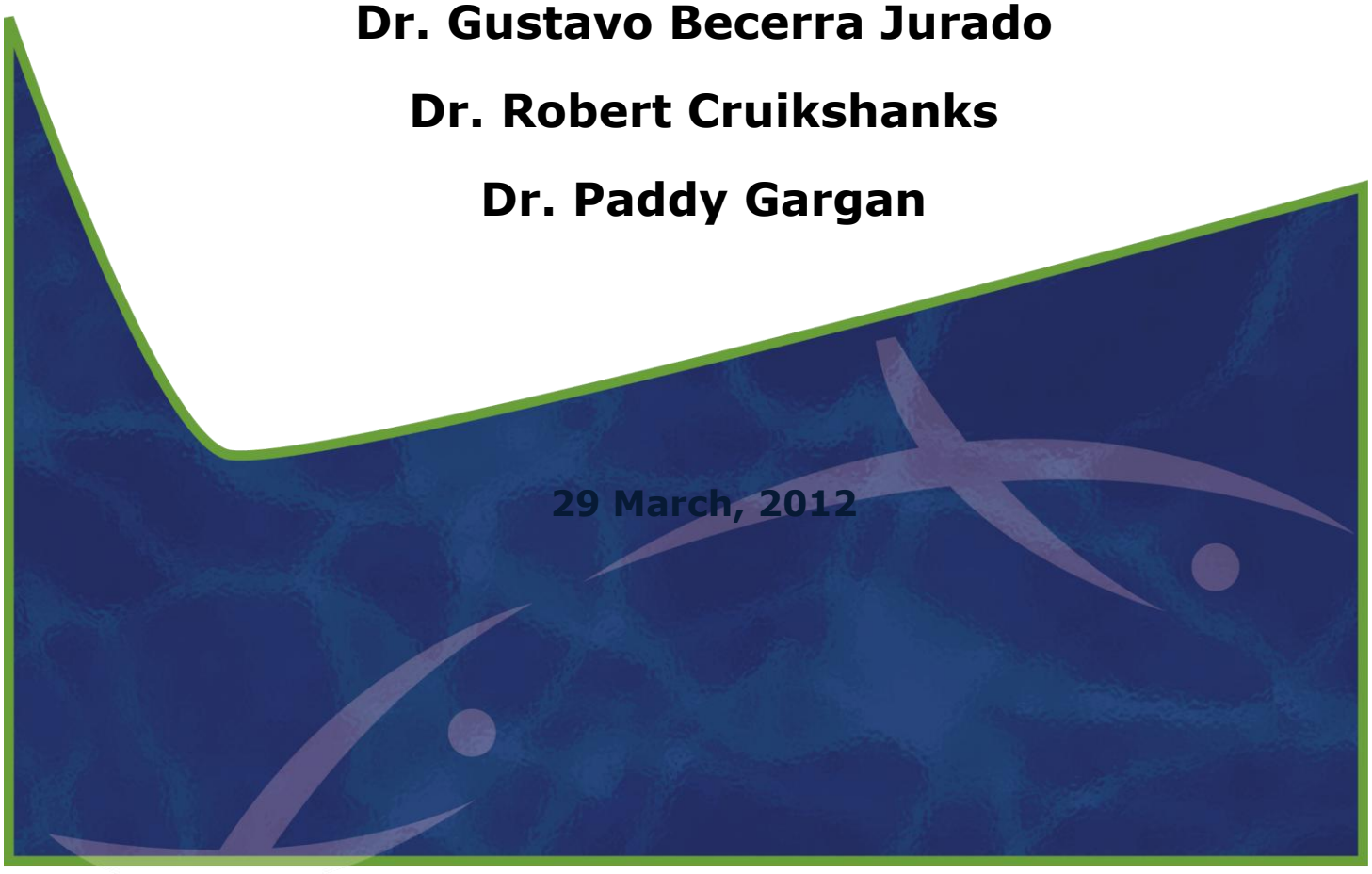

29 March, 2012

Summary

In response to advice from the International Council for the Exploration of the Sea (ICES) that the European eel (*Anguilla anguilla* L.) is endangered and that the fishery is unsustainable the EC regulation establishing measures for the recovery of the European eel (Council Regulation 11000/2007) was created. This regulation for the recovery of the eel stock required Ireland to establish an eel management plan to reduce eel mortality and ensure an increase in the number of silver eel escaping Ireland to spawn. Ireland's management plan involved closure of the fishery, mitigation of hydropower, ensuring upstream eel migration at barriers and improvement in water quality. In June 2009 the EU accepted our national plan as an adequate address to the issues raised in the regulation. Under the regulation each member state must report to the commission initially every 3 years until 2018 and subsequently every 6 years. The next review is due in June 2012.

Inland Fisheries Ireland was tasked with monitoring the eel population since the implementation of the National Management Plan in 2009. A detailed monitoring programme was outlined in this plan and the Eel Monitoring Programme (EMP) has tried to fulfil all of these tasks. The monitoring of recruitment of eels to Ireland is important to determine the success of the EU eel regulation. The ICES working group report 2011 suggests that in the best situation, the detection of changes in the recruitment trend will take four years to be visible. The working group's power analysis study highlighted the need for a structured recruitment monitoring programme. This programme needs to be a long term programme with a running time of at least a decade. Due to the difficulty in sampling for glass eels in estuaries, IFI have focused efforts on the elvers entering freshwater. In 2010, IFI extended the number of elver monitoring stations around the country from 3 to 6. The aim of this programme is to ensure a long-term national coverage of the eel recruitment to Ireland in addition to the monitoring on going by the ESB on the Shannon and Erne.

Over the course of the last 3 years an extensive yellow eel survey was carried out in key Irish lakes. This programme achieved a number of the monitoring objectives such as creating a baseline data set for monitoring changes to the yellow eel population over time, comparison with historical surveys and inter calibration with Water Framework Directive surveys. An investigation into the use of yellow eel data to indirectly estimate silver eel escapement was also carried out. In the Corrib, Shannon, Erne and Burrishoole catchments yellow eels (>30cm) were tagged with passive integrated transponders (TROVAN PIT tags). All silver eel catches from these catchments are scanned in order to detect the maturing tagged yellow eels.

In addition to the key lakes a number of transitional waters and lagoons were surveyed by the EMP namely the Suir, Barrow and Slaney transitional waters and the South Sloblands (a brackish lagoon). The aim of these surveys is to investigate the importance of transitional waters to the Irish eel population.

Silver eel investigations were carried out in the Corrib, Erne and Fane catchments over the 3 years. Mark Recapture studies were carried out to determine the efficiency of the fishery and to aid in determining silver eel escapement. The loss of data from the Galway Fishery due to its closure for safety reasons has affected the results of this objective.

To investigate the quality of the Irish eel stocks, yellow and silver eels were sacrificed for further analysis in the laboratory. A quantity of eels from a number of locations were dissected, the swimbladders were examined for the presence of the parasite *Anguillicoides crassus*, otoliths were removed for age and growth analysis, gonads were examined to determine the sex and diet was investigated.

A detailed programme is planned for the next three years (2012- 2015) concentrating on gathering information on all continental life stages (elver, yellow and silver), eel quality (age, growth and parasite prevalence) in various water body types (Rivers, Lakes and Transitional waters). Due to restricted resources a greater collaboration within other IFI research groups will be undertaken to maximise efficiencies and data collection.

Acknowledgments

The IFI Eel Monitoring Programme team would like to acknowledge the amount of work carried out by the local staff within Inland Fisheries Ireland throughout the country without whose help the objectives of the programme would not have been reached. The authors acknowledge the contribution of the Marine Institute particularly Dr. Russell Poole, AFBINI, DCAL, ESB and NUIG to the IFI national eel monitoring programme. Thanks are also due to the commercial eel fishermen who provided eels for research under this programme. The provision of eel data collected under other IFI programmes (Water Framework Directive, Environmental Riverine Enhancement Programme, Habitats Directive programme and the Coarse Fish Unit) is greatly appreciated. The hydrometric data supplied by the Office of Public Works is also gratefully acknowledged.

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1 Introduction

1.1 Background

In response to advice from the International Council for the Exploration of the Sea (ICES) that the European eel (*Anguilla anguilla* L.) is endangered and that the fishery is unsustainable the EC regulation establishing measures for the recovery of the European eel (Council Regulation 1100/2007) was created. This regulation for the recovery of the eel stock required Ireland to establish an eel management plan to reduce eel mortality and ensure an increase in the number of silver eel escaping Ireland to spawn. Ireland's management plan involved closure of the fishery, mitigation of hydropower, ensuring upstream eel migration at barriers and improvement in water quality. In June 2009 the EU accepted our national plan as an adequate address to the issues raised in the regulation. Under the regulation each member state must report to the commission initially every three years until 2018 and subsequently every six years. The next review is due in June 2012.

The cause of the decline in eel stocks is not fully understood but there are a number of factors likely to be the primary cause of the decline including:

- habitat loss
- poor water quality
- presence of barriers to both upstream and downstream migration (e.g. hydroelectric dams)
- overfishing
- oceanic change/climate change
- parasitology
- increased abundance of predators

These potential causes are covered in the management objectives outlined in the Management plan.

1.2 Monitoring Objectives

The Scientific Eel Group (SEG) was established by the Department of Energy, Communications and Natural Resources in March 2009 and appointed by the Minister. Consultation with the Department of Culture, Arts and Leisure in Northern Ireland ensures the co-operation with Northern Ireland agencies to cover the specific needs of the trans-boundary North Western International River Basin District eel management plan. In 2010 the SEG was reconstituted as a Standing Scientific Committee for Eel (SSCE) under the Inland Fisheries Ireland legislation with a revised Term of Reference. The SSCE comprises scientific advisers drawn from the Marine Institute (MI), Inland Fisheries Ireland (IFI), The Loughs Agency, the Agriculture, Food and Biosciences Institute for Northern Ireland (AFBINI) and the Electricity Supply Board. Although the scientists are drawn from these agencies, the advice from the SSCE is independent of the parent agencies.

In 2009 the IFI eel monitoring programme was initiated to carry out the monitoring objectives outlined in the National Management Plan. These objectives are:

1 Synthesise available information into a model based management advice tool;

2 Estimate silver eel escapement (in collaboration with ESB, NUIG, Marine Institute);

i. Estimate silver eel escapement indirectly using yellow eels;

3 Monitor the impact of fishery closure on yellow eel stock structure CPUE, age and growth studies;

4 Inter-Calibration with Water Framework Sampling;

5 Compare current and historic yellow eel stocks;

6 Establish baseline data to track changes in eel stock over time;

7 Evaluate impedance of upstream colonisation: migration and water quality effects;

8 Determine parasite prevalence and eel quality (Prevalence of *Anguillicoides crassus*, (swimbladder parasite) age and growth analysis).

Within the National Management Plan is a research schedule to be carried out during the 3 year programme. IFI collaborates with partners in the SSCE to reach the objectives outlined above.

2 National Eel Database

In May 2011 the national eel database was installed in the IFI office in Swords. This database was created under the Sea Change strategy with the support of the Marine Institute and the Marine Research Sub-Programme of the National Development Plan 2007-2013. The overall aim of the project was to establish an information management framework for the development of River Basin Eel Management Plans (EMP). This involved the collation of base information to assist the publication of the initial National Plan (DCENR, 2008) and importantly the establishment of a GIS and database system for continued information collation, analysis, management and planning. Integrated eel management is at an early stage of development. It is anticipated that the technical framework developed through this project can provide a rational basis for this development and support the work of the Government's advisory Standing Scientific Committee on Eel (SSCE).

As a starting point, a major objective of the project has been to collate and record the available (historical) information on eel stocks within a standardised database schema (SQL Server). This has been achieved and the opportunity exists to build a comprehensive resource through the continued addition of new survey data. The inclusion of contemporary data will enhance the utility of the database to adequately indicate the temporal and spatial nature of the eel stock. The database will not have a user interface due to the limited funds available at present. As a result the data will have to be manually uploaded into the database and will require the allocation of time for this process to occur. The data incorporated into the database during the lifetime of the project was a small proportion of the data available. This small sample was used to create the SQL database layout. There still remains a large quantity of historical data available that needs to be incorporated into the database.

Research groups within IFI are supplying detailed records of eels captured during electrofishing and fyke net surveys. These programmes include the Water Framework Directive, the Environmental Riverine Enhancement Programme, Coarse Fish Unit and Habitats Directive. This vital information is helping to populate catchments not sampled under the Eel Monitoring Programme and will be used for modelling the current eel populations in Ireland for comparison with the historical data. IFI are a data provider to the EU project POSE; 'Pilot projects to estimate potential and actual escapement of silver eel'. Fulfilling IFI requirement for POSE involved extensive data mining and cleaning and this data is ready for inclusion in the database.

Under the terms of reference for the Standing Scientific Committee on Eels there is a requirement to 'update the national eel database and oversee quality control of the data'. It is the recommendation of the authors that the outstanding data available for inclusion in the database is incorporated. This will assist in the analysis of Ireland's eel stocks.

3 Barriers

3.1 Introduction

Under the National Eel Management Plan, objective 7 requires the evaluation of upstream colonisation: migration and water quality effects. Lasne and Laffaille (2008) found that while eels are capable of overcoming a wide array of obstacles the resulting delay in migration can have an impact on the eel distribution in the catchment. Knowledge of what constitutes a barrier for eels (at different life stages) will assist in the estimation of eel population densities and escapement for future management plan reviews.

The EU Habitats Directive (Directive 92/43/EEC) and Water Framework Directive (2000/60/EC) both require the assessment of barriers to fish migration. In order to tackle the issue on a multispecies level IFI established a National Barrier Group in 2011. This group is building on the earlier work to develop a standardised assessment of barriers nationally and is currently preparing a survey sheet and methodology. The long term aim is to develop a national database of barriers for rating fish pass ability which in turn will provide information to target mitigation measures at the most significant obstructions.

3.2 Existing Barriers

A salmon barrier impact assessment case study was initiated in 2007 in the Nore catchment using field data collected by the Southern Regional Fisheries Board. In this study 508 structures were identified, photographed and measurements were taken. In 2010 a Maynooth Masters student Anthony Ryan modified this salmon study into a multispecies assessment (Ryan *et al.,* 2010). In particular the identified structures were evaluated for eel pass ability. A total of 55 barriers were classified as impassable with a total of 5.5% of the Nore wetted area removed for eels. A further 34 barriers were classified as 'High Risk', representing a potential 18% of the wetted area. Knowing what a barrier is and where they are located within a system has knock on effects on how we manage our resources. By taking into account the presence of impassable and high risk barriers on the Nore catchment it changes the current eel escapement from 2,695 kg to 2,097 kg. It is recommended that a long term national multispecies barrier assessment is undertaken in Ireland to fulfil our commitments to the Eel Regulation, Water Framework Directive and the Habitats Directive.

A multispecies barrier assessment form was created taking information from the two Nore studies and the UK SNIFFER study. This form contains all relevant information required to assess a structure for pass ability of different species e.g. salmon, lamprey and eel (Figure 3-1). To date a rating sheet has been developed for eels however a similar rating sheet for salmon and lamprey needs to be developed.

The Eel Monitoring Programme in IFI undertook a desk study to identify potential obstacles within a catchment using geographical databases (OSI Discovery and 6inch maps), aerial photographs (courtesy of Dr. Martin O'Grady, IFI) and satellite images (Google Earth). The report is entitled 'Desktop Study to remotely identify potential obstacles to fish migration'. The objective of this study was to remotely locate potential obstacles to fish migration. The top 20 eel productive catchments were identified and the first 20 km of river channel from the high water mark were examined. A report containing detailed information is available for these obstacles. Details include the source of information, coordinates, maps, and the type of structure (e.g. weir, ford etc.). A total of 125 potential obstacles were found (Table 3-1). Most potential obstacles were found on the Shannon, Boyne, Barrow and Liffey catchments. These structures will need to be evaluated in the field using the multispecies barrier assessment form.

River System:				RBD:			Date:	
River/ Trib name and location (bridge name; townsland name etc):					Office:	Surveyed by:		
GPS Waypoint No.		Easting:		Northing:		Accuracy as given on GPS:		
1. Nature of Obstruction:	1a. Bridge Apron	1b. Weir	1c. Rock/Bedrock	1d. Culvert	1e. Ford	1f. Hydro scheme present	1g. Bridge no apron	1h. Natural
1i. Sluice	1j. Other							
2. Material Type:	2a. Mass Concrete	2b. Rock/ Bedrock	2c. Masonry	2d. Timber	2e. Natural Bed Mat.	2f. Corrugated Steel	2g. Smooth Steel	2h. Other
3. Structure	3a. Maintained	3b. Abandoned		4. River Conditions During Survey	4b. Low Flow	4c. Mod Flow	4d. High	4e. Flood Flow
5. Roughness of structure	5a. Smooth	5b. Rough	5c. Very Rough	6. Slope	6a. Vertical	6b. Steep	6c. Modest	6d. Gentle
7 a Weirs etc	S	H	CD	LL	CW			
7 b Bridge OR Culvert	W	L	BL	D	H	8. Is floor of culvert sloped	8a. Yes	8b. No
9. Is fish pass provided	9a. Yes	9b. No	9c Denil	9d. Pool	9e. Other	10. Position of pass to channel	10a. Central	10b. Side
11. Is water Diverted?	11a. Headrace y/n	11b. Screens (y/n)	11c. Tailrace y/n	11d. Screens (y/n)				
12. Fringe Effects (easier passage along barrier) y/n		13. Plunge pool under face of structure (y/n)		13 a Max depth of plunge pool (m)				
		High	Moderate	Low	None			
14 Risk posed by structure to particular fish species	14a. Salmon							
	14b. Eel							
	14c. Lamprey							
	14d. Trout							
	14e other							
15. Photographs	15a. Upstream shot	15b. Downstream shot		15c. Diagonal /profile	15.d Edge effects	15e. Fish pass	15f. Other	
16. Relevant Details:								

Figure 3-1 IFI Multispecies Barrier Assessment Sheet

Table 3-1 Top 20 eel catchments in Ireland and potential obstacles in first 20 km of river channel

District	Name	RBD	EMU	Prod kg	Number of potential obstacles
Limerick	Shannon (River)	ShIRBD	ShIRBD	188,849	30
Ballyshannon	Erne (ROI NI)	NWIRBD	NWIRBD	108,185	2
Galway	Corrib (River)	WRBD	WRBD	103,062	2
Ballina	Moy (River)	WRBD	WRBD	45,962	1
Drogheda	Boyne (River)	ERBD	EEMU	10,940	17
Ballyshannon	Drowes (River)	NWIRBD	NWIRBD	10,566	5
Kerry	Laune (River)	SWRBD	SWRBD	10,544	4
Dublin	Liffey (River)	ERBD	EEMU	10,153	12
Sligo	Garvogue (River)	WRBD	WRBD	9,610	5
Sligo	Ballysadare (River)	WRBD	WRBD	7,768	2
Waterford	Suir (River)	SERBD	SERBD	4,842	3
Loughs Agency	Foyle (ROI NI)	NWIRBD	NWIRBD	4,893	2
Bangor	Owenmore (River)	WRBD	WRBD	4,167	2
Waterford	Nore (River)	SERBD	SERBD	3,862	0
Waterford	Barrow (River)	SERBD	SERBD	3,689	24
Lismore	Blackwater (River)	SWRBD	SWRBD	3,614	1
Limerick	Fergus (River)	ShIRBD	ShIRBD	3,386	5
Cork	Lee (River)	SWRBD	SWRBD	3,174	3
Connemara	Ballynahinch (River)	WRBD	WRBD	2,951	2
Kerry	Currane (River)	SWRBD	SWRBD	1,449	3

4 Recruitment

The monitoring of recruitment of eels to Ireland is important to determine how successful the EU eel regulation is. The ICES working group report 2011 suggests that in the best situation, the detection of changes in the recruitment trend will take four years to be visible. The working group's power analysis study highlighted the need for a structured recruitment monitoring programme. This needs to be a long term programme with a running time of at least a decade. Due to the difficulty in sampling for glass eels in transitional waters IFI have focused our efforts on the elvers entering freshwater. Understanding the recruitment of elvers to the freshwater stock is critical to evaluate the dynamics underlying our eel stocks. Naismith and Knights (1988) suggest that the majority of elvers do not leave brackish water or if they do they only penetrate a short distance upstream. For this reason we have concentrated our activities at the high water mark.

Locating appropriate sites is difficult as the traps need to be safely mounted to be safe from spate floods and vandalism (White, 1994, White & Knights, 1994, 1997). This difficulty has been noted in locating an adequate sampling location in the Slaney and Barrow Rivers. Another key factor in choosing a location is the accessibility; samplers need to be able to access the traps every three days from approximately April to July. This surveying method is time consuming, selecting a location which will take minimum time to check allows IFI staff time to continue with their other duties.

4.1 IFI Sampling Locations:

The aim of this monitoring programme is to set up a long-term elver national data series. Elver monitoring has been taking place on the Feale and the Maigue since 1994 and in the Inagh since 1996 by the Shannon Regional Fishery Boards and now by Inland Fisheries Ireland Limerick. Fixed ramp style traps are used at these locations (Plate 4-1). It is proposed to continue monitoring these sites due to the importance of these long-term data series. In addition to these three sites, it was proposed to extend the sampling locations around Ireland to incorporate a comprehensive monitoring programme. The additional locations are the Ballysadare, Corrib and Erriff in the West coast, and the Liffey in the East coast. It was proposed to sample the Barrow and Slaney Rivers, however after two years of field work no suitable location could be found and it is now proposed to survey the Boyne River instead.

Plate 4-1 Elver ramp trap on the Inagh River

4.1.1 Long-term Data Series

IFI Limerick (formerly Shannon Regional Fisheries Board) have been monitoring the elver catch on the River Feale and River Maigue since 1994 and the Inagh River since 1996. In addition to these sites the Shannon estuary was monitored for glass eels since 1997. All data is supplied to the Standing Scientific Committee on Eels and are reported in Irelands Country Reports and submitted to the EU.

The numbers of elvers and yellow eels in the Feale have decreased since 2010 (Table 4-1). The elver numbers in the Maigue increased from 3 kg in 2010 to 5 kg in 2011. The Inagh also recorded a large increase in elver catch, increasing from 1 ½ kg in 2010 to 8 kg in 2011.

Table 4-1 Long-term elver and glass eel data (kg) from the Shannon International River Basin District

Year	R Feale	R Maigue	Inagh R	Sh. Estuary Glass Eels
1985	503			
1986				
1987				
1988				
1989				
1990				
1991				
1992				
1993				
1994	70	14		
1995	0	194		
1996	0	34	140	
1997	407	467	188	616
1998	81	8	11	484
1999	135	0	0	416
2000	174	0	120	43
2001	58	2	18	1
2002	116	5		37
2003	36	72	111	147
2004	0	0	24	1
2005	0	1	0	41
2006	1	0	4	3
2007	0	0	39	12
2008	0	0	82.5	2
2009	42			
2010	20	3	1.312	3
2011	5	5	8	

4.1.2 Corrib

In 2010 pipe style traps were placed in to the River Corrib at the downstream face of the Galway weir (Plate 4-2). The traps are located on the left and right hand banks. They have been monitored for two years. In 2010, 30 kg of elvers were trapped (approx. 95,000 individuals) along with 7 kg of yellow eels (equivalent to 728 individuals). In 2011, there was a large drop in the number of elvers trapped with 4 kg (approx. 12,000 individual elvers) trapped mainly during June and July. The amount of yellow eels trapped increased to 24 kg (equivalent to 3,200 individuals).

Plate 4-2 Elver pipe traps set in the fish pass at Galway weir

4.1.3 Erriff

Dr. Christopher Moriarty surveyed the river in 1974, 1975; 1979. Dr. Moriarty proposed using the Erriff as a source of elvers for stocking to other rivers with a commercial fishery present. The Western Regional Fisheries Board captured elvers at the Erriff for sale to Aqua Arklow Ltd. and for stocking into Lough Corrib. In 1997, 32 kg of elvers were caught from April 6th – May 5th 1997. In 2010 and 2011 elver pipe traps were set in the Erriff, however no significant numbers were caught. The locations where elvers were historically visible (under stones near the estuary and ascending the Aasleigh Falls) were checked during the sampling period but very few numbers were observed. It is proposed to keep observing the Erriff, and if the elver numbers improve, resume the monitoring programme with the pipe traps.

4.1.4 Ballysadare

A site was fished downstream of the falls in Ballysadare by Dr. Moriarty in 1979 and again by Aqua Arklow in 1997. In 2010 and 2011 the local IFI staff surveyed the river using pipe traps to locate an adequate location for a permanent ramp trap. In 2010 no visible elver run was found however in 2011 a significant run was observed using the fish pass at the Ballysadare Falls in July 2011. The run contained both elvers and yellow eels (Plate 4-3). It is proposed to set up a ramp trap similar to the Shannon traps on this river for 2012.

Plate 4-3 Yellow and elvers at Ballysadare July 2011

4.1.5 Liffey

In 2010 a ramp trap was installed on the right hand bank of the Islandbridge weir on the River Liffey. Very low numbers were caught in 2010. In 2011 in addition to the ramp trap a number of pipe traps and substrate traps were also used to determine if more eels were bypassing the ramp trap or using the other bank. It is the opinion of the IFI that the trap needs to be moved closer to the weir with an increase in flow of water down the ramp. If it is possible a second ramp trap should be installed on the left hand bank of the river.

4.1.6 Barrow

In 2010 and 2011 the Barrow at the weir at St Mullins was sampled for elvers. Very low numbers were recorded in the elver pipe traps.

4.1.7 Slaney

In 2010 and 2011 various sites on the Slaney River were sampled for elvers. Very low numbers were recorded in these surveys and no suitable location was found for the setting up of a permanent monitoring station.

4.2 Conclusion and Recommendations:

In 2011 it was decided to separate the catch between elvers and juvenile yellow eels. This is done on a visual basis; larger thicker eels are separated from the smaller catch and weighted separately. In 2012 it is proposed to use a sieve method of separating the eels based on different mesh sizes.

It is recommended that in at least two locations, samples of elvers are sacrificed for age analysis and detailed length measurements.

5 Yellow Eel Assessment 2009 - 2011

5.1 Introduction

Yellow-eel stock monitoring is integral to gaining an understanding of the current status of local stocks and for informing models of escapement, particularly within transitional waters where silver eel escapement is extremely difficult to measure directly. Such monitoring also provides a means of evaluating post-management changes and forecasting the effects of these changes on silver eel escapement. The monitoring strategy aims to determine, at a local scale, an estimate of relative stock density, the stock's length, age and sex profiles, and the proportion of each length class that migrate as silvers each year. Furthermore, individuals from this sample will be used to determine levels of contaminants and parasites to assess spawner quality. Two classes of survey methodologies were employed; eel specific surveys and multi-species surveys, mainly involving standardised fyke netting and electro-fishing.

Fyke net surveys, carried out between 1960 and 2008 by State Fisheries Scientists will provide a useful bench mark against which to assess the changes in stock after the closure of the fishery. The yellow eel monitoring strategy relied largely on the use of standard fyke nets. Relative density was established based on catch per unit (scientific-survey) effort.

Under the Irish Eel Management Plan a detailed research programme was outlined for the 3 year period. This monitoring programme aimed to meet a number of objectives.

2.1 Estimate silver eel escapement using indirect assessment from yellow eel stocks;

3. Monitor the impact of fishery closure on yellow eel stock structure;

4. Inter-calibration with water framework sampling;

5. Compare current and historic yellow eel stocks;

6. Establish baseline data to track changes in eel stock over time.

A number of changes were made to the schedule over the three year period, dictated by availability of resources and weather conditions. In order to survey the lakes comprehensively Lough Derg and Lough Ree were both divided into two lakes (upper and lower, Table 5-1). Due to the presence of the silver eel trap at Burrishoole and the long-term data series available, Lough Feeagh and Lough Bunaveela were sampled every year as opposed to the one year outlined in the schedule. As a result of the extra additions and time constraints, four lakes were omitted from the schedule, Lough Allen, Lough Arrow, Lough Mask and Dromore Lough. Ballysadare was removed from the schedule as recent IFI surveys of the area resulted in very low eel catches. Waterford estuary was surveyed a second time in place of Ballysadare. The South Sloblands were surveyed in place of Lady's Island Lake due to the availability of historical data. The extent of sampling locations surveyed over the three year period is presented in Figure 5-1.

5.1.1 Methodology

The yellow eel fyke net surveys consisted of setting 10 chains of 5 fyke nets for 6 nights, resulting in an effort of 300 net nights. The lakes were surveyed over at least two time periods to account for variation in time. Five to six lakes were intensively sampled each year.

In the fyke net surveys there are two life stages encountered: the yellow resident stage and the silver migratory stage. Stage determination is based on skin colour: an eel that displays a silver belly well separated from a black dorsal region by the lateral line is considered at the 'silver stage'. However eels are found with intermediate features so additional measurements are recorded (ICES, 2009).

- Eye measurements: horizontal and vertical right eye is measured (not just the iris but the whole visible eye, mm);
- Pectoral fin measurements (corresponds to the tip of the fin to the greatest possible length (mm);
- Total body length (cm);
- Wet body weight (kg);
- State of lateral line (presence of black corpuscles);
- Presence of metallic colouration (i.e. bronze);
- Dorso-ventral colour differentiation.

Eels were anaesthetized with a solution of chlorobutanol and lake water. For each night's fishing, as many live samples as possible were measured for weight, length, and INDICANG style morphological features associated with silvering. At each location approximately 100 eels were sacrificed for further analysis in the laboratory. Total length (to nearest cm), weight (to nearest g) and silvering characteristics were determined on site. In the laboratory, otoliths were removed for age evaluation (cracking and burning – Christensen, 1964, Hu & Todd, 1981, Moriarty, 1983 and Graynoth, 1999), gonads for sex determination (macroscopically), swimbladders for evaluation of nematode parasite, *Anguillicoloides crassus* (Kuwahara, Niimi & Hagaki, 1974) and stomachs for diet composition.

A second objective of the yellow eel study was to carry out an indirect estimation of silver eel escapement. For lakes with a research silver eel fishery or Trap and Transport operation within the system, all yellow eels >30 cm captured in the fyke nets were tagged using Trovan Passive Integrated Transponders (PIT tags). The detection of these tagged eels in the silver eel run over subsequent years will provide information regarding the maturation rate of the yellow eel population.

5.1.2 Summary

During the three year programme, 13,194 yellow eels were captured over 5,308 net*nights. Summary catch information is available in Table 5-2. Factors affecting the number of net*nights include bad weather and interference of nets. Further details of these surveys will be found in the following sections.

Over the course of the three year programme an extensive amount of information was gathered on the yellow eel in Ireland (Catch per unit of effort (CPUE), length, weight, morphometric data, age, growth and parasite prevalence etc.). This information will be used as a baseline data set to track changes in the population structure of eels in Ireland over the coming years as a result of the closure of the fishery and the endangered status of the stock (Objective 3 and 6). An inter calibration study was conducted between the Eel Monitoring Programme and Water Framework Directive lake programme (Objective 4). The intensive survey work carried out incorporated repeat surveys allowing for the comparison with historical records from the 1960's, 1970's, 1980's and 1990's (Objective 5). New technology was employed in monitoring the maturation rate of yellow eels to silver eels. Yellow eels were implanted with Passive Integrated Transponders (PIT tags) in order to carry out Mark Recapture studies and for the estimation of the maturation rate of yellow eels to silver eels (Objective 2.1).

Lough Derg recorded the highest catch per unit of effort for a lake with a CPUE of 3.89 (Table 5-2). Lough Oughter recorded the lowest CPUE, for a water body of this size, this result was not expected. It is proposed to resurvey Lough Oughter in the following three year programme. Upper and Lower Lough Corrib also recorded quite low number of eels for the amount of nets set on the lake.

For the transitional waters, both the Barrow and Suir surveys caught good numbers of eels for the number of nets set however the Slaney transitional water recorded low numbers.

In addition to the eel monitoring programmes, various research groups within IFI and other agencies have supplied survey information on eels from surveys around the country (Water Framework Directive, Environmental River Enhancement Programme (EREP), Coarse Fish Unit, Habitats Directive, Marine Institute, AFBINI, and National University of Galway). This information will be incorporated into the National Eel Database and will be used in future assessments. The WFD data is presented in Appendix I, II and III.

The first three year eel monitoring programme has concentrated on the distribution of yellow eels in lakes as they are a dominate component of Ireland's wetted area comprising more that 85%. Many European countries that are modelling eel population do not take into account lake habitat due to the difficulty involved in relating CPUE data to density and abundance. It is recommended that further research into estimating density of eels in lakes is carried out to support the national management plan.

Table 5-1 Locations of eels specific surveys; planned and executed 2009 – 2011 (√ surveyed, √! added to list, † not surveyed

Water body	2009	2010	2011
Burrishoole	√	√	√
Lower Derg*	√		√
Upper Derg		√	
Upper Corrib		√	
Lower Corrib	√		
L. Cullen	√		
L. Conn	√		
Upper L. Erne		√	
L. Ree (Upr. & Lwr.)		√	
L. Oughter			√
L. Ramor			√
L. Inchiquin			√
Ballynahinch			√
L. Arrow		†	
L. Allen			†
L. Mask			†
Dromore L			†
Waterford Estuary	√		√
Slaney Estuary		√	
South Sloblands		√	
Lady's Island Lake			†
Ballysadare Estuary	†		

Table 5-2 Summary details from the yellow eel surveys 2009 - 2011

Lake	Year	No. Eels	Nets Nights*	CPUE	Total Weight (kg)	No. weighed	Mean Length (cm)	Min. Length (cm)	Max. Length (cm)	Mean Weight (kg)	Min. Weight (kg)	Max. Weight (kg)
Lower Lough Derg	2009	669	300	2.230	117	670	44.06	25.00	85.00	0.175	0.030	1.867
Upper Lough Derg	2010	771	255	3.010	110	758	46.0	28.1	81.2	0.179	0.045	1.316
Meelick Bay (L. Derg)	2011	856	220	3.891	204	847	43.1	28.7	67.0	0.157	0.039	0.592
Lower Lough Corrib	2009	314	300	1.047	57	327	45.97	27.00	71.00	0.173	0.042	0.742
Upper Lough Corrib	2010	471	300	1.57	99	445	50.1	31.50	87.5	0.222	0.046	1.372
Lough Feeagh	2009	517	295	1.75	54	332	42.16	20.80	79.80	0.161	0.009	1.340
Lough Feeagh	2010	496	300	1.65	73	478	42.5	26.6	89.1	0.154	0.026	1.656
Lough Feeagh	2011	73	60	1.22	13	76	43.22	29.0	86.2	0.173	0.039	1.590
Lough Bunaveela	2009	29	75	0.387	5	29	44.72	30.50	58.50	0.162	0.044	0.393
Lough Bunaveela	2010	11	50	0.22	-	5	47.9	36.2	58.3	-	-	-
Lough Bunaveela	2011	2	30	0.07	0.44	2	47.5	38.4	56.6	0.22	0.095	0.345
Lough Furnace	2011	52	90	0.5778	8	53	42.2	19.4	86.1	0.159	0.03	1.35
Lough Ramor	2011	1067	300	3.557	241	1042	47.9	26.4	84.1	0.366	0.030	1.150
Lough Cullin	2009	377	215	1.753	64	321	44.72	28.70	82.30	0.200	0.041	0.960

Lake	Year	No. Eels	Nets Nights*	CPUE	Total Weight (kg)	No. weighed	Mean Length (cm)	Min. Length (cm)	Max. Length (cm)	Mean Weight (kg)	Min. Weight (kg)	Max. Weight (kg)
Lough Conn	2009	595	250	2.380	98	510	46.41	31.00	81.00	0.192	0.044	1.200
Lower Lough Ree	2010	505	300	1.68	90	500	46.4	28.2	84.5	0.184	0.028	1.503
Upper Lough Ree	2010	345	270	1.27	69	342	47.7	29.6	69.8	0.200	0.034	0.707
Lough Inchiquin	2011	548	250	2.19	151	543	52.5	31.7	77.8	0.2773	0.0450	1.110
Lough Ballynahinch	2011	434	300	1.45	64	434	41.7	28.0	90.5	0.1480	0.0420	1.760
Upper L. Erne	2010	493	300	1.64	106	491	49	28.90	78.7	0.221	0.035	0.950
Lough Oughter	2011	296	300	0.987	66	284	50.4	30.7	78.5	0.233681	0.0425	0.641
Barrow T. Waters	2009	1,410	215	6.560	-	100	42.5	22.50	65.00	0.197	0.021	0.980
Barrow T. Waters	2011	155	20	7.75	16	162	36.13	20.40	69.20	0.097	0.013	0.633
Suir T. Waters	2009	1,888	163	11.580	-	1,281	37.7	21.5	79.00	-	-	-
Suir T. Waters	2011	574	90	6.38	70	572	38.7	22.10	74.30	0.123	0.018	0.665
Slaney T. Waters	2010	350	210	1.67	-	346	33.9	22.70	57.90	-	-	-
South Sloblands	2010	24	30	0.800	4	24	43.9	29.8	64.20	0.172	0.0455	0.441

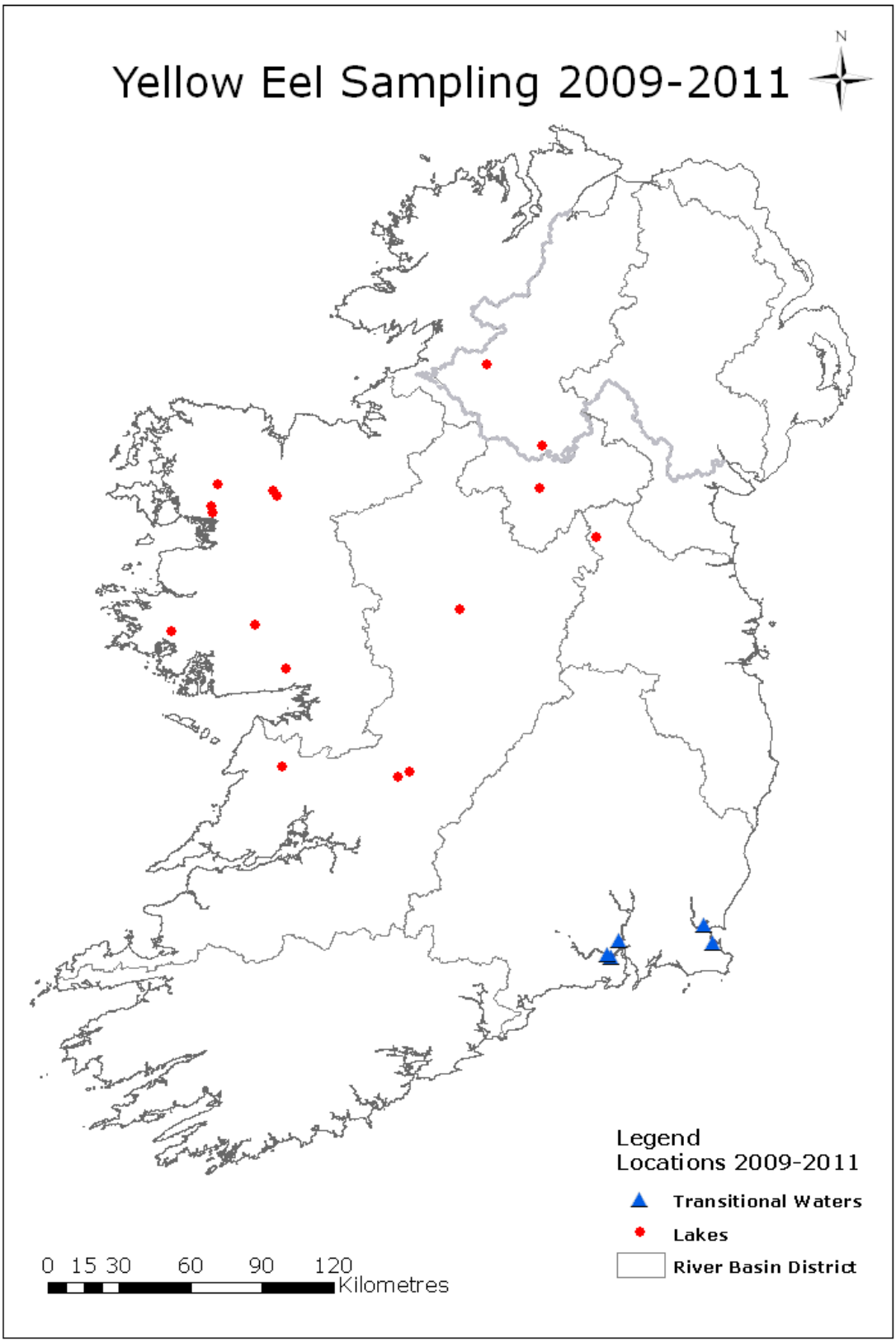


Figure 5-1 Locations of yellow eel surveys carried out between 2009 - 2011

6 Transitional Waters

6.1 Waterford Survey 2009/2011

Feunteun *et al.* (2000) reported that eels can represent approximately 50% of the fish biomass in estuarine systems (lagoons and downstream reaches of rivers). In order to determine the population density within an important eel habitat, a spatially explicit mark recapture experiment was carried out in the Waterford Harbour in July 2009 (Efford, 2004, Hightower & Nesnow, 2006, Morrison & Secor, 2003, 2004). This method consisted of 2-4 grids of 15-20 fyke net, with each fyke net spaced 50 m apart. Fyke nets were set in grids along the right and left bank of the transitional water, avoiding the main shipping channel (Figure 6-1). Nets were not set on consecutive nights as the anaesthetic suppresses appetite and therefore tagged eels are unlikely to forage directly after release impacting on their recapture rate. Data indicated that eels feed every 2-3 days (Tesch, 1977 and Moriarty, 1978). The fyke nets were not baited to avoid attracting eels into the study area (Morrison & Secor, 2004). All eels >30 cm were tagged with passive integrated transponders (TROVAN PIT tags).

On the Suir, two locations were selected, one upstream of the bridge in Waterford city and one downstream. The upstream site was only fished for one night (02nd July 2009). The downstream site was fished for four nights spread out over seven nights (02nd, 06th, 08th & 13th July 2009). One site on the Barrow estuary was fished for five nights spread out over nine nights (02nd, 06th, 08th, 13th, 15thJuly 2009) with an additional two sites (upstream and downstream of the main site) on the last night. The survey was carried out by Inland Fisheries Ireland (formerly Central Fisheries Board) with the collaboration of the Southern Regional Fisheries Board and the Marine Institute who provided field staff. Three charter boats were hired to assist in the survey. One hundred eels were sacrificed on the last day of the survey in the Barrow transitional waters. Total length (to nearest cm), weight (to nearest g) and silvering characteristics were determined on site. In the laboratory, otoliths were removed for age evaluation (cracking and burning, Christensen, 1964, Hu & Todd, 1981, Moriarty, 1983 and Graynoth, 1999), gonads for sex determination (macroscopically), swimbladders for evaluation of nematodes and stomachs for diet composition.

In total, 1,888 eels were captured in the fyke net survey in the Suir transitional waters with a catch per unit effort of 11.58 (Table 6-1). A large catch of 483 eels were captured in the upstream site (upstream of Waterford bridge) after one nights fishing and 712 eels were tagged in the downstream site (downstream of Waterford bridge). No eels from the upstream site were recaptured in the downstream site during the study period. Within site 2 (downstream of Bridge), 30 eels were recaptured over the time period giving a recapture rate of 4%. No tagged eels were recaptured more than twice in this survey (Table 6-2).

Hightower and Nesnow (2006) suggested that a three day mark recapture survey is sufficient to get an indication of the density of the population. To test this theory a traditional fyke net survey (5 nets in a chain) was carried out in July 2011. The nets were set off the main channel around Waterford Castle Island approximately one kilometre downstream from the 2009 survey. Six chains of nets were set for three nights and a total of 574 eels were captured giving a CPUE of 6.38. No tagged eels from the 2009 survey were recorded but two eels were recaptured within the survey period.

In the Barrow transitional waters 1,410 eels were captured with a catch per unit effort of 6.56 in 2009 (Table 6-1). A total of 849 eels were tagged and 52 eels were recaptured giving a recapture rate of 6% (Table 6-3). No tagged eels were recaptured more than three times in the trapping session. In 2011 traditional fyke net chains were set in the Barrow main channel for one night in the same location as the 2009 survey. A total of 155 eels were caught giving a CPUE of 7.75. One eel tagged in 2009 was recaptured in 2011.

Moriarty (1986) concluded that recapture rates of 5.5 – 18.5% could be expected if a population was non-migratory, rates below 2% indicating a very mobile population. In the Suir, tagged eels were caught at most twice and in the Barrow only three eels were caught three times. This low recapture rate could be due to trap shyness or because the home range of the species in question is greater than the trapping area.

Table 6-1 Suir and Barrow transitional water fyke net survey 2009 and 2011

T_Water	Year	Location	No. Eels	No. Nets	CPUE
Suir	2009	Main Channel	1,888	163	11.58
	2011	Island	574	90	6.38
Barrow	2009	Main Channel	1,410	215	6.56
	2011	Main Channel	155	20	7.75

Table 6-2 Mark Recapture data from the Suir Survey 2009

Occasion i	1	2	3	4
Caught at time i	345	80	136	181
1st caught at time i	345	73	132	162
Caught exactly i times	682	30	0	0
Marked animals at i+1	345	418	550	712

Table 6-3 Mark Recapture data from Barrow Survey 2009

Occasion i	1	2	3	4	5
Caught at time i	97	335	240	266	18
1st caught at time i	97	331	228	243	2
Caught exactly i times	849	49	3	0	0
Marked animals at i+1	97	428	656	899	901

6.1.1 Population Estimation

Population density is a key ecological variable and it has recently been shown how captures on an array of traps over several closely spaced time intervals may be modelled to provide estimates of population density (Borchers and Efford 2008; Efford *et al.,* 2009). A maximum likelihood spatially explicit capture recapture (ML- SECR) experiment was carried out in the Barrow and Suir estuary in 2009. The Density programme 4.4 (Efford, 2009) estimates the density of animal populations from capture – recapture data collected using an array of detectors (traps). Detectors are live capture traps with animals uniquely marked with PIT tags. Three models are used (Half- Normal, Hazard and Negative Exponential) and the model with the lowest Akaike Information Criterion (AIC) value is the density value reported.

Thibault *et al.* (2007) found that tagged eels in the St Jean watershed had a home range of between 100m to 1 km. Morrison & Secor (2003) found an average distance travelled by eels in their study to be approximately 588 m with a maximum distance travelled at 4.5 km. In this analysis we looked at a boundary zone of 100 m, 500 m and 1,000 m to cover the variation in home range size.

For the Suir estuary, the half normal model had the lowest AIC value for both tests (Table 6-4). If a boundary of 100 m is used, the model predicts a density of 58 eels/ha (46 -69 eels/ha). An increase in the size of the boundary to 1,000 m results in the density decreasing to 9 eels/ha (7- 11 eels/ha). Therefore, a conservative estimate of eel density in the Suir estuary is between 9 – 58 eels/ha.

For the Barrow estuary, the hazard model had the lowest AIC value for all tests (Table 6-5). For the 100 m boundary analysis, the model predicts a population of 49 eels/ha (42 – 56 eels/ha). When the boundary zone is increased to 1,000 m, the density decreases to 8 eels/ha (7 – 10 eels/ha). Taking a conservative estimate, the density of eels in the Barrow estuary is estimated to be between 7-49 eels/ha.

The density values reported here are representative of the gear dependent proportion of the population as fyke nets are size selective. In this study it was decided to tag eels that were >30 cm. These density values are similar to recent density values reported in the literature. Morrison & Secor (2004) found a density of 9.5 eels/ha (1 – 30 eels/ha) for the Hudson River Estuary USA. Hightower & Nesnow (2006) reported a value of 4 – 13.8 eels/ha in the White Oak River Estuary, USA. These values are less than those reported by other studies (Table 6-6). Telemetry studies will give a clearer indication of the movement habits of eels in estuaries close to the river channel.

Table 6-4 Comparison of models for density and spatial detection of eels in the River Suir

Boundary zone	Distribution Type	AIC	AICc	Density ha	SE	G0	SE	Sigma	SE
100m	Half Normal	3291.39	3291.42	57.67	11.613	0.0004	0.0001	791.73	245.37
	Hazard*	3297.24	3297.30	57.09	11.504	0.0003	0.0001	33173.13	na
	Neg Exponential	3291.06	3291.10	57.93	11.704	0.0005	0.0002	985.37	641.15
1,000m	Half Normal	3293.74	3293.78	8.66	1.840	0.0005	0.0002	1212.73	578.76
	Hazard*	3297.24	3297.30	8.07	1.583	0.0003	0.0001	30041.54	na
	Neg Exponential	3294.26	3294.30	8.52	1.742	0.0006	0.0005	1673.46	5401.94
500m	Half Normal	3292.20	3292.23	19.98	4.036	0.0005	0.0002	855.23	329.42
	Hazard*	3297.24	3297.30	18.97	3.766	0.0003	0.0007	25517.64	n/a
	Neg Exponential	3292.89	3292.93	19.93	3.961	0.0006	0.0004	1076.08	1239.82

Table 6-5 Comparison of models for density and spatial detection of eels in the River Barrow

Boundary Zone	Distribution Type	AIC	AICc	Density ha	SE	G0	SE	Sigma	SE
100m	Half Normal	3068.87	3068.90	48.06	6.677	0.0017	0.0003	313.52	24.73
	Hazard*	3063.54	3063.58	48.83	6.960	0.0015	0.0003	355.91	59.06
	Neg Exponential	3070.86	3070.89	48.15	6.844	0.0032	0.0007	233.21	32.94
1,000m	Half Normal	3122.68	3122.71	9.35	2.068	0.0011	0.0002	782.73	159.37
	Hazard*	3108.42	3108.46	8.44	1.161	0.0007	0.0001	1458.42	11.96
	Neg Exponential	3125.61	3125.64	10.01	36.884	0.0021	0.0042	592.21	16458.06
500m	Half Normal	3101.22	3101.24	19.64	3.111	0.0013	0.0002	511.52	60.12
	Hazard*	3083.26	3083.31	19.48	2.705	0.0008	0.0001	885.15	8.30
	Neg Exponential	3107.49	3107.52	19.63	3.568	0.0023	0.0007	413.28	110.56

Table 6-6 Density estimates for *Anguilla rostrata* from the literature

Location	System	Fishing Method	Density eels/ha	Min eels/ha	Max eels/ha	Min length	Max length	Ref
Hudson River, NY, USA	Estuary	Pots	9.5	1	30	28	67	Morrison & Secor, 2004
White Oak River Estuary, N. Carolina, USA	Estuary	Pots		4	13.8			Hightower & Nesnow, 2006
Georgia Tidal Creek	Estuary	Pots		182	232	20	80	Bozeman *et al.*, 1985
Massachusetts Tidal creek	Estuary	Traps	875			15	63	Ford & Mercer, 1986
Maine	River	e/fishing		800	2200	>10		Oliveira & McCleave, 2000
Rhode Is.	River	e/fishing		450	3230	16	74	Oliveira, 1997
Vermont Lake	Lake	e/fishing		232	636	-	-	La Bar & Facey, 1983

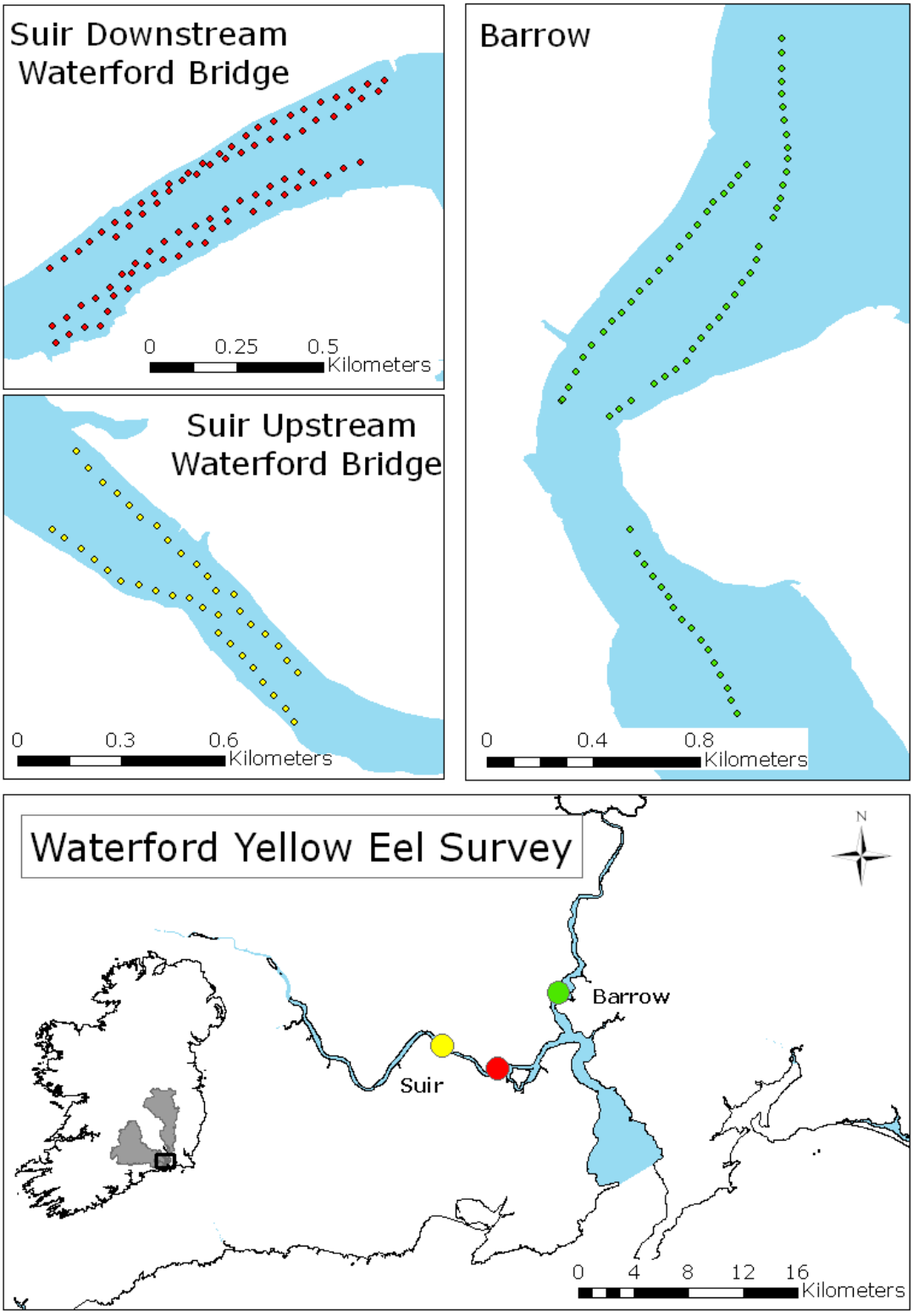


Figure 6-1 Location of surveys sites in Waterford Harbour, Suir and Barrow 2009

6.2 Slaney Estuary

In July 2010, a spatially explicit mark recapture experiment was undertaken downstream of the Ferrycarraig bridge and upstream of Wexford town (Figure 6-2). This location was chosen due to the size of the trapping area required for the MR survey. The commercial eel fishermen usually fish further upstream (above Killurin) due to the abundance of crabs in the estuary. Finding adequate depth to set nets proved difficult for this site. Two chains of fyke net were set; each chain consisted of 15 fyke nets with each net spaced 50 m apart.

A similar sampling method to that used in the Slaney estuary was employed in the Waterford estuary in 2009. However, due to the low recapture rate recorded, the methodology was modified for the 2010 Slaney survey. In 2009, nets were not set on consecutive nights as the anaesthetic suppresses appetite and the tagged eels are not expected to be recaptured. However, for the Slaney estuary survey, it was felt that to capture the whole population (untagged eels) the area needs to be fished on consecutive nights. Fyke nets were not baited to avoid attracting eels into the study area.

Two chains of 15 nets were set for seven nights (13th July to 23rd July, excluding weekends) with a trapping area of 17 ha. A total of 350 eels were captured in 210 net*nights giving a catch per unit of effort of 1.67. All eels >30 cm were tagged with passive integrated transponders (PITs) and released. The survey was carried out by staff from IFI Swords and the Enniscorthy office. One charter boat was hired to assist with the survey.

In total, 240 eels of the 350 caught were tagged. The eels captured by fyke nets ranged in length from 22.7 cm to 57.9 cm with an average length of 33.9 cm (Figure 6-4). A very low recapture rate was recorded for the Slaney Estuary (1%, Table 6-7). Two eels were recaptured (one twice and one three times). The recaptured eels travelled less than 400 m. No eels were taken back to the laboratory for further analysis due to the low numbers caught. Due to the low recapture rate, the Slaney data was not analysed using the Density programme as it requires a minimum of 20 recaptures (Efford *et al.,* 2009).

Home range is dependent on the size of the eel, diurnal and nocturnal activities but also on the habitat itself (Thibault *et al.,* 2007). Studies show that the home range of eels is very dependent on the habitat available with home ranges for A. *rostrata* ranging from 325+/-64 ha in a tidal estuary in Maine to 0.5 to 2.0 ha in an estuary of the Calumet River (Dutil *et al.* 1988; Parker 1995). Ford and Mercer (1986) found that 93% of eels travelled less than 100 m in a tidal marsh giving a mean home range of 209 m^2. A telemetry study of either the Slaney or Waterford Estuary would indicate whether these eels are utilising an area within their home range or are undertaking a migratory or seasonal journey.

Table 6-7 Mark Recapture data from the Slaney Estuary

Occasion *i*	1	2	3	4	5	6	7
Caught at times *i*	83	47	18	6	23	25	41
First caught at times *i*	83	46	18	6	22	25	40
Caught exactly *i* times	238	1	1	0	0	0	0
Marked animals at *i* +1	83	129	147	153	175	200	240

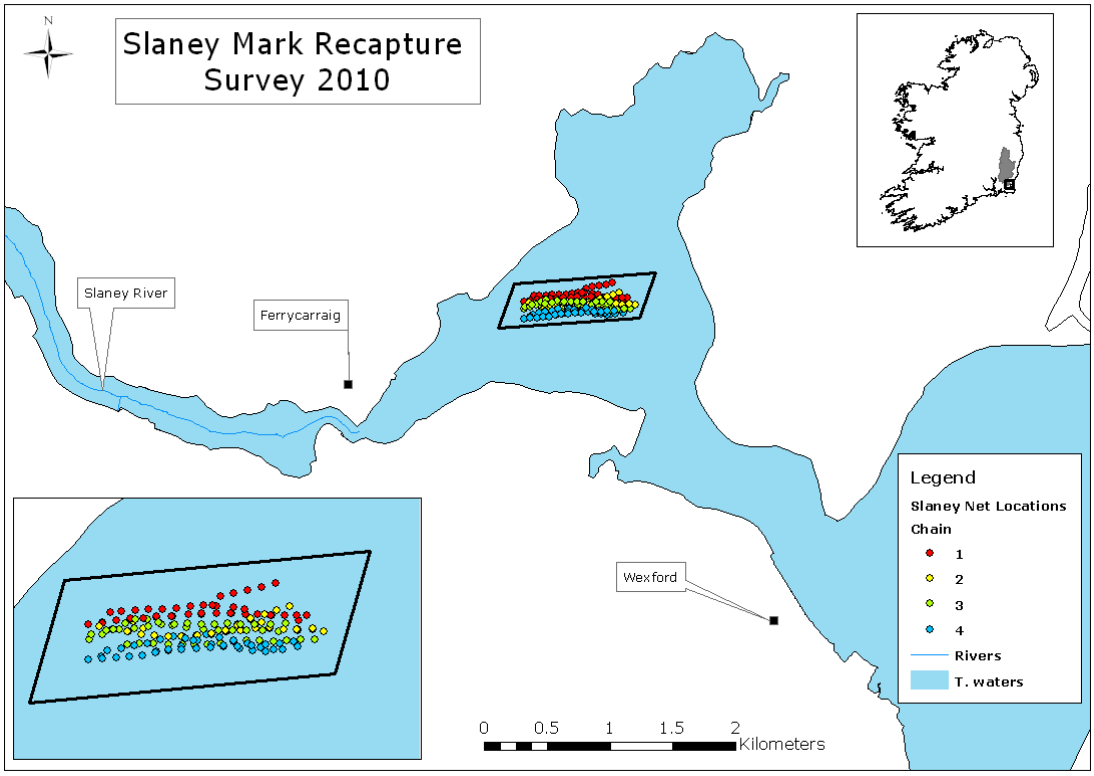


Figure 6-2 Locations for the Slaney Transitional Waters survey 2010

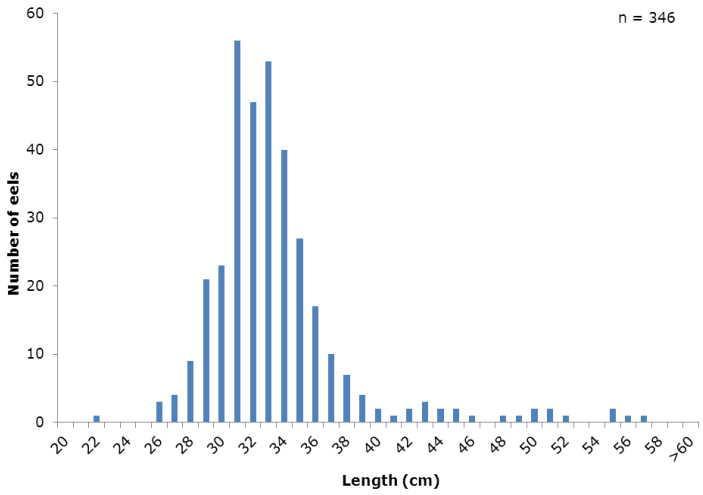


Figure 6-3 Length Frequency of yellow eels captured at Slaney Estuary, 2010

6.3 Yellow Eel Biology

An analysis to compare the length, weight and condition factor of yellow eels from lakes and transitional waters was carried out on data from the 2009 -2011 surveys. A Mann Whitney test showed a significant difference in the length of eels from transitional waters and lakes ($p<0.001$, Table 6-8 and Figure 6-4). The average length of an eel in the lakes is 45.8 cm compared to only 38.6 cm for eels in transitional waters, with a medium effect size ($r=0.3$; Table 6-8).

A Mann Whitney analysis showed a significant difference in the weight of eels found in transitional waters and lakes ($p <0.001$, Table 6-9, Figure 6-6). The average weight of an eel in the lake is 0.194 kg compared with 0.127 kg in the transitional waters. A medium effect size was calculated for this analysis ($r=0.3$)

A Mann Whitney analysis showed a significant difference in the condition factor of eels found in the transitional waters and lakes ($p < 0.001$, Table 6-10, Figure 6-7). However the effect size calculated for this analysis is very low $r = 0.04$ and could be an effect of the larger sample size for the lake analysis ($n = 5,521$) compared to the sample size in the transitional waters ($n = 834$). The average condition factor for eels in the lakes is 0.178 compared with an average condition factor of 0.180 for the transitional water eels.

Growth analysis will confirm if there is a difference in biological characteristics of eels from the two locations. Morrison (2002) found growth rates for eels in brackish waters were twice the rate in freshwater. Morrison *et al.* (2003) found that eels had a higher size at age and matured faster when eels resided in brackish waters compared with those freshwater periods in their life history.

Table 6-8 Mann Whitney statistics for length (cm) of eels from lakes and transitional waters

	No. Eels	Mean	Median
Lakes	5,521	45.8	44.6
T waters	834	38.6	35.8
U	1,251,199		
r	0.3		
sig	<0.001		

Table 6-9 Mann Whitney statistics for weight (kg) of eels from lakes and transitional waters

	No. Eels	Mean	Median
Lakes	5,521	0.194	0.157
T waters	834	0.127	0.083
U	1,249,978		
r	0.3		
sig	<0.001		

Table 6-10 Mann Whitney statistics for condition factor of eels from lakes and transitional waters

	No. Eels	Mean	Median
Lakes	5,521	0.180	0.178
T waters	834	0.178	0.175
U	2,129,779		
r	0.04		
sig	<0.001		

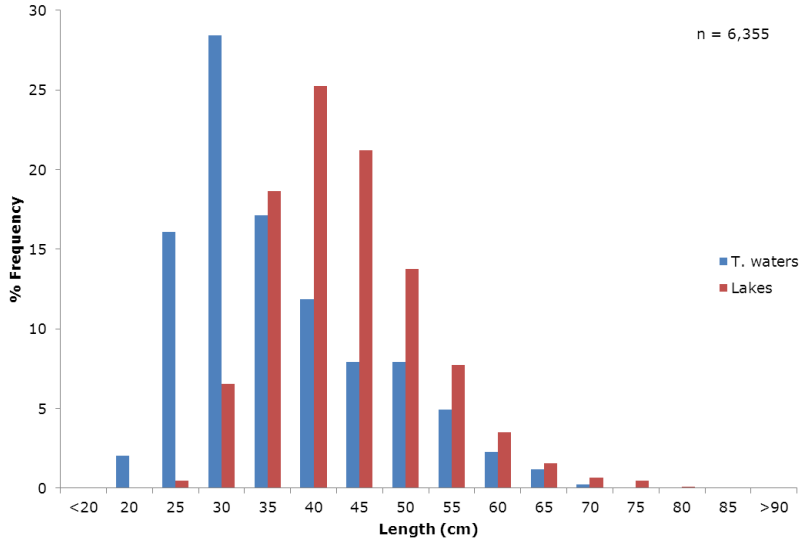


Figure 6-4 Length frequency of yellow eels from transitional waters and lakes

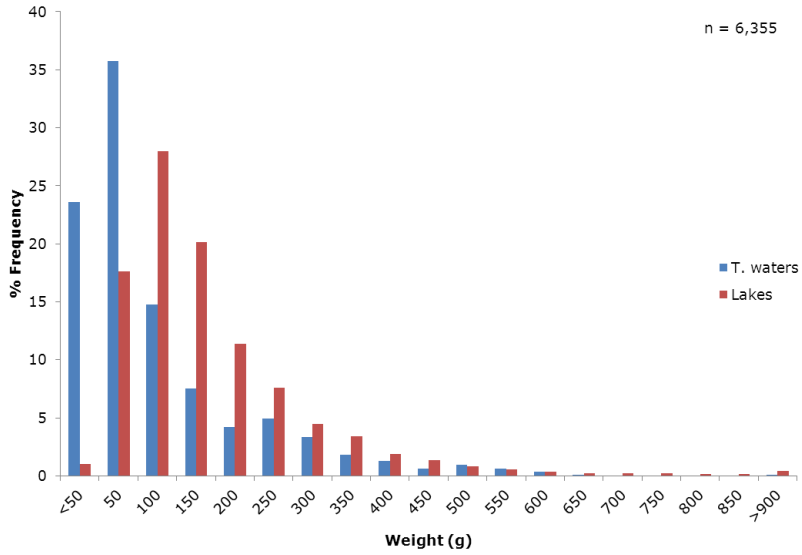


Figure 6-5 Weight frequency of yellow eels from transitional waters and lakes

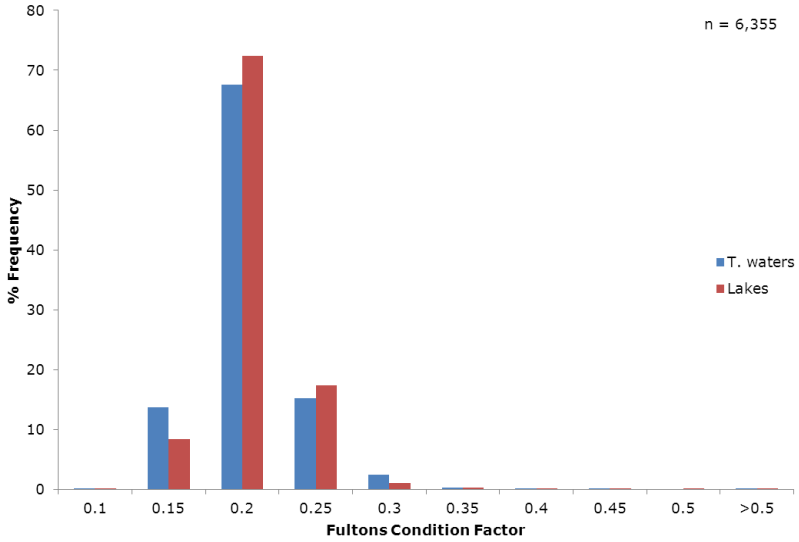


Figure 6-6 Frequency of Condition factor for yellow eels from transitional waters and lakes

6.4 Discussion

Three surveys carried out in the Barrow, Suir and Slaney transitional waters have highlighted the difficulty in carrying out fyke netting surveys in these habitats, the fyke nets can be disturbed by changing tides and by the wake of ships. On a number of occasions the nets were recovered tangled together as a result of these conditions. It is recommended that in future surveys, fyke nets are only set in sheltered areas away from main shipping channel due to the disturbance of the nets by boats and ships passing. Surveys should be planned during the neap tide periods to avoid large variations in water depth and strong currents during high tide. As eels captured in the main river channel could be undertaking migratory routes or have large home ranges, it is proposed to examine more sheltered areas to survey more resident yellow eels.

Moriarty (1978) suggested that eels prefer the narrow stretches of estuaries, EMP surveys have looked at both narrow river channels (Suir) and wider areas (Barrow, Slaney), however while the Suir and Barrow surveys recorded large catches, the Slaney had a very low catch of eels. Bozeman *et al.* (1985) suggested that eels in transitional waters have reduced movement due to the increased productivity of the area. To determine the extent of movement of eels between the freshwater and transitional waters, telemetry studies and otolith microchemistry analysis is recommended. Many studies have shown that eels utilise both freshwater and brackish water during their lifetime (Harrod *et al.,* 2005; Lamson *et al.,* 2006).Therefore we cannot consider transitional waters as separate entity to the freshwater habitat of eels without further research into the extent of seasonal migrations between the two habitats. Amilhat *et al.* (2008) reported that the Bages-Sigean lagoon produces 87% male eels, with the number of females increasing with the distance upstream, however a sample of 100 eels taken from the Barrow estuary in 2009 showed a ratio of female to male of 67:33.

Transitional waters have a higher production rate for eels and faster growth compared with freshwater habitats (Morrision *et al.,* 2003). This process of different maturation rates depending on habitat maybe a compensatory tactic to reduce the effect of a poor recruitment year on the silver eel migration numbers.

7 Comparison of current and historic yellow eel stocks

Extensive survey work was carried out on eels throughout Ireland from 1968 until the late 1990's by the Fisheries Research Centre (FRC). These surveys covered all water body types (rivers, lakes and transitional waters) and valuable time series were created. The raw data sheets were available to the Marine Institute and Inland Fisheries Ireland and a large section of this historical data was collated into a national eel database under the NDP 'Eel Plan' Project, (Anon, 2009). Objective 5 of the National Eel Management Plan is to compare current and historic yellow eel stocks and the FRC datasets will be used in this comparison.

The Fisheries Research Centre used Dutch fyke nets which were generally set in chains of 10 nets. The same nets were used under the Eel Monitoring Programme; however chains of 5 fyke nets were set rather than 10. In one instance, in a repeat survey carried out in Meelick Bay, Lough Derg in 2011, chains of 10 fyke nets were set to compare with the extensive survey carried out by the FRC from 1981 – 1994, also using 10 nets. A variation in CPUE over time could be a factor of the use of different crews to set and haul the nets.

7.1 Moy Catchment

7.1.1 Lough Conn

Lough Conn in the Moy catchment was surveyed under the eel monitoring programme in 2009. This lake had previously been surveyed by the Fisheries Research Centre in 1972 and again in 1988 (Moriarty, 1973; Figure 7-1). Historical and current length (cm) and weight (g) were available. Due to the non-normal distribution of biological data a non-parametric test was used to examine the length and weight between the three years of data.

7.1.1.1 CPUE

The historical CPUE data is not broken down into effort per net, therefore a worked up average is used for each night. As we have nightly catch data but not net data, preliminary statistics were performed on this data set. There was no significant difference in CPUE between 1972, 1988 and 2009 (p=0.098, Table 7-1)

7.1.1.2 Length

A Kruskal Wallis test showed that there was a significant difference in length between the years 1972, 1988 and 2009 (Table 7-2 & Figure 7-2). A post hoc Mann Whitney test showed a significant difference for two analyses, between the years 1972 and 2009 and between the years 1988 and 2009 (Table 7-3, bonferroni correction, $p<0.0017$). There was no significant difference in length for 1972 and 1988 (p=0.568). From the median and mean length it is clear that the length of eels caught in 2009 was greater than the length of eel's surveyed in 1972 or 1988.

7.1.1.3 Weight

The weight analysis was only carried out on the FRC 1972 data and the EMP 2009 data. There was a significant difference in weight between the years 1972 and 2009 (Table 7-4, Figure 7-3).

7.1.2 Summary

Overall, there was an increase in the length and weight of eels over the 37 year period. Further analysis using growth from the otoliths will give a clearer indication regarding the current condition of eels in the Moy catchment.

Table 7-1 Kruskal Wallis test for CPUE for Lough Conn

Year	Number	Mean	Median
1972	2	3.23	3.23
1988	3	6.56	5.92
2009	5	2.4	2.08
H	4.651		
df	2		
p	0.098		

Table 7-2 Kruskal Wallis test for length (cm)

Year	Number	Mean	Median
1972	84	39.6	38.2
1988	237	39.6	39.0
2009	504	46.5	45.2
H	151.266		
df	2		
p	<0.001		

Table 7-3 Post hoc Mann Whitney Test for length (cm)

Year	U	Sig	Bonferroni Correction	Effect Size
1972 v 2009	10,157	<0.001	<0.017	-0.3
1988 v 2009	29,717	<0.001	<0.017	-0.4
1972 v 1988	9,537	0.568		0.03

Table 7-4 Mann Whitney test for Weight (g)

Year	Number	Mean	Median
1972	84	117	100
2009	504	191	153
U	10,683		
r	0.3		
p	<0.001		

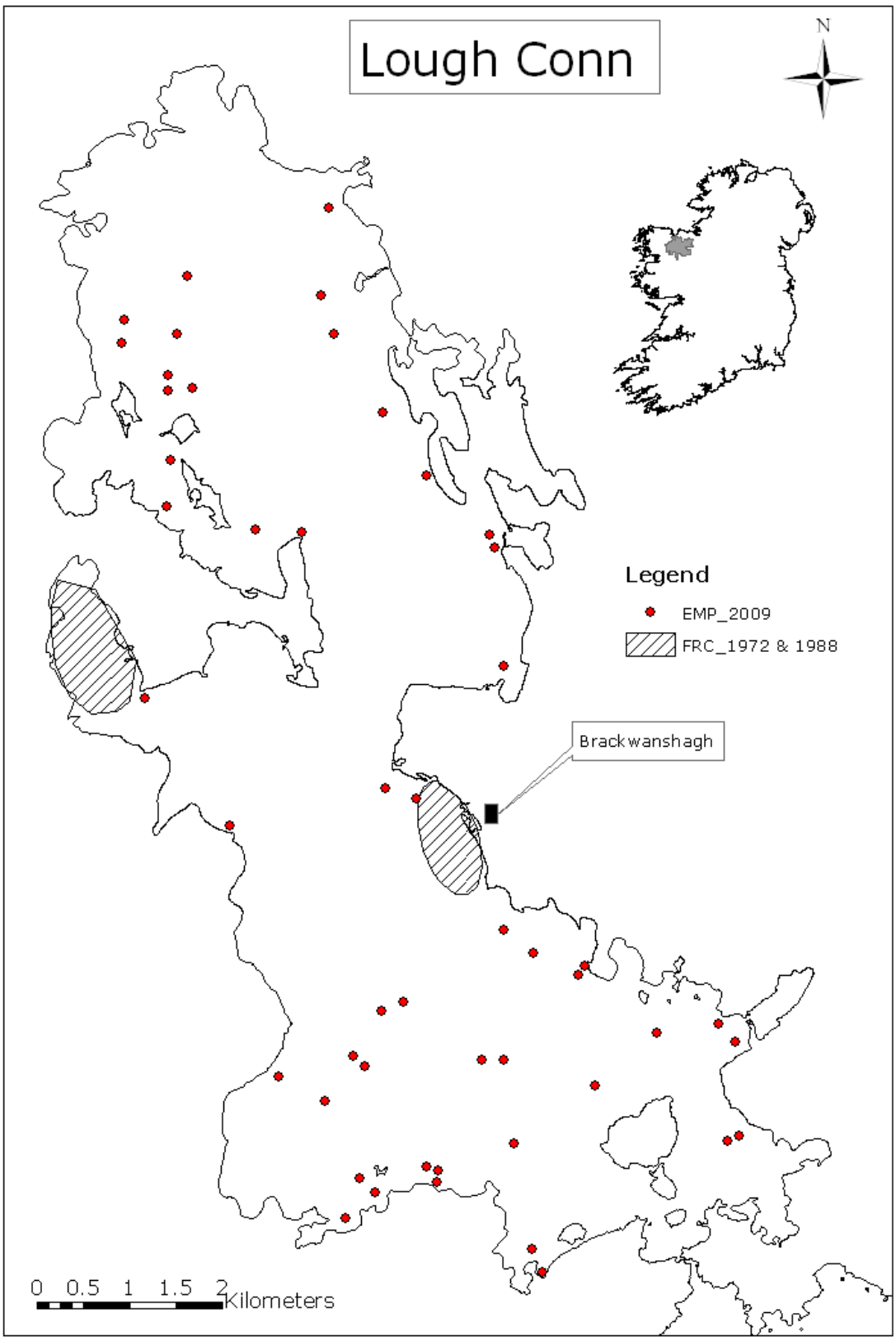


Figure 7-1 Location of FRC survey sites in 1972, 1988 and IFI sites in 2009 in L. Conn

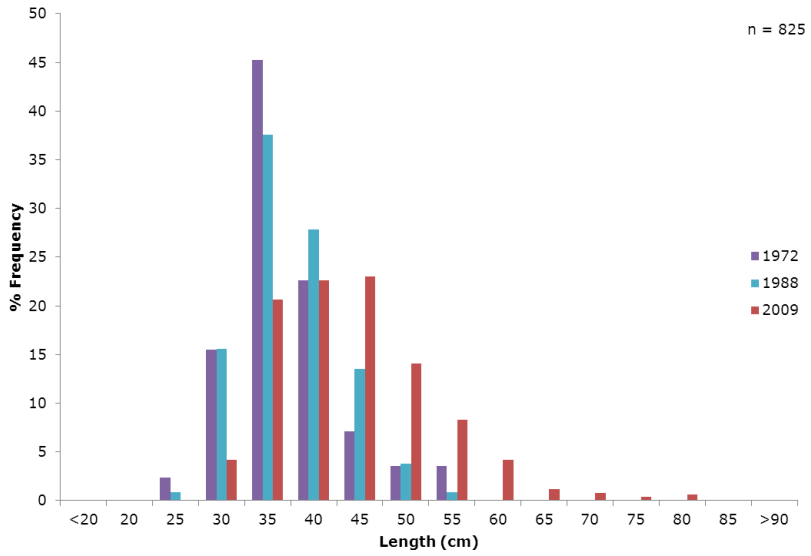


Figure 7-2 Length frequency of yellow eels from 1972, 1988 and 2009 in Lough Conn

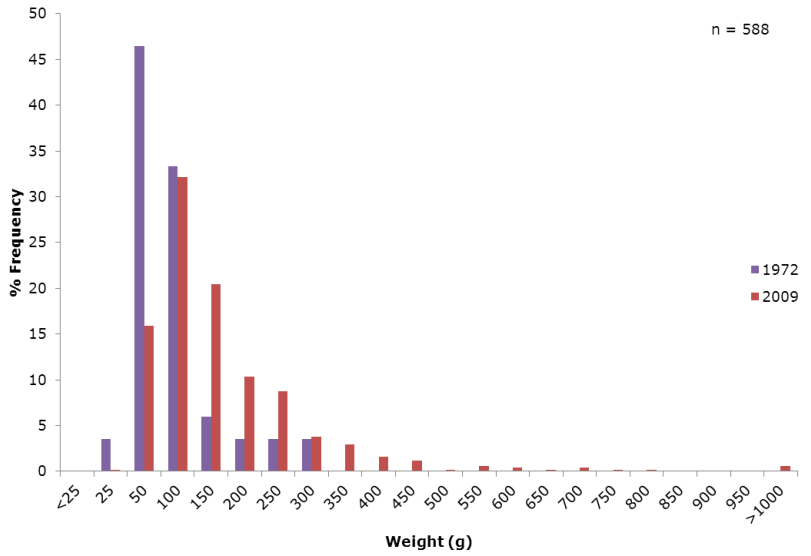


Figure 7-3 Weight frequency of yellow eels caught in Lough Conn

7.2 Corrib catchment

7.2.1 Lower Lough Corrib

Lower Lough Corrib was surveyed by the Fisheries Research Centre in 1969, 1985, 1989, 1990 and by the Eel monitoring programme in 2009 (Moriarty, 1972, 1992; Figure 7-4). Length and weight data were only available for 1969 and 2009. Due to the non-normal distribution of biological data non-parametric statistics were used.

7.2.1.1 CPUE

For the historical data, only worked up CPUE's are available, these values are from netting surveys spread out over the season. There can be a lot of variation in the catch of eels per chain and per night, as this variation is not available, no statistics was performed on this data set. The summary CPUE data are presented in Table 7-5, the value found for 2009 is lower than previous surveys.

7.2.1.2 Length

Length data was the only parameter available to date for the four time periods (Figure7-5). For comparison with the weight data a Mann Whitney test was carried out to determine if there was a difference in the length of eels captured over two time periods (FRC_1969 and EMP_2009). A significant difference was detected by the test ($p<0.001$; Table 7-6), with the eels caught in EMP_2009 having a greater median length than the eels captured in FRC_1969. The fyke net surveys carried out by the FRC captured smaller eels in the 30-40 cm size class which were not present in the EMP_2009 surveys. Moriarty's report in 2001 stated that 'medium sized and large eels were more plentiful in 1990 than in 1967 while small specimens were fewer'. The 2009 survey concurs with this statement. It must be taken into account that while the fyke nets target the larger eels generally missing the <30 cm eels, these eels were caught in the fyke nets used in 1969 and in fykes set in transitional waters. This is probably indicative of the low recruitment in recent years.

7.2.1.3 Weight

A Mann Whitney test was used to compare the weight of eels from FRC_1969 and EMP_2009. A significant difference in weight was found ($p<0.001$; Table 7-7). The median weight of EMP_2009 was higher than the median weight of FRC_1969, while the average weights were not very different; the median weight is a more accurate description of the statistics used.

Table 7-5 Fisheries Research Centre surveys of Lower Lough Corrib in 1969 and 1990 and the Eel monitoring programme surveys in 2009

Group	Year	No eels	No nets	CPUE
FRC	1969	458	288	1.59
	1985	93	58	1.60
	1989	152	82	1.85
	1990	1,172	615	1.90
EMP	2009	300	314	1.05

Table 7-6 Mann Whitney test for length (cm)

Year	No. Eels	Mean	Median
1969	301	44.0	42.3
2009	324	46.0	46.0
U	35,488		
r	0.24		
p	<0.001		

Table 7-7 Mann Whitney test for weight (g)

Year	No. Eels	Mean	Median
1969	301	183	127
2009	324	172	157
U	37,785		
r	0.2		
p	<0.001		

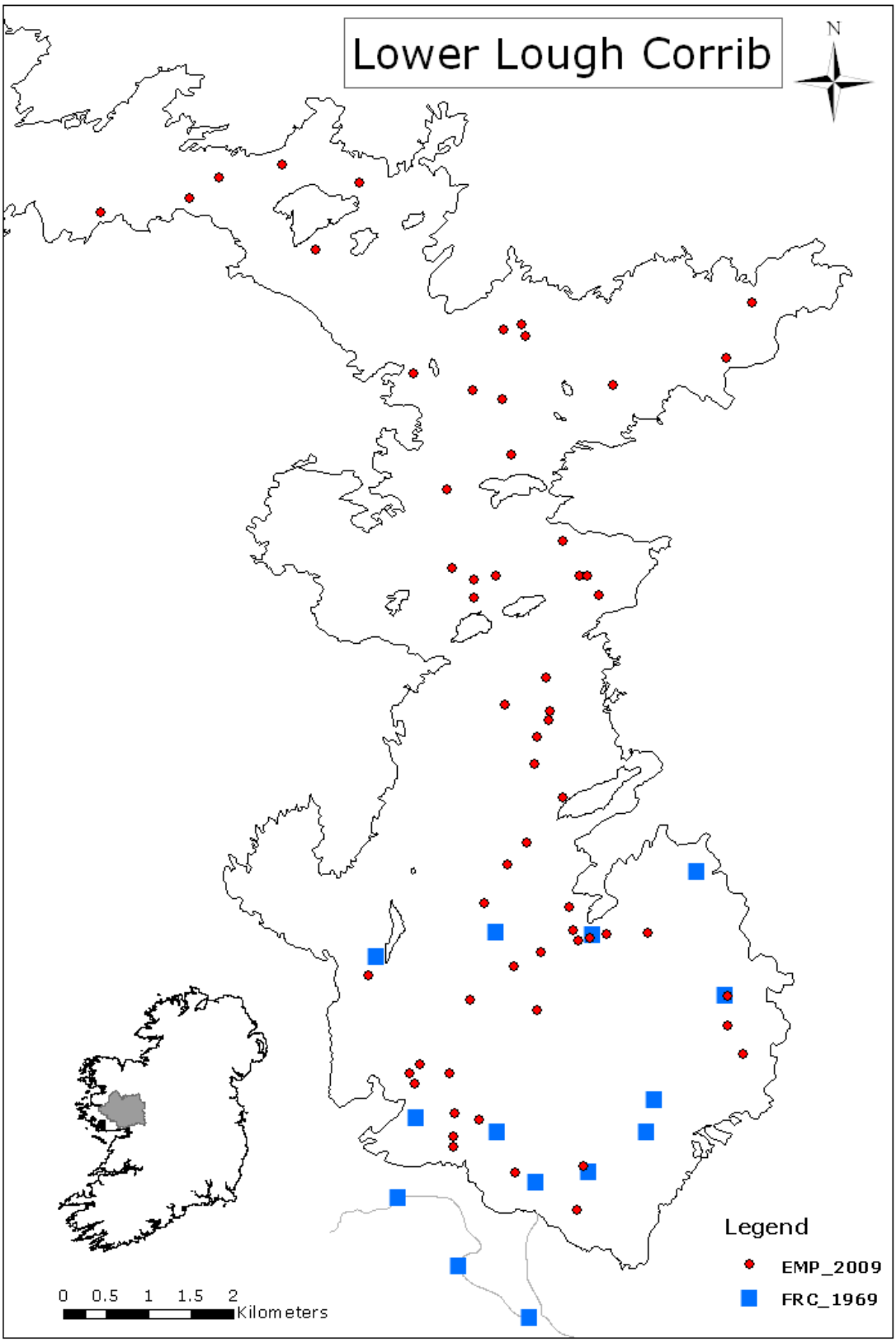


Figure 7-4 Net locations for surveys carried out in Lower L. Corrib 1969 and 2009

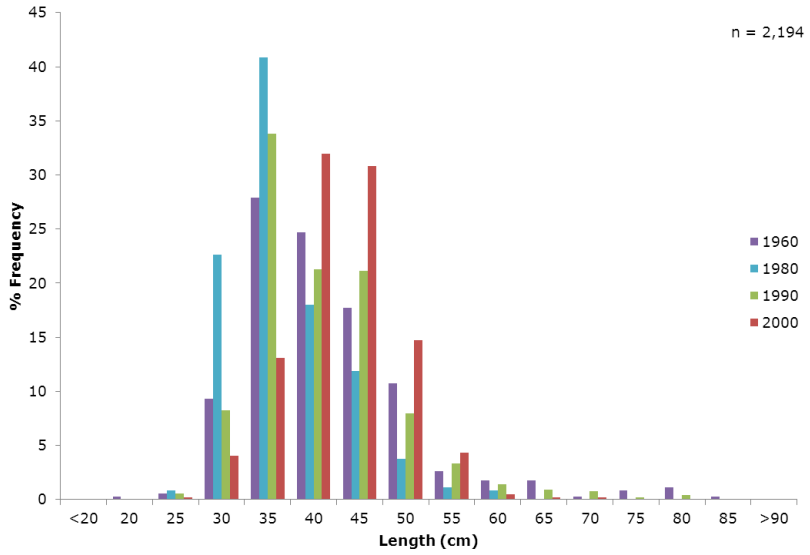


Figure 7-5 Length frequency for Lower Lough Corrib, grouped by decade

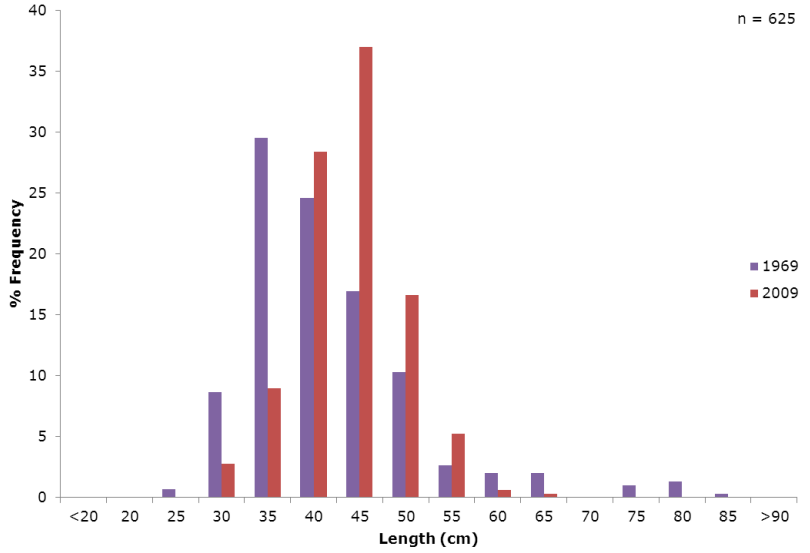


Figure 7-6 Length frequency for Lower Lough Corrib, 1969 and 2009

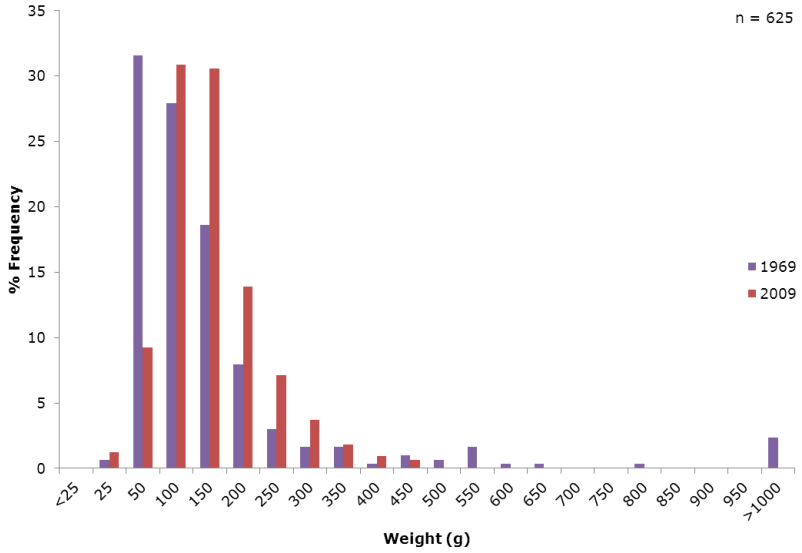


Figure 7-7 Weight frequency for Lower Lough Corrib, 1969 and 2009

7.2.2 Upper Lough Corrib

Upper Lough Corrib was surveyed by the Fisheries Research Centre in 1967, 1968, 1990 and by the Eel Monitoring Programme in 2010 (Figure 7-8). CPUE, length and weight is available for 1967, 1968 and 2010; only length data is available for the 1990 surveys (Table 7-8).

Table 7-8 Catch per unit of effort for the Fisheries Research Centre and Eel Monitoring Programme Surveys

Group	Year	Av. CPUE	Mdn CPUE	Min CPUE	Max CPUE
FRC	1967	1.447	1.00	0	8.33
	1968	1.077	0.667	0.20	5.50
	1960's	1.373	0.833	0	8.33
EMP	2010	1.570	1.40	0	6.0

7.2.2.1 CPUE

A Mann Whitney test to examine the relationship between CPUE from the two surveys in the late sixties to the current survey was undertaken. A significant difference was found ($p<0.05$, Table 7-9). The average CPUE for Upper Lough Corrib was greater in 2010 than in the 1967 and 1968 surveys.

7.2.2.2 Length

A Mann Whitney test comparing length of eels from the sixties to the present showed a significant difference in length ($p<0.001$, Table 7-10, Figure 7-9). The 2010 surveys had a higher average length to the eels captured in the '60's.

7.2.2.3 Weight

A Mann Whitney test comparing the weight of eels from the sixties to the present showed a significant difference in length ($p<0.001$, Table 7-11, Figure 7-10). The 2010 surveys had a higher average weight to the eels captured in the '60's.

Table 7-9 Mann Whitney statistics for CPUE

Year	No. surveys	Mean	Median
1967/8	106	1.373	0.833
2010	60	1.570	1.40
U	2,485		
r	0.2		
p	<0.05		

Table 7-10 Mann Whitney statistics for Length (cm) of eels in Upper Lough Corrib

Year	No. Eels	Mean	Median
1967/8	1,147	43.2	42.0
2010	443	50.1	48.9
U	136,356		
r	0.4		
p	<0.001		

Table 7-11 Mann Whitney statistics for weight (g)

Year	No. Eels	Mean	Median
1967/8	1,147	180	124
2010	443	223	190
U	153,472		
r	0.3		
p	<0.001		

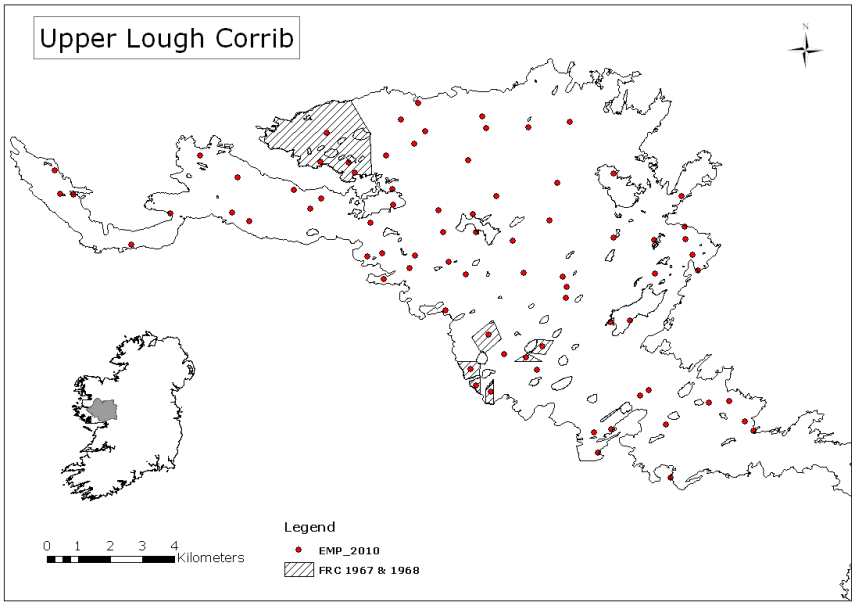


Figure 7-8 Locations of fyke nets in Upper Lough Corrib

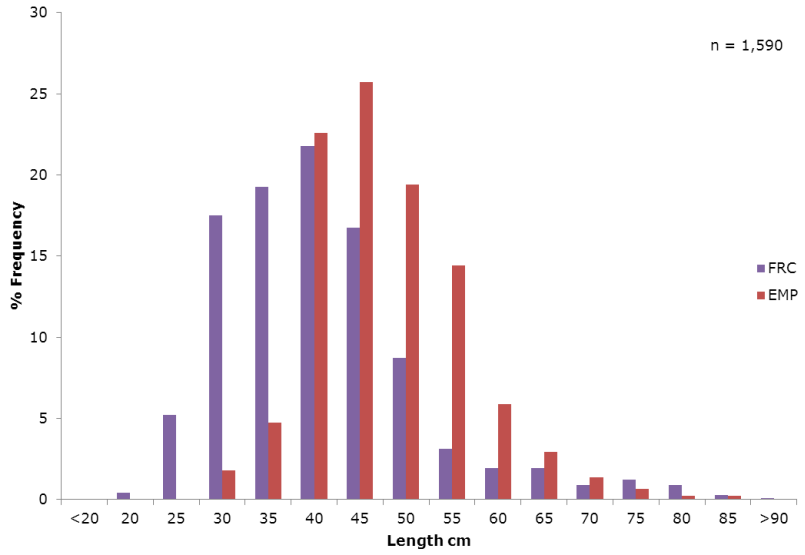


Figure 7-9 Length frequency of eels from the 1960's FRC surveys and the 2010 EMP surveys for Upper Lough Corrib

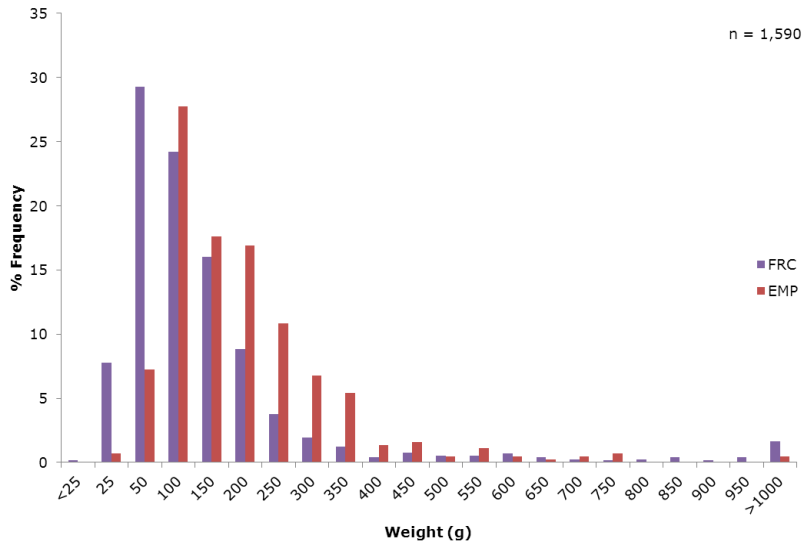


Figure 7-10 Weight frequency for eels from the FRC 1960's surveys and the current 2010 survey for Upper Lough Corrib

7.2.3 Summary Corrib catchment

In general there was an increase in the length and weight of eels captured in the surveys of 2009 and 2010 when compared with the surveys from the 1960's. The absence of smaller eels in the fyke nets of 2009 is a concern and should be investigated further. Fyke nets are size selective and smaller eels are not a target size class however small eels were caught in the 1960s in the fyke nets and are also caught in the transitional waters in fyke nets. Therefore if the eels were present it is felt that a number of them would have been observed over the course of the surveys. Naismith and Knights (1990) report that small eels are usually caught by fyke nets and there absence in the catch could indicate the absence of this life stage within the water body.

7.3 Fergus Catchment

7.3.1 Lough Inchiquin

Lough Inchiquin was surveyed by the Fisheries Research Centre between July 11th and August 9th1968 and by IFI in June and August 2011. A similar catch per unit of effort was found for the worked up values for the lakes in the two time periods (Table 7-12). Detailed nightly catch records are not available for the 1968 data; therefore no statistics was carried out on the CPUE.

7.3.1.1 Length

Length data was available for 1968 and 2011. A Mann Whitney test showed a significant difference in length between the two time periods with a higher average length of eels caught in 2011 compared with 1968 (Table 7-13).

Table 7-12 Catch per unit of effort for Lough Inchiquin

Group	Year	No. Net*Nights	No. Eels	CPUE
FRC	1968	72	164	2.28
EMP	2011	250	548	2.19

Table 7-13 Mann Whitney statistics for Length (cm) of eels in Lough Inchiquin

Year	No. Eels	Mean	Median
1968	233	43.3	40.1
2010	548	52.5	52.5
U	21,395		
r	0.53		
p	<0.001		

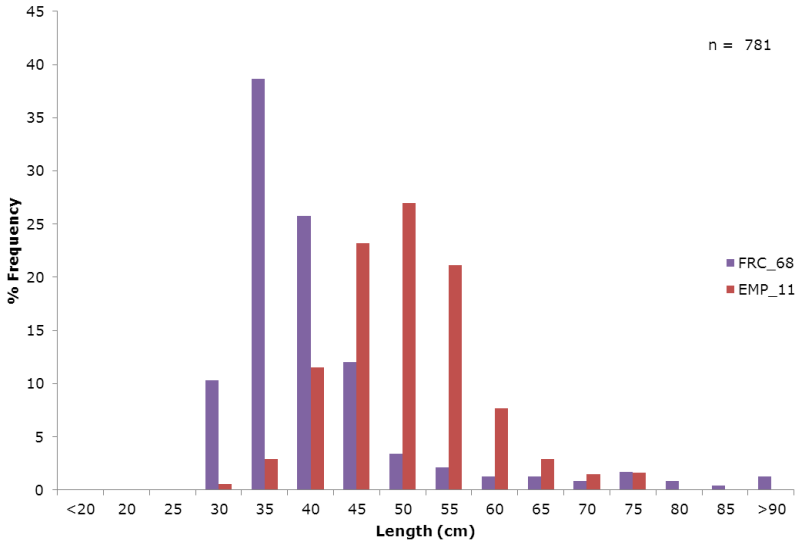


Figure 7-11 Length frequency of eels from the 1980's FRC surveys and the 2010 EMP surveys for Lough Inchiquin

7.4 Shannon Catchment

7.4.1 Lough Ree

Lough Ree was surveyed by the Fisheries Research Centre in 1969, 1982, 1983, 1986 and by IFI in 2010 (Figure 7-12). CPUE data is available for FRC_1986 and EMP_2010 surveys (Table 7-14). No statistics were carried out on the data as only one night was fished in 1969 and two nights were fished in 1986. Moriarty (1987) reports the highest catch recorded for fyke nets in Lough Ree at Lanesborough where 466 eels were caught in one chain of nets. This is represented by the high CPUE for Lough Ree for 1986. The large CPUE reported by Moriarty in 1987 was also recorded in a survey by NUIG in the 1990's (T.K. McCarthy, personal communication). It is possible that this clustering of eels could be due to local enrichment or a behavioural response to migration or presence of a food source.

7.4.1.1 Length

Length data is available for 1982, 1983 and 2010. A non-parametric Mann Whitney test was carried out. There was no significant difference in the length of eels from the FRC_1980's data and EMP_2010 (Table 7-15, Figure 7-13). The sample size for the 1980's data is smaller than the 2010 data.

Table 7-14 Catch per unit of effort for Lough Ree

Group	Year	No. Net*Nights	No. Eels	CPUE
FRC	1969	24	16	1.5
FRC	1986	20	475	23.75
EMP	2010	570	850	1.49
WFD	2010	36	114	3.17

Table 7-15 Mann Whitney statistics for Length (cm) of eels in Lough Ree

Year	No. Eels	Mean	Median
1980's	251	48.9	47.2
2010	894	46.9	46.0
U	103,122		
r	0.06		
p	0.05		

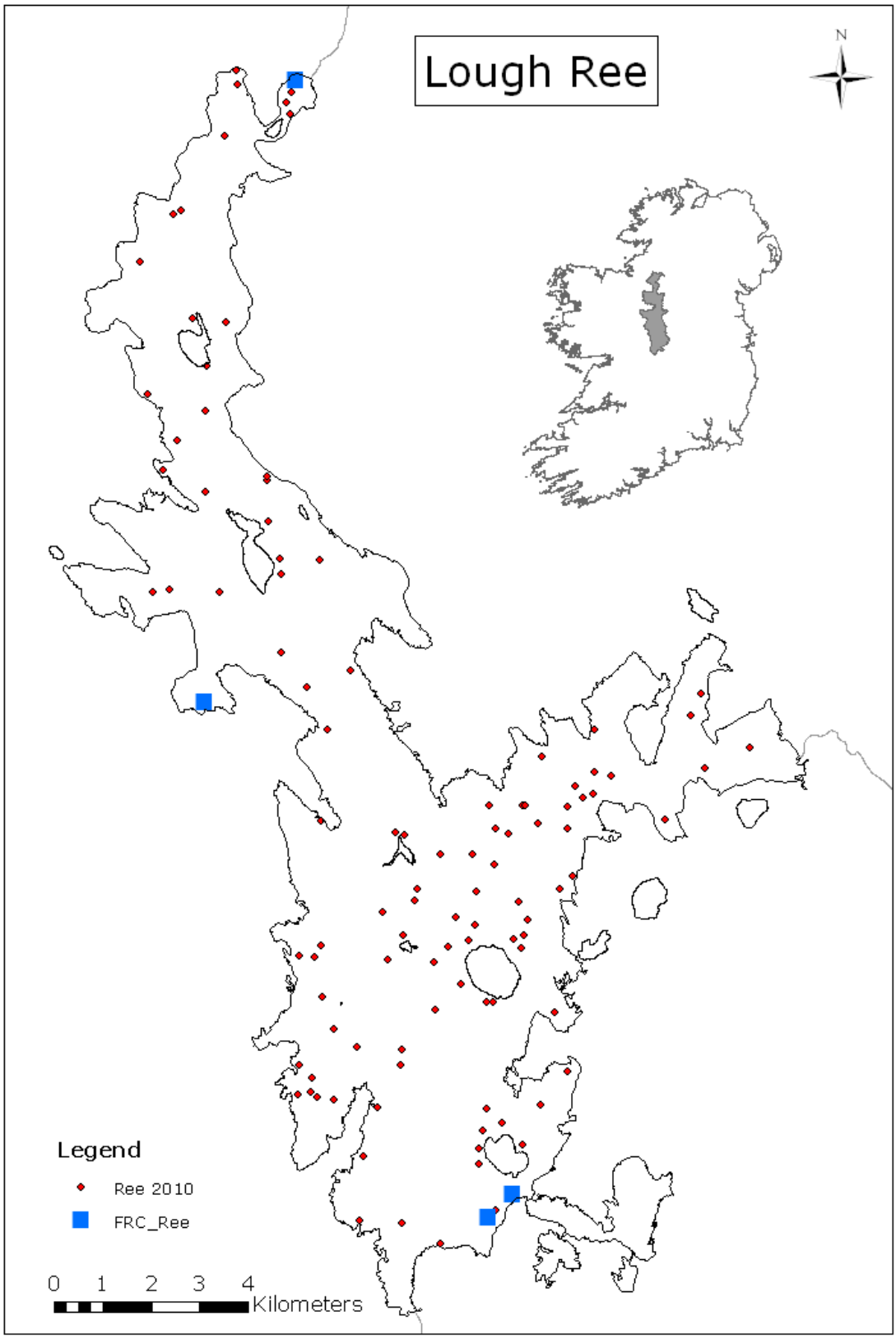


Figure 7-12 Locations of surveys on Lough Ree

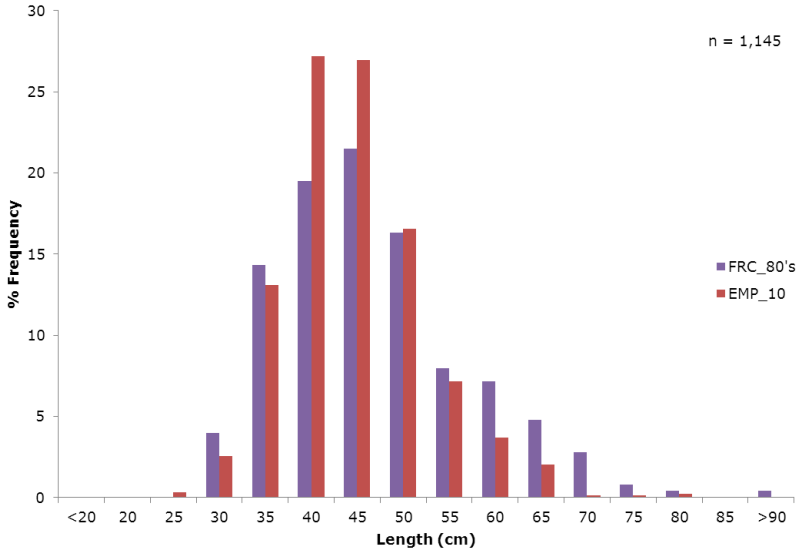


Figure 7-13 Length frequency of eels from the 1980's FRC surveys and the 2010 EMP surveys for Lough Ree

7.4.2 Lough Derg

The Fisheries Research Centre surveyed Meelick Bay in Lough Derg from 1981 – 1992 using chains of 10 fyke nets (Figure 7-14; Moriarty, 1996). Inland Fisheries Ireland surveyed Lough Derg in 2009 and 2010 using chains of 5 fyke nets and Meelick bay in 2011 using chains of 10 fyke nets. Catch per unit of effort is available for these years 1981-1988, 2009 – 2011 (Table 7-16). Only FRC surveys carried out between June and September were used in the analysis to compare with the survey period of EMP.

7.4.2.1 CPUE

A non-parametric Kruskal Wallis test on the worked up CPUE over time was carried out and no significant difference was detected (p=0.440). It should be noted that the 2 years of the EMP surveys used chains of 5 instead of chains of 10. When the individual net CPUEs are analysed between the 2 groups (FRC and EMP) there was no significant difference (Mann Whitney p= 1.00, Table 7-17)

7.4.2.2 Length

To analyse length data, the data was pooled into two groups, the FRC data and EMP data. There was a significant difference in length of eels from 1980's and 2000's with the 2000's eel having a higher average length than the eels from 1980's, however the effect size is low (p< 0.001, r = 0.1; Table 7-18 and Figure 7-15).

7.4.2.3 Weight

There was also a significant difference in weight between the decades with larger average eels in 2000s compared with the 1980's (Table 7-19, Figure 7-16).

Table 7-16 Catch per unit of effort for Lough Derg

Group	Year	Eels	net*nights	CPUE
FRC	1981	478	210	2.276
	1982	1039	300	3.463
	1983	830	320	2.594
	1984	1159	450	2.576
	1985	1255	520	2.413
	1986	927	380	2.439
	1987	941	340	2.768
	1988	744	280	2.657
EMP	2009	669	290	2.307
	2010	771	255	3.024
	2011	856	220	3.891

Table 7-17 Mann Whitney analysis of selected CPUE between 1980 and 2000

Year	No. Surveys	Mean	Median
1980's	280	2.633	1.8
2000's	131	2.85	2.2
U	16,494		
r	0.08		
p	1.0 ns		

Table 7-18 Mann Whitney statistics for Length (cm) of eels in Lough Derg

Year	No. Eels	Mean	Median
1980's	2,327	42.8	41.8
2000's	2,125	44.2	43.5
U	2,145,011		
r	0.115		
p	<0.001		

Table 7-19 Mann Whitney statistics for Weight (g) of eels in Lough Derg

Year	No. Eels	Mean	Median
1980's	2,327	158	128
2000's	2,125	167	144
U	2,151,653		
r	0.112		
p	<0.001		

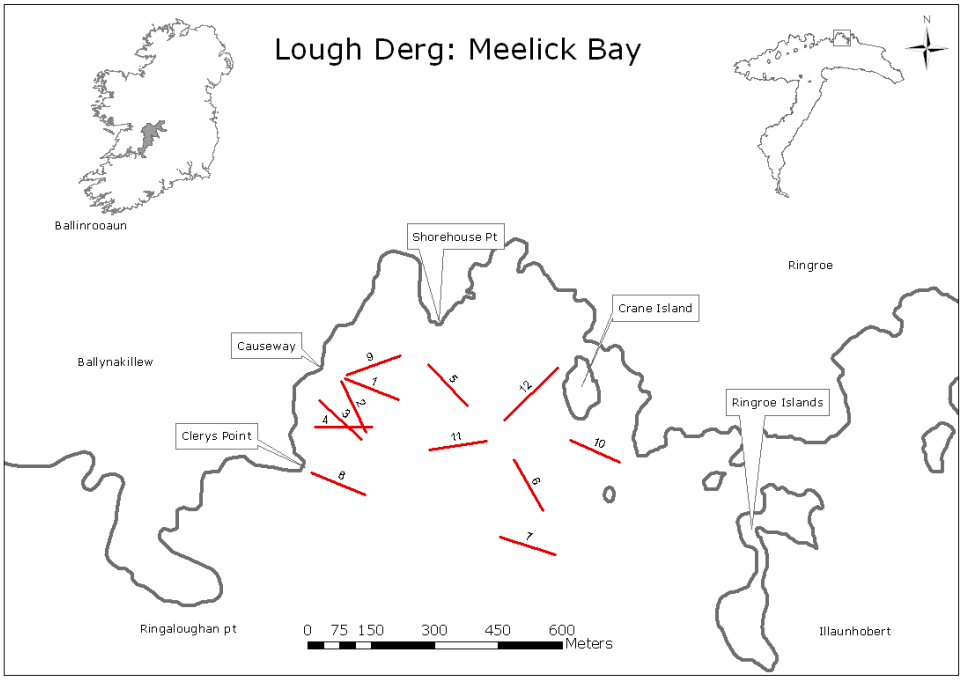


Figure 7-14 Locations of surveys sites for Meelick Bay, Lough Derg

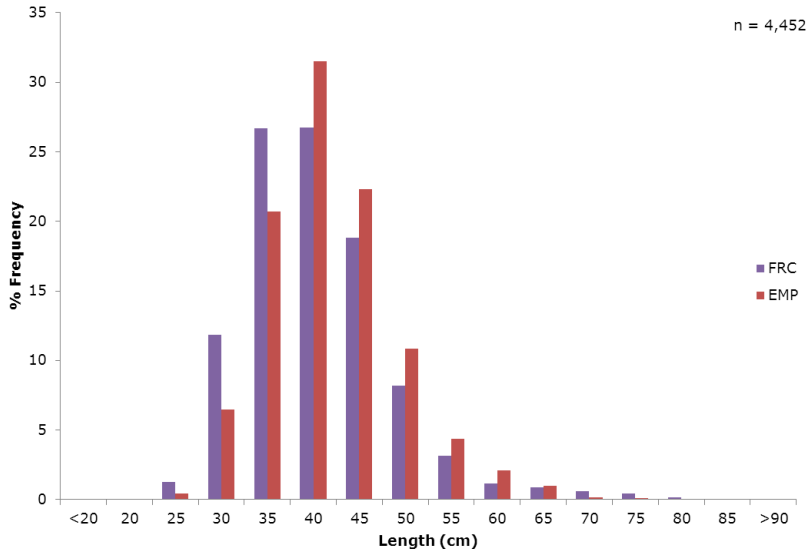


Figure 7-15 Length frequency of eels from Lough Derg

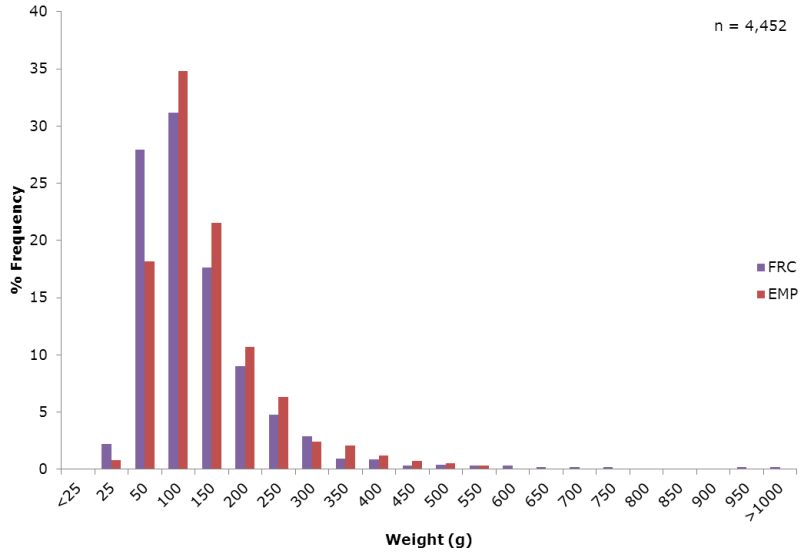


Figure 7-16 Frequency of weight from Lough Derg

7.4.3 Summary Shannon Catchment

There is a significant difference in length and weight of eels from the current surveys and from the surveys of the FRC_1980's and FRC_1960's; with an increase in the length of eels for Lough Derg. For Lough Derg, this comparison is for illustrative purposes only. The EMP surveyed the whole of Lough Derg and Meelick Bay, the FRC study was concentrated in Meelick bay only. It is proposed to continue monitoring this bay over the coming years to allow a more accurate comparison with the historical Meelick Bay study. In 2001, commercial fishing in Lough Derg was restricted as a stock conservation measure with effort shifting to the upper catchments therefore the eel population is Lough Derg has been protected for 8 years longer than the eel population of Lough Ree.

7.5 South Sloblands

The South Sloblands in Wexford harbour were intensively surveyed in the 1970's and high catches were recorded for this productive coastal lagoon habitat. The lake was surveyed in 1970, 1971, 1973, 1974 and 1975 collecting data on length, weight, sex and CPUE (Moriarty, various reports).

Chains of 10 fyke nets were set in the early surveys, whereas the EMP set chains of 5 fyke nets. In 2010 the South Sloblands was fished for one night using two chain lengths. Two chains were set with 10 nets and 2 chains were set with 5 nets. The location of nets was randomly assigned using the trap builder tool in Density 4.4 (Efford, 2009), the number of nets per chain for the net location was assigned using a random number tables.

In total 24 eels were caught in 30 net nights in 2010 giving a catch per unit of effort of 0.8 (Table 7-20). The CPUE from 2010 is low compared with the historical values recorded for the area. The South Sloblands were intensively commercially fished in 1971. In the following years a recovery of the stock was observed with the increase in CPUE from 1972 to 1975 (Table 7-20; Moriarty, 1976).

Due to the availability of historical data from the Fisheries Research Centre it is proposed to repeat this survey over the next three year monitoring programme.

Table 7-20 Catch details of the South Sloblands survey

Year	Net Number	No. Eels	Net* Nights	CPUE
2010	1	9	10	0.9
2010	2	1	5	0.2
2010	4	1	5	0.2
2010	5	13	10	1.3
2010	Total	24	30	0.8
1970	Total	752	48	15.7
1972	Total	15	54	0.3
1973	Total	457	96	4.8
1974	Total	157	24	6.5
1975	Total	234	16	14.6

8 Transboundary Catchments

An Erne Eel Enhancement programme was carried out from 1998 – 2000 covering the entire Erne catchment. The aim of the programme was to maximise recruitment of glass eel and elver to the Erne; determine the current status of eel stocks and ascertain the potential for increased exploitation and to develop a cross-border management plan for the Erne eel fishery. Under this programme detailed records of the catches of yellow and silver eels were kept. A detailed stock assessment was carried out using this data.

Upper Lough Erne and Lough Oughter were surveyed under the Eel Monitoring Programme 2009-2011. The aim was to compare the current stock status with that reported in the Eel Enhancement Programme a decade earlier. Historical data is also available as the Fisheries Research Centre surveyed Upper Lough Erne in 1972, and in 1968 surveyed Lough Oughter.

8.1 Upper Lough Erne

In June and August 2010, Upper Lough Erne was surveyed by IFI and Department of Culture, Arts and Leisure (DCAL). Fyke nets were set with random net location (Figure 8-1). In 2011, AFBI contracted ex-commercial fishermen to fish Upper Lough Erne in July 2011. Table 8-1 shows the summary CPUE values for the different surveys.

8.1.1 CPUE

A Kruskal –Wallis test was carried out on the CPUE's. A significant difference in CPUE was found (Table8-2, $p < 0.001$). A post hoc Mann Whitney test showed a difference between the AFBI CPUE which was higher than the Erne Eel Enhancement Programme ($U = 30$, $p < 0.01225$, Table 8-3). The Erne Eel Enhancement programme had a higher CPUE than the scientific survey carried out by the IFI eel monitoring programme ($U = 499.5$, $p < 0.01225$). The two scientific surveys carried out by IFI in 2010 and by FRC in 1972 had no significant difference in CPUE ($U = 92$, $p = 0.436$ ns). However it must be noted that during the summer 2010 the growth of the invasive weed Nuttall's Pond weed (*Elodea nuttallii*) caused some difficulty and could be responsible for the lower catch rates for this period.

8.1.2 Length

A non-parametric Kruskal Wallis test was carried out on the length data from the four groups. A significant value was returned ($p<0.001$, Table 8-4; Figure 8-2). A post hoc Mann Whitney test was carried out. The median length of eels was greater for the EMP_2010 and AFBI_ 2011 compared with the Eel Enhancement programme ($p< 0.01225$, Table 8-5). There was no difference between the EMP_2010 and the FRC_1972 ($p = 0.818$ ns). There was also no significant difference in length between EMP and AFBI ($p=0.219$ ns, Table 8-5).

8.1.3 Weight

A similar result was found for the weight of eels as for the lengths, a significant difference was detected for weight over the four organisations survey periods (Table 8-6, Figure 8-3). A post hoc Mann Whitney test between the EMP_2010 and AFBI_2011 had no significant difference between median weight (Table 8-7). There was also no significant difference between the EMP_2010 and the FRC_1972. The Eel Enhancement programme weight was significantly less than both the EMP_2010 and the AFBI_2011.

Table 8-1 CPUE values for Upper Lough Erne

Group	No. Nights	No. Eels	Av. CPUE	Mdn. CPUE	Min. CPUE	Max. CPUE
Enhanc_P_ 1998/99	3,745	14,527	4.065	3.68	0.40	10.10
IFI_2010	300	493	1.643	1.40	0	6.20
AFBI_2011	100	850	8.500	7.0	3.0	16.40
FRC_1972	144	138	0.969	1.0	0.35	1.52

Table 8-2 Kruskal Wallis Test for CPUE

Group	Year	Number	Mean	Median
FRC	**1972**	4	1.0	0.969
EEP	**1998/99**	62	3.68	4.065
EMP	**2010**	60	1.4	1.643
AFBI	**2011**	20	7.0	8.5
	H	78.133		
	df	3		
	p	<0.001		

Table 8-3 Post hoc Mann Whitney statistics for CPUE

Group	U	p	Bonferroni Correction	Effect Size	sig
EEP v EMP	500	<0.001	<0.0125	0.63	sig
FRC v EMP	92	0.436		0.1	ns
EEP v AFBI	206	<0.001	<0.0125	0.5	sig
EMP v AFBI	30	<0.001	<0.0125	0.7	sig

Table 8-4 Kruskal Wallis statistics for length (cm)

Group	Year	Number	Mean	Median
FRC	**1972**	72	49.53	47.25
EEP	**1998/99**	1,855	44.2	42.4
EMP	**2010**	500	49.0	48.8
AFBI	**2011**	50	50.26	50.1
	H	219		
	df	3		
	p	<0.001		

Table 8-5 Post hoc Mann Whitney statistics for length (cm)

Group	U	p	Bonferroni Correction	Effect Size	sig
EEP v EMP	283,126	<0.001	<0.0125	-0.3	sig
FRC v EMP	17,698	0.818		0.01	ns
EEP v AFBI	23,468	<0.001	<0.0125	0.14	sig
EMP v AFBI	11,184	0.219		0.05	ns

Table 8-6 Kruskal Wallis statistics for weight (g)

Group	Year	Number	Mean	Median
FRC	**1972**	72	230	178
EEP	**1998/99**	1,855	204	150
EMP	**2010**	500	222	193
AFBI	**2011**	50	240	240
	H	59.95		
	df	3		
	p	<0.001		

Table 8-7 Post hoc Mann Whitney statistics for weight (g)

Group	U	p	Bonferroni Correction	Effect Size	sig
EEP v EMP	372,632	<0.001	<0.0125	-0.1	sig
FRC v EMP	17,572	0.744		0.01	ns
EEP v AFBI	30,992	<0.001	<0.0125	0.1	sig
EMP v AFBI	10,619	0.079		0.1	ns

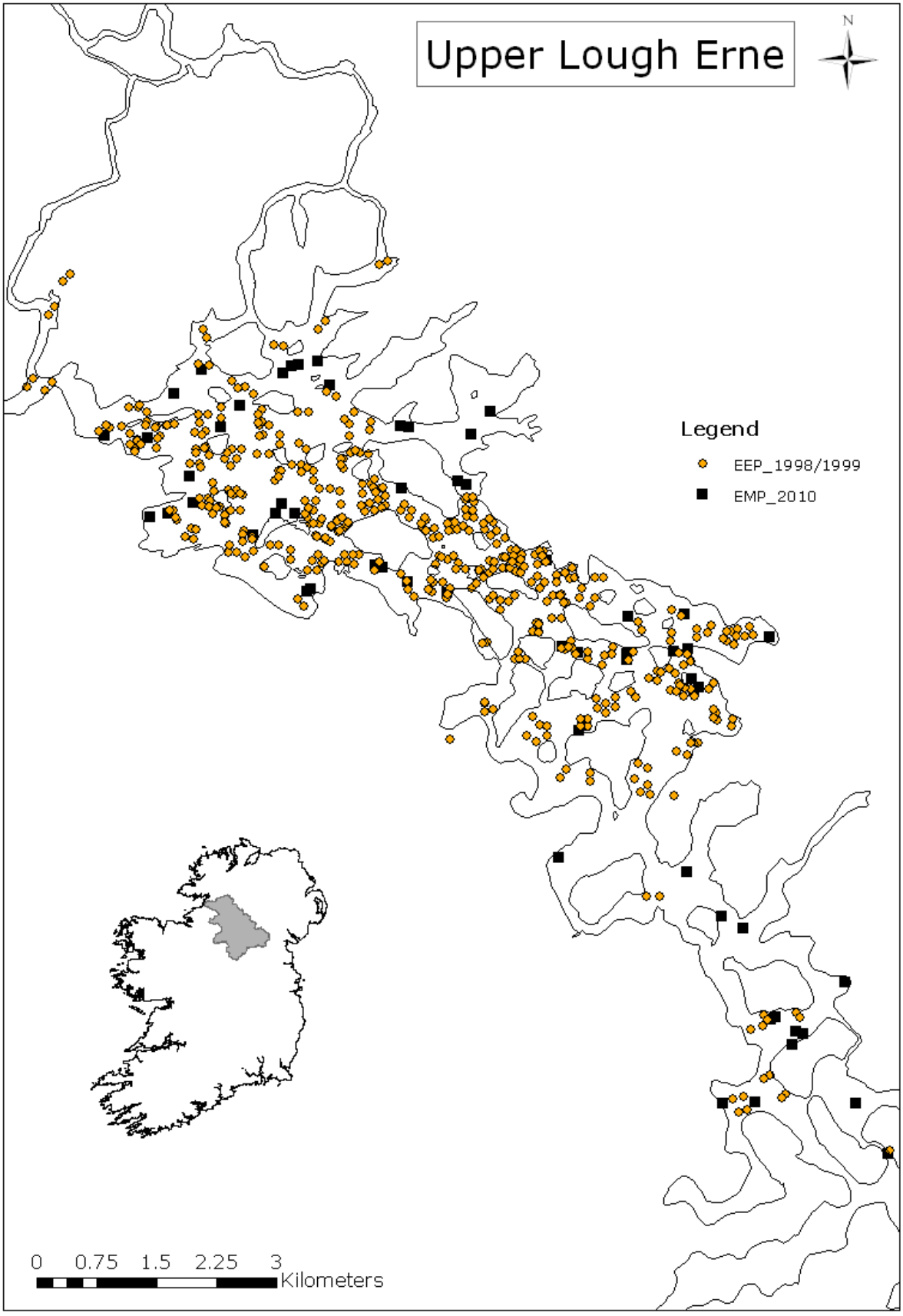


Figure 8-1 Locations of sampling for EEP and EMP programmes

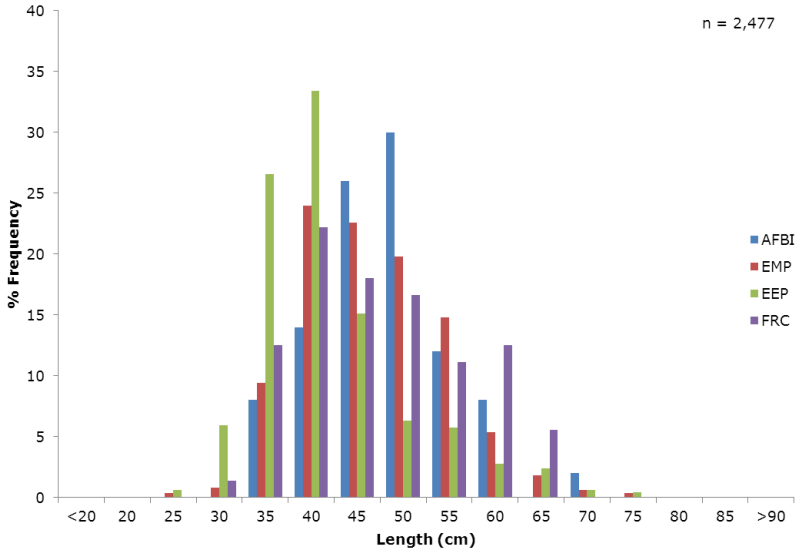


Figure 8-2 Length frequency for Upper Lough Erne

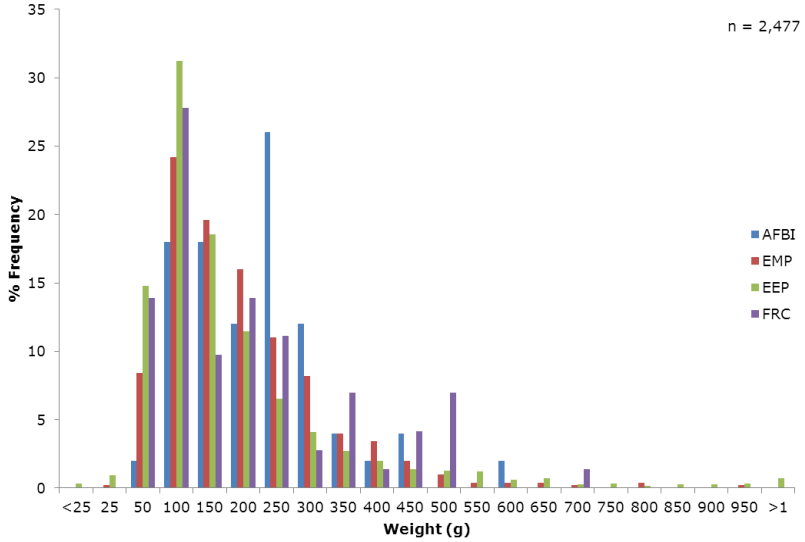


Figure 8-3 Weight frequency for Upper Lough Erne

8.2 L. Oughter

In 2011, Lough Oughter was surveyed by IFI as part of the Eel Management plan 2009- 2011 (Figure 8-4). This lake was also sampled during the Erne Eel Enhancement Programme 1998 – 2000 (Figure 8-4). Lough Oughter was also fished by the Fisheries Research Centre in 1968, however only worked up data is available and was not included in the statistical analysis.

8.2.1 CPUE

A Mann Whitney test was carried out on the CPUE of the Eel Monitoring Programme, and Erne Enhancement programme. As there was only worked up values for the Fisheries Research Centre this data was removed from the analysis. There was a significant difference between CPUE values for the two groups, with the Enhancement programme having a larger CPUE than the EMP programme (Table 8-8). The CPUE for the EMP was the lowest recorded for the 3 year programme.

8.2.2 Length

A Mann Whitney test to compare the length of eels between the two groups (EMP and EEP) showed no significant difference (Table 8-9, Figure 8-5). However the sample size for the EMP 2010 is smaller than other analyses carried out (n = 282).

8.2.3 Weight

A significant difference in weight was detected for the two groups with the EEP having a greater median weight than the current study (Table 8-10, Figure 8-6).

8.3 Summary Erne catchment

The highest CPUE was found in the 1998 /99 period for both Lough Oughter and Upper Lough Erne. The length for the 2000 data is higher than the 1998/99 for Upper Lough Erne. However for Lough Oughter the 1998/99 programme had the significantly higher weight but there was no significant difference between 1998/99 and 2010 for the length of eels. Both Upper Lough Erne and Lough Oughter were stocked with elvers from 1993 to 2000 in order to develop the fishery in the Erne catchment. As a result of this stocking the low CPUE for the fyke nets in Lough Oughter was not expected. It is recommended to repeat these two surveys over the coming years in order to carry out a more complete comparison with the Erne Eel Enhancement Programme, which was an intensive three year programme.

Table 8-8 Mann Whitney statistics for CPUE for L. Oughter

Group	n	Av. CPUE	Mdn. CPUE
EEP	368	1.425	1.00
EMP	60	0.0987	0.0800
U	13,881		
R	0.1		
p	<0.05	sig.	

Table 8-9 Mann Whitney statistics for length (cm)

Group	No. Eels	Mean	Median
EEP	2,045	51.9	48.2
EMP	282	50.3	49.6
U	282,666		
r	0.01		
p	0.591 ns		

Table 8-10 Mann Whitney statistics for weight (g)

Group	No. Eels	Mean	Median
EEP	2,045	347	220
EMP	282	234	204
U	258,457		
r	0.1		
p	<0.05	sig	

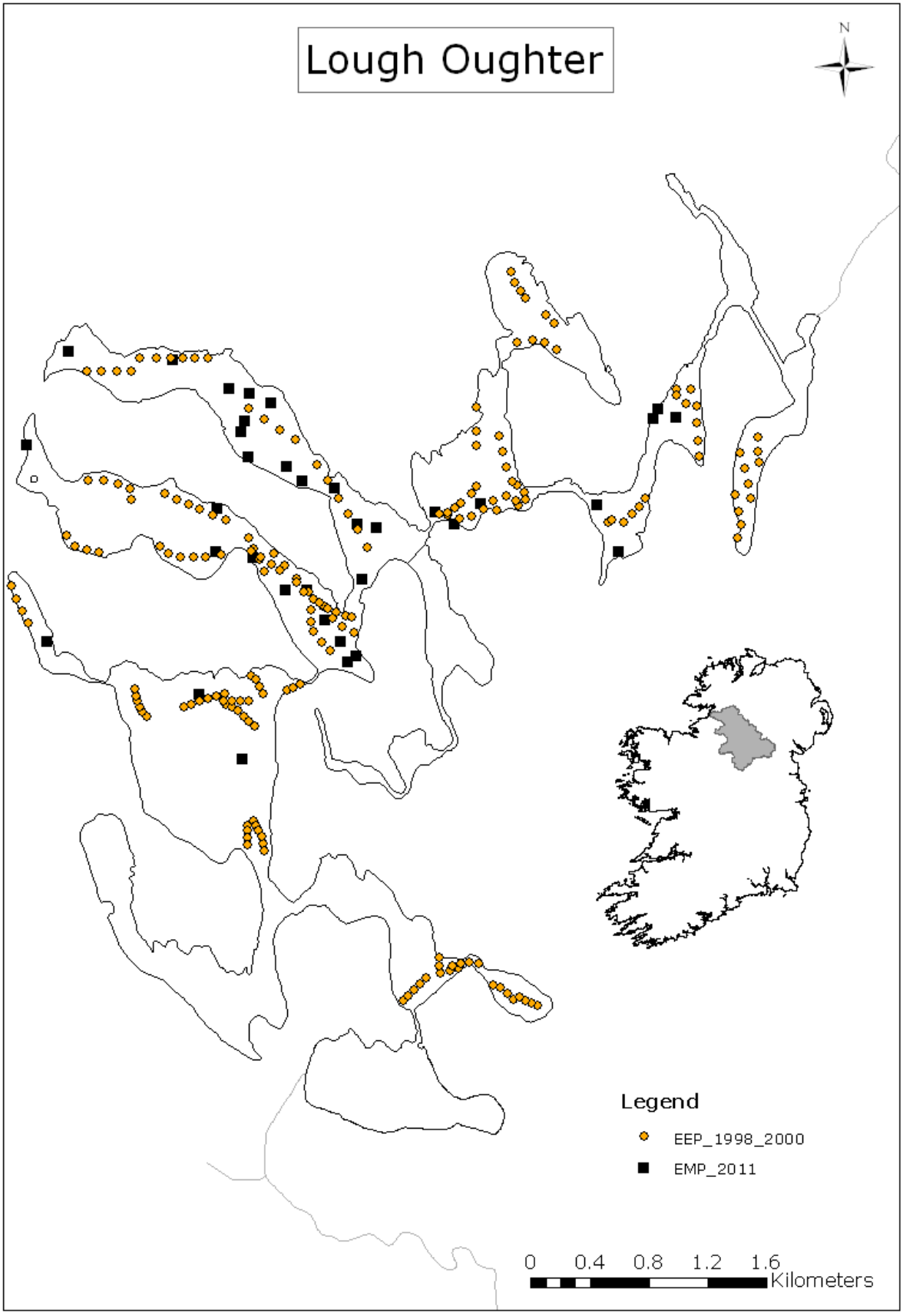


Figure 8-4 Location of surveys in the Erne Eel enhancement programme and Eel Monitoring Programme

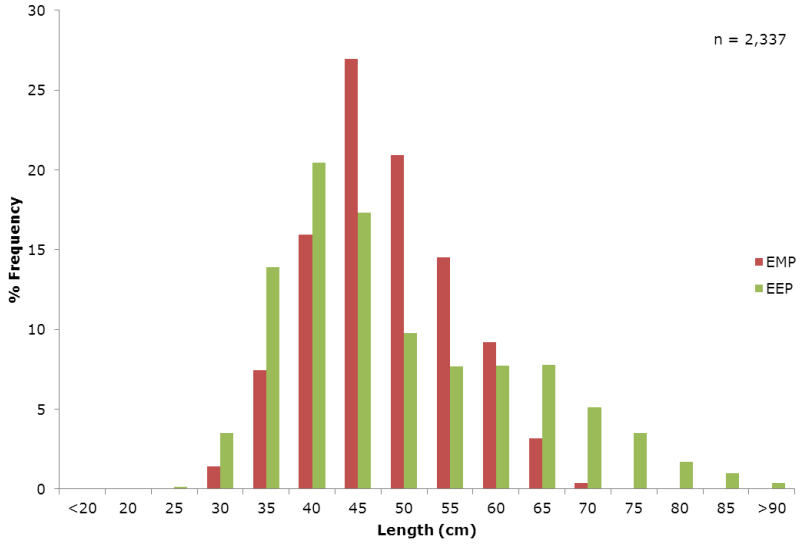


Figure 8-5 Length frequency for L. Oughter

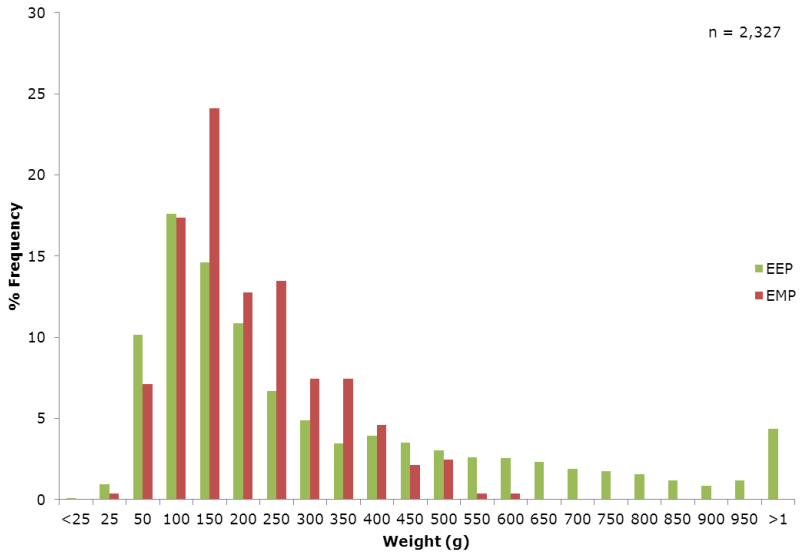


Figure 8-6 Weight frequency for L. Oughter

9 Length Weight Relationship

The comparisons between the historical and current fyke net studies are showing a general increase in the length and weight of eels through time. To examine if there is a difference in the length weight relationship between eels from the 1960's, 1980's and the current eels, length weight regression analysis was carried out. An increase in length and weight is an expected effect when a population is in decline, the reduced numbers results in less competition for resources (De Lafontaine *et al.* 2009; Olsen *et al.* 2004).

A least squares regression analysis was carried out on each time series in each lake (Table 9-1). To determine if there is a change in the relationship between lengths and weight over time a Kruskal Wallis test was carried out on the slope of the regressions lines. No significant difference was found between the gradient of the regression slope between the pre 1980's, post 1980's: pre 2000's and post 2000's data (Table 9-2). Graphs highlighting the regression for each lake and group are presented (Figure 9-1). It is clear from the regression plots that the general relationship between length and weight hasn't changed despite the appearance of *Anguillicoides crassus* in Ireland in 1997.

The parasite *Anguillicoides crassus* was introduced to Ireland in 1997 and since then has been spreading around the country. Studies on the effects of the nematode on the growth and condition of eels has been a topic of discussion ever since. Kelly *et al.* (2000) reported that from the parameters examined in the laboratory, there is little evidence that chronic *A. crassus* infection adversely affects the physiological status of wild European eels at most times of the year and they assume that the eels can generally adapt to the chronic effects of parasitism. A number of other studies have found no effect of the parasite on body condition (Neto *et al.* 2010, Sjoberg *et al.* 2009). However the effect the parasite has on eels during their migration route to the Sargasso Sea and on their reproductive ability is still not known. The effect of infection on the annual growth of eels is being examined over the coming years within the eel monitoring programme.

Table 9-1 Regression statistics for yellow eels

Location	Group	r	r2	y intercept (bo), a	bo SE	gradient b1, b	b1 SE	Beta	p value (t)	n
Conn	FRC_77	0.971	0.943	1.907	0.009	0.321	0.009	0.971	0.001	84
Conn	EMP_09	0.955	0.912	1.909	0.004	0.315	0.004	0.955	0.001	504
Derg	FRC_1980's	0.98	0.961	0.959	0.003	0.313	0.001	0.98	0.001	2,327
Derg	EMP_00's	0.947	0.897	0.974	0.005	0.307	0.002	0.947	0.001	2,125
Lwr Corrib	FRC_69	0.974	0.949	1.897	0.004	0.309	0.004	0.974	0.001	301
Lwr Corrib	EMP_09	0.956	0.914	1.886	0.004	0.283	0.005	0.956	0.001	324
Oughter	EMP_11	0.945	0.893	1.87	0.001	0.277	0.002	0.945	0.001	2,045
Oughter	EEP_98/99	0.979	0.959	1.905	0.003	0.305	0.004	0.979	0.001	282
Upr Corrib	EMP_10	0.974	0.948	1.912	0.003	0.304	0.003	0.974	0.001	443
Upr Corrib	FRC_67/68	0.98	0.961	1.898	0.002	0.307	0.002	0.98	0.001	1,147
Upr L. Erne	FRC_72	0.972	0.946	1.9	0.006	0.297	0.009	0.972	0.001	72
Upr L. Erne	EMP_10	0.957	0.917	1.898	0.003	0.3	0.004	0.957	0.001	500
Upr L. Erne	AFBI_11	0.961	0.924	1.889	0.008	0.29	0.012	0.961	0.001	50
Upr L. Erne	EEP_98/99	0.853	0.728	1.821	0.003	0.233	0.003	0.853	0.001	1,855

Table 9-2 Kruskal Wallis statistics for Regression gradient comparisons

Series	No.	Mean	Median
Pre 1980's	4	0.31	0.31
Post 80's pre 00's	3	0.28	0.31
Post '00;s	7	0.30	0.30
H	1.859		
p	0.395	ns	

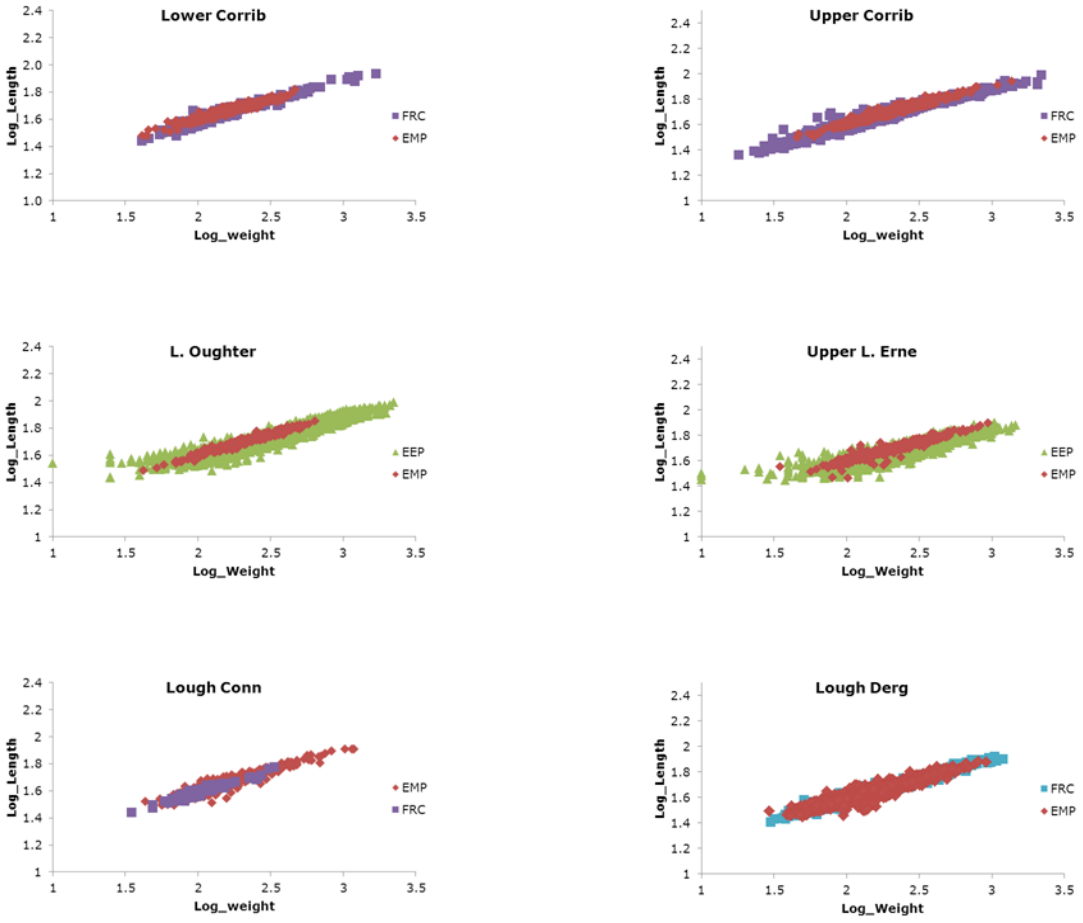


Figure 9-1 Length weight regressions plots for current and historical yellow eel data

10 Overview of Historical Data

Detailed analysis of historical and current eel data was carried out in four catchments (Moy, Corrib, Erne and Shannon). An overview of the summary catch per unit of effort data is presented in Table 10-1. There are a number of issues with comparing data over time due to the variations in the crews setting the nets and the locations chosen (random or optimised fishing sites). The general trend in this dataset is a change in the length frequency of eels caught by fyke nets over the four decades investigated (Figure 10-1 and Table 10-2). The current fyke net population has shifted to larger and heavier eels compared with the pre 1980's data which may be a reflection of reduced competition and improved growth as a result of the reduced population density. The vulnerability of eels to be captured by fyke nets hasn't changed over the time period therefore the absence of smaller eels from the sample population is an indication of a change reflecting reduced recruitment (Figure 10-1). When this change occurred varies for the different water bodies.

Olsen *et al.* (2004) found that in the years before the closure of the fishery, cod stocks were maturing earlier due to the reduced competition for resources; cod had faster growth rates and matured at smaller sizes. Overall there has been a change in the population structure of eels in lakes nationally. The length frequency distribution reflects the interaction of the rates of recruitment, growth and mortality on the fyke net or gear dependent portion of the eel population at the different time periods. This length frequency data should be coupled with growth analysis, age at length and age at weight analysis to give further information on the state of the eel stock. This information is being worked on at present and will be analysed and reported on at a later stage.

The historical data available for analysis spans a number of important time periods. The pre 1980's data is representative of the population of eels in Ireland before recruitment collapsed after 1980. The data from the period 1980- present represents the period of change that is occurring as a result of this collapse. As the average continental life span of male and female eels is between 5 and 15+ years (Dekker, 2009) the change in the population structure is reflected in the data from the 1980's on. The eel population structure is also influenced by the effects of the commercial fishery (up to 2008).

Table 10-1 Catch per unit of effort for historical and current surveys

Location	Year	CPUE				
		Count	Mean	Median	Min.	Max.
L. Conn	1972	2	3.23	3.23	2.92	3.54
	1988	3	6.56	5.92	3.42	10.33
	2009	5	2.4	2.08	1.32	3.5
Upper. L. Corrib	1960's	107	1.37	0.83	0	8.33
	2009	60	1.57	1.4	0	6
Lower. L. Corrib	1969	-	1.59	-	-	-
	1985	-	1.6	-	-	-
	1989	-	1.85	-	-	-
	1990	-	1.9	-	-	-
	2009	-	1.05	-	-	-
Upper. L. Erne	1972	4	0.97	1	0.35	1.52
	1998/99	62	4.07	3.68	0.4	10.1
	2010	60	1.64	1.4	0	6.2
	2011	20	8.5	7	3	16.4
L. Oughter	1968	2	0.95	0.95	0.5	1.40
	1998/99	568	1.43	1	0	10
	2011	60	0.99	0.8	0	5.4
L. Derg	1980's	280	2.63	1.8	0	19.9
	2000's	131	2.85	2.2	0	13.1
L. Ree	1968	1	1.5	-	-	-
	1986	2	23.75	23.75	0.9	46.6
	2011	108	1.42	1	0	8.6
L. Inchiquin	1968	1	2.28	-	-	-
	2011	50	2.24	1.9	0	9.4

Table 10-2 Summary length and weight of yellow eels

Location	Year	Count	Mean Length (cm)	Mdn. Length (cm)	Min. Length (cm)	Max. Length (cm)	Mean Weight (kg)	Mdn. Weight (kg)	Min. Weight (kg)	Max. Weight (Kg)
L. Conn	1972	84	39.6	38.2	27.5	59.5	117	100	35	334
	1988	237	39.6	39	29	56	-	-	-	-
	2009	504	46.5	45.2	31	81	191	153	44	1,200
Upr. L. Corrib	1960's	1,147	43.2	42	23	97.8	180	124	18	2,196
	1990's	1,390	49.9	48.7	19	85.6	-	-	-	-
	2009	443	50.1	48.9	31.5	87.5	223	190	46	1,372
Lwr. L. Corrib	1960's	344	43.88	42.4	22	86.5	180	130	40	1,680
	1980's	346	38.61	37	28	64	-	-	-	-
	1990's	909	43.1	41.5	29.2	83.5	-	-	-	-
	2000's	597	45.08	45	29	71	170	160	40	470
Upr. L. Erne	1972	72	49.5	47.3	34.8	69.5	230	178	68	717
	1998/99	1,855	44.2	42.4	28.1	79.6	204	150	5	1,460
	2010	500	49	48.8	28.9	78.7	222	193	35	950
	2011	50	50.3	50.1	35.8	70.8	240	240	60	600
L. Oughter	1968	100	50.3	47.9	10.4	86.5	-	-	-	-

Location	Year	Count	Mean Length (cm)	Mdn. Length (cm)	Min. Length (cm)	Max. Length (cm)	Mean Weight (kg)	Mdn. Weight (kg)	Min. Weight (kg)	Max. Weight (Kg)
	1998/99	2,045	51.94	48.2	27.3	97.5	350	220	10	2240
	2011	282	50.3	49.6	30.7	70.9	230	200	40	640
L. Derg	1980's	2,327	42.8	41.8	25.6	83.5	158	128	30	1,200
	2000's	2125	44.2	43.5	28.1	76.1	167	144	30	915
L. Ree	1980's	251	49	47	31	94	-	-	-	-
	2010	894	46.9	46	28.2	84.5	191	158	28	1503
L. Inchiquin	1968	233	43.28	40.1	30.9	92.5				
	2011	548	52.51	52.5	31.7	77.8	277	253	45	1110

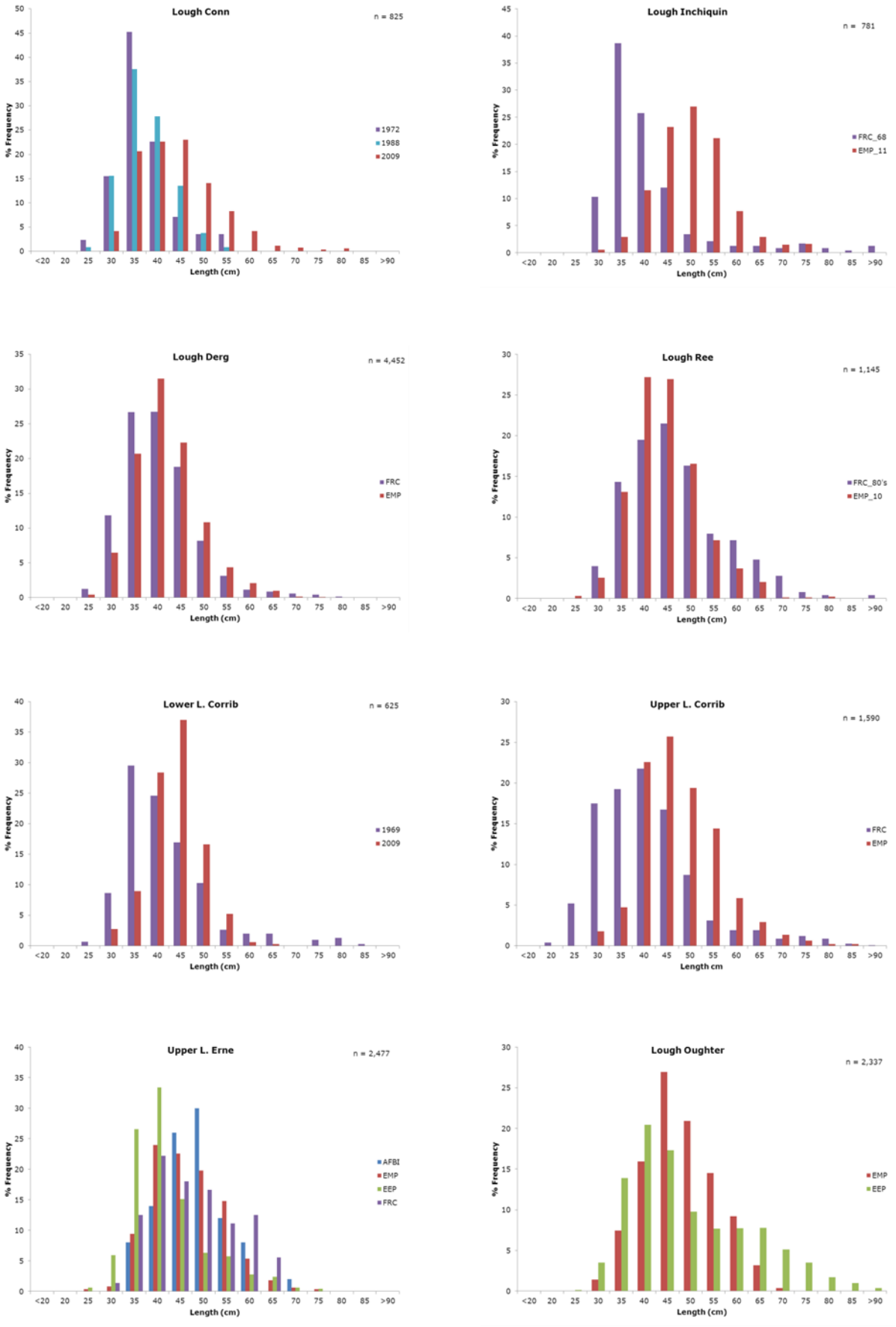


Figure 10-1 Length Frequencies for 8 lakes in the historical analysis

11 Water Framework Directive: 2008 - 2010

11.1 Introduction

In December 2000, the European Union introduced the Water Framework Directive (WFD) (2000/60/EC), as part of a standard approach for all countries to manage their water resources and to protect aquatic ecosystems. The fundamental objectives of the WFD are to protect and maintain the status of waters that are already of good or high quality, to prevent any further deterioration and to restore all waters that are impaired so that they achieve at least good status by 2015.

A key step in the WFD process is for EU Member States to assess the health of their surface waters through national monitoring programmes. Monitoring of all biological elements including fish is the main tool used to classify the status (high, good, moderate, poor and bad) of each water body. The responsibility for monitoring fish has been assigned to Inland Fisheries Ireland. A national fish stock surveillance monitoring programme has been initiated at specified locations in a 3-year rolling cycle.

Under the Eel Management Plan, monitoring objective four relates to an inter-calibration study between the Water Framework Directive Sampling and the Eel Monitoring Programme. This study was undertaken successfully in 2010 in Lough Ree and Upper Lough Erne.

11.2 Methods

Lakes

Lakes are surveyed between June and September. Standard multi-mesh monofilament survey gill nets were used to sample the fish population. Surface floating nets, "Dutch" fyke nets and benthic braided single panel (62.5mm mesh knot to knot) gill nets were used to supplement the gillnetting effort. Survey locations were randomly selected using a grid placed over the map of the lake and portable GPS instruments were used to mark the precise location of each net. All nets were set between 3 and 6 pm, fished overnight and lifted between 10.00 am and 12.00-midday in order to ensure that the activity peaks of each fish species were included.

Rivers

Electric fishing is the method of choice for WFD surveillance monitoring of fish in rivers to obtain a representative sample of the fish assemblage at each sampling site. The standard methodology includes fish sampling, hydrochemistry sampling, and a physical habitat survey. A macrophyte survey was also carried out at selected sites. Surveys were carried out between July and early October (to facilitate the capture of 0+ salmonids) when stream and river flows were moderate to low. Three fishing's were carried out in a contained area. In small shallow channels (<0.5 -0.7 m in depth), a portable (bank based) landing net (anode) connected to a control box and portable generator (bank-based) or electric fishing backpack was used to sample in an upstream direction. In larger deeper channels (>0.5 -1.5 m), fishing was carried out from flat-bottomed boat(s) in a downstream direction using a generator, control box and a pair of electrodes. All habitats, in wadable and deeper sections, were sampled (i.e. riffle, glide, pool).

Transitional Waters

A multi-method approach is used for sampling the transitional waters. Beach seining using a 30 m fine-mesh net is used to capture fish in littoral areas. Beam trawling is used for specified distances (100 – 200 m) in open water areas adjacent to beach seining locations. Fyke nets were set overnight in selected areas adjacent to beach seining locations.

11.3 Results Summary, 2008-2010

Locations for WFD sampling sites are shown for lakes, rivers and transitional waters from 2008 to 2010 (Figure 11-1). A summary table detailing the surveys carried out by the WFD team in these years is provided in Appendices I - III.

A total of 78 lakes were sampled from 2008-2010 (Table 11-1). In 2009 and 2010, all lakes surveyed recorded eels as present (Appendix Table I-1 – I-3). No eels were caught in Lough Skeagh upper in 2008, but all other lakes surveyed had eels present in that year. One hundred and eighty river sites were sampled in total across 2008-2010 (Appendix Table II-1- II-3). No eels were recorded at 20 sites in 2008, 11 sites in 2009 and 10 sites in 2010. Seventy-four transitional waters were sampled from 2008 to 2011 (Appendix Table III-1 – III-3). Eels were recorded in all but three transitional waters in 2009 (no eels were captured in Inner Donegal Bay, Swilly Estuary and Lough an tSaile). The Kinvara survey was the only survey to not catch eels in 2009. In 2008, no eels were recorded in 11 transitional waters (Argideen, Maigue, Colligan, Harpers island (Lough Mahon), Lough Mahon, Ilen, Lee (Tralee), Lower Lee, Bridge Lough, Tullaghan Estuary, Westport estuary).

Anguillicoloides crassus was present in 9 out of 19 lakes sampled in 2010 with six lakes showing a prevalence of >50%. Eight of the 24 lakes surveyed in 2009 showed infection with a prevalence of >50% (Appendix ; Table I-4 – I-6). In 2008, *A. crassus* was present in 10 of the 24 lakes with eight lakes having a prevalence rate of 50% or greater. The intensity of the infection was variable in the lakes sampled. In 2010, mean infection intensity was highest in Lough Urlaur at 16.33 (n=6 eels). Intensity rates were lower across all lake sites in 2009, with just 1-2 parasites recovered per eel on average. The highest infection intensity from 2009 was found at Lough Cullin (mean infection intensity, 26 parasites per eel, n=2). Intensity was higher and varied for 2008. Lough Sheelin, Lough Gill and Lough Nanoge had the highest intensity rates with 15.00, 9.30 and 9.00 parasites per eel, respectively. Lough Corglass had the lowest (mean infection intensity, 2.60, 83.33% prevalence, n=6).

Analyses of 2010 rivers sampled eels showed that six out of ten rivers (at which eels were retained for dissection) presented *Anguillicoloides* infection, with prevalence values ranging from 27 to 53% (Appendix Table II-7). In 2009, 14 out of 40 rivers sampled presented with Anguillicolosis. Prevalence ranged from 6.7 to >80% (Owvane and Liffey (Lucan) respectively), (Appendix Table II-8). In 2008, 23 of the 55 river sites sampled had infected eels. Thirteen sites had a prevalence rate of >50% (Appendix Table II-9). On the Brosna River, the sites, Clonony and Pollagh, had an average parasite intensity of 14 and 8, respectively. However the majority of river sites had a low parasite loading with 17 sites recording <5 parasites per eel.

In 2010, only one eel was retained for dissection from the WFD sampled transitional waters (retained from Middle Suir Estuary; Appendix Table III-4). However, this single individual was infected with seven *A. crassus* specimens. Out of the 20 transitional waters surveyed in 2009, *A. crassus* was present in 7 (4 had a prevalence rate >50%; Appendix Table III-5). Eight of the 24 transitional waters surveyed in 2008 had the parasite (Appendix Table III-6). The Corrib estuary had the highest average intensity rate of 15 parasites per eel.

These results, along with those of the National Eel Monitoring Programme, highlight the current distribution of the parasite in the Republic of Ireland. Prevalence and intensity rates vary from east to west, but the northwest and southwest of the country show little to no infection by *A. crassus* (Figures 11-2). Further monitoring and management will be necessary to maintain the parasite free status of catchments in these areas.

11.4 Potentially 'at risk' catchments – early stages of Anguillicolosis

The Blackwater (Munster) catchment in the south of Ireland shows a river site near the estuary (sampled in 2010) with a low level infection (prevalence 27%, mean intensity 2.83, n=22). The estuary itself was sampled in 2008 with a prevalence and mean intensity of 32% and 8.22, respectively (n=28 eels). The catchment upstream of these sampling points remains apparently uninfected by *A. crassus*, however eventual infection maybe likely over time. One upstream site (Blackwater (Killavullen Bridge)) recorded the parasite, however only one eel was retained from the site as reference. The WFD are due to repeat this surveys on a three year rolling cycle, it is the recommendation of the authors that eels are retained in future surveys in this catchment.

The infection of the Blackwater (Munster) catchment may also serve as an entry point for the parasite in other catchments in the south of Ireland. A site in the river Flesk in the Laune catchment (sampled in 2008) just west of the Blackwater, retained seven eels for dissection with an apparent single specimen record of *A. crassus*. This result will also need to be clarified with further sampling. These potential records of the parasite may indicate early stage infections entering the southwest of the country.

Another catchment which is in the early stages of Anguillicolosis is the Fergus in Co. Clare. The Fergus estuary (sampled by the WFD team in 2008) presented with a low level prevalence and mean intensity of 33% and 5, respectively (n=9 eels). A site on the river Fergus upstream of the estuary (sampled in 2008) showed a lower level infection with a prevalence and mean intensity of 10% and 1.0, respectively (n=31 eels). However, several lakes upstream of this site (L. Callaun, L. Muckangh, L. Bunny, L. Dromore and L. Inchicronan, all sampled in 2009) remain parasite free, suggesting that one year after the initial downstream records, the infection has not yet travelled upstream through the catchment. In 2011, the Eel Monitoring Program sampled the upstream Fergus catchment lake, L. Inchiquin (Co. Clare), which is located near the WFD sampled lakes. On that occasion, *A. crassus* was confirmed, albeit a low level infection (Prevalence: 1%, Mean Intensity 1.00, n=97) highlighting the movement of the parasite through the catchment. Continued monitoring of 'at risk' catchments such as those noted above, will be essential in tracking and containing the spread of *A. crassus* in Ireland.

This report has focused on the sections of WFD monitoring relevant for the eel monitoring programme. A substantial monitoring programme is being undertaken by the WFD team and further information is available from Lynda Connor at Inland Fisheries Ireland, Swords (IFI, Swords). Email: Lynda.Connor@fisheriesireland.ie or the WFD website www.wfdfish.ie

WFD reports published to date:

Kelly, F.L., Harrison, A.J., Connor, L., Matson, R., Wightman, G., Morrissey, E., O'Callaghan, R., Feeney, R., Hanna, G., Wogerbauer, C. & Rocks, K. (2010).*Sampling fish for the Water Framework Directive – Summary report 2009*.Central and Regional Fisheries Boards report.

Kelly, F.L., Connor, L., Wightman, G., Matson, R. Morrissey, E., O'Callaghan, R., Feeney, R., Hanna, G. and Rocks, K. (2009) *Sampling fish for the Water Framework Directive – Summary Report 2008*. Central and Regional Fisheries Boards report.

Kelly, F.L., Connor, L. and Champ, T. (2007) *WFD Surveillance Monitoring – Fish in Lakes 2007.* Central and Regional Fisheries Boards report.

Table 11-1 Site numbers in the surveys carried out by the WFD team, 2008-2011

Water body	2008	2009	2010	Total
Lakes	32	24	22	78
Rivers	83	54	43	180
Transitional Waters	42	22	25	89

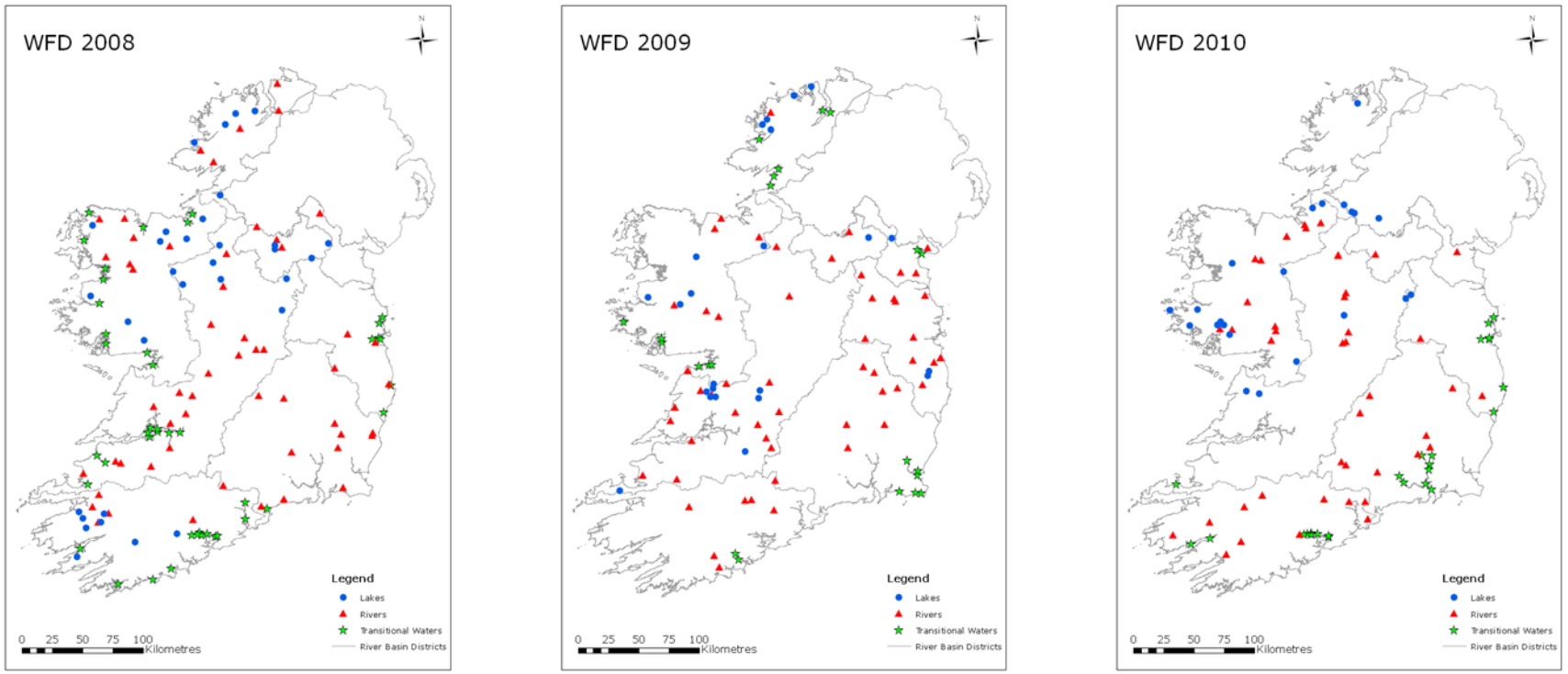
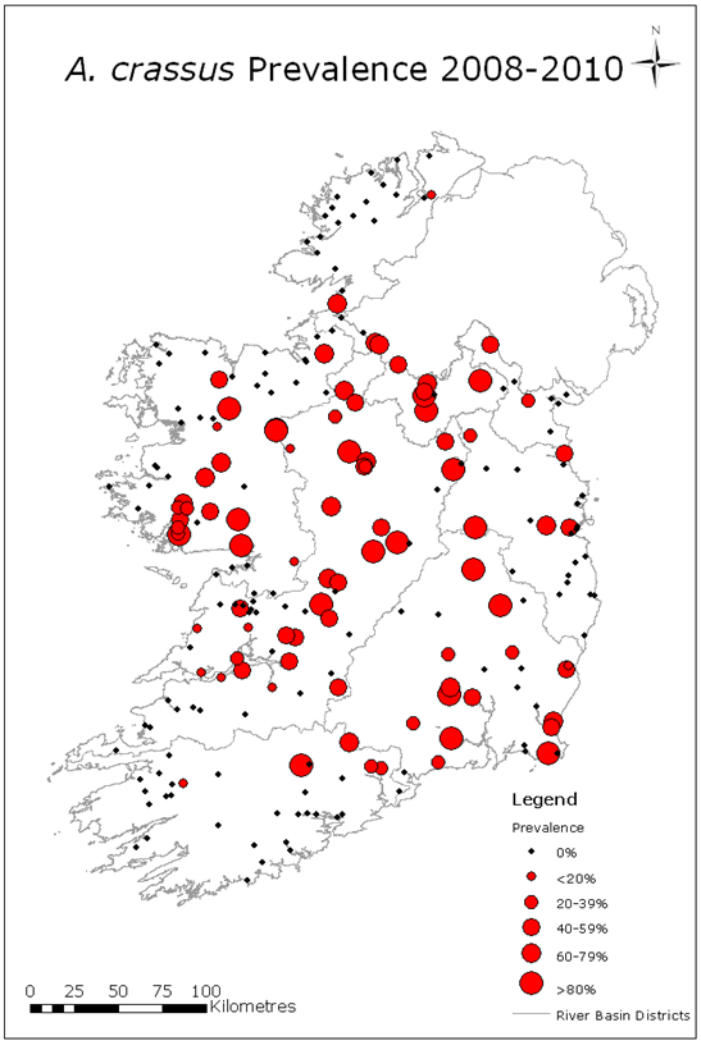


Figure 11-1 Locations surveyed by IFI under the Water Framework Directive 2008 – 2010



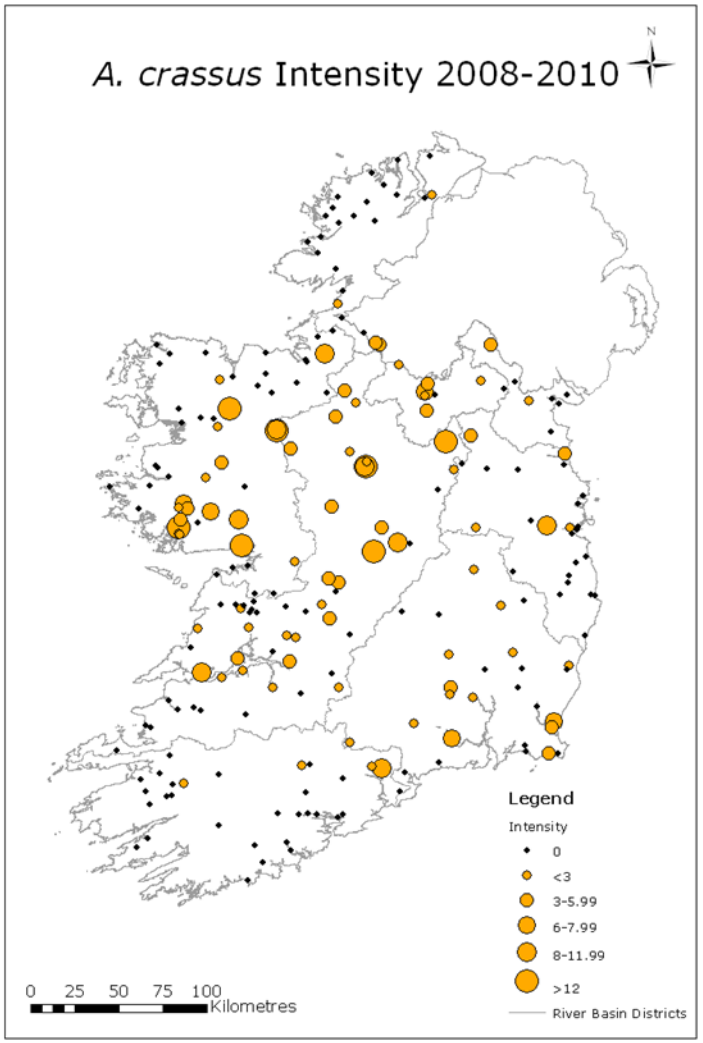


Figure 11-2 Anguillicoides crassus prevalence and mean intensity distribution in Ireland

12 EMP/WFD Inter calibration

12.1 Introduction

Monitoring objective 4 of the National Management Plan refers to an inter-calibration study between the Eel Monitoring Programme (EMP) and the Water Framework Directive (WFD) fyke net sampling methodology. The WFD sampling programme covers a total of 78 national lakes surveyed between 2008 and 2010. The national eel survey uses intensive fyke net effort in chains of five fykes nets while the WFD employs a lower effort in chains of three nets. O'Neill *et al.* (2009) demonstrated no difference in precision in CPUE determined between chains of five and chains of ten nets, but chains of three nets were not tested. A power analysis of more than 3,800 5-net nights indicated a high effort required to achieve a modest precision of, for example, 10% coefficient of variation which equates to approximately 250 net nights; more net nights at low densities and less net nights at higher densities of eel.

The aim of this exercise is to test the broad-scale low effort surveys of the WFD against the intensive eel specific surveys of the national eel monitoring programme (EMP) in order to assess the possible application of the WFD surveys for determining eel stock structure and relative density.

12.1.1 Methodology

The fyke net surveys, carried out by the WFD team, consist of setting Dutch fyke nets in chains of 3. The number of fyke net chains to be set in a lake is determined by the wetted area of the lake. The locations of the nets were randomly assigned to the shallow regions around the lake shore (2 depth zones 0-2.9 m, 3-5.9 m). Occasionally nets are moved closer to possible eel habitat such as near the mouth of a river. Nets are set perpendicular to the shore.

The EMP uses the same fyke nets as the WFD programme but the nets are set in chains of 5 as opposed to 3 in the WFD. A total effort of 300 net nights is carried out per lake, usually distributed into 2 sessions of 3 nights with 50 nets set per night. The location of each chain of nets was randomly allocated for each session using the trap builder task in Density 4.4 (Efford, 2009). The EMP survey sites include a greater range of depths than those covered by the WFD surveys.

In 2010, two lakes were sampled simultaneously by the WFD and EMP teams in order to compare the efficiency of the two methods. Upper Lough Erne and Lough Ree in the Shannon catchment (Lough Ree was surveyed as two lakes, upper and lower). In addition to the simultaneous sampling, four additional lakes were surveyed by the two teams but in different years, these include Lough Cullin, Upper and Lower Lough Corrib, Upper and Lower Lough Derg (due to the size of the lake it was split into upper and lower).

12.1.2 Results

Examples of the catch per night of effort is displayed in Table 12-1. Due to the non-normal distribution of biological data, non-parametric statistics was performed on the data. A Mann Whitney Test was used to analyse the CPUE of the lakes sampled by both teams (n = 8, CPUE). There was no significant difference in Catch per Unit of effort for the EMP and WFD lakes (U = 40, p=0.442 ns; Table 12-2, Figure 12-1).

A Mann Whitney test was used to analyse the length and weight of eels sampled by the EMP and WFD nets. There was no significant difference in the length of eels sampled (U=76,894, p=0.341 ns; Table 12-3). There was also no significant difference in the weight of eels sampled (U = 78,257, p = 0.524 ns; Table 12-4).

12.1.3 Conclusion

Harley *et al.* (2001) recommend that if using CPUE to estimate abundance, surveys must be carried out multiple times or that the survey represents a good coverage of the stocked area. O'Neill *et al.* (2009) indicate that a high effort is needed to achieve good precision in the CPUE estimates. Initial indications from this inter calibration study are that the size structure of the local eel populations and the CPUE of the two surveys are generally comparable and it is intended to investigate this further. However, a low net effort and small number of sites lends itself to a wide variation in catch and therefore the higher net effort will be required to identify relative changes in eel stock structures and densities with any precision.

Approximately 81 lakes were surveyed by the WFD team in the three year cycle (2008-2010) compared with 13 lakes by the Eel monitoring programme. The WFD national programme gives a good representation of the state of the eel stocks in selected Irish lakes and will be repeated every three years. Further analysis after the second cycle will give a clearer indication of how to use the WFD data for stock analysis.

The intensive fyke net surveys undertaken by the EMP have resulted in a large dataset of morphological measurements. It is through these measurements that the maturation of the yellow eels into silvers will be assessed, a requirement for silver eel escapement. To determine the quality of eels in a lake such as age, growth and parasite prevalence, a large sample size is required. This requirement is not met under the WFD methodology with a maximum of 66 eels captured for a lake. Therefore, intensive fyke netting surveys, while time consuming, are required when information on the stock structure is the target.

The use of fyke nets to assess the population of eels in a lake must take into account the gear dependent fraction of the catch. Fyke netting samples a length class >30 cm (Naismith and Knights, 1990). Both mesh size and length of leader of the fyke nets have been identified as introducing bias to the catch. Therefore the CPUE used in this analysis refers to the population of eels >30-40 cm (Moriarty, 1972). However, generally the mesh size and leader length are standardised between the different surveys and are similar to those used in historical Irish surveys making it easier to compare the different results. Further analysis of how to relate CPUE to population abundance is currently on-going through the EMP Mark Recapture surveys.

Table 12-1 Catch per unit of effort for selected lakes surveyed by WFD and EMP

Lake	Group	Year	No. Eels	Net* Nights	CPUE
L. Cullin	EMP	2009	420	220	1.909
	WFD	2009	48	12	4.000
Lower L. Corrib	EMP	2009	420	300	1.400
	WFD	2008	8	15	0.533
Upper L. Corrib	EMP	2010	470	300	1.567
	WFD	2008	28	18	1.556
Lower L. Derg	EMP	2009	669	290	2.307
	WFD	2009	57	18	3.167
Upper L. Derg	EMP	2010	765	255	3.000
	WFD	2009	66	18	3.667
Lower L. Ree	EMP	2010	501	300	1.670
	WFD	2010	44	18	2.444
Upper L. Ree	EMP	2010	299	240	1.246
	WFD	2010	26	18	1.444
Upper L. Erne	EMP	2010	490	300	1.633
	WFD	2010	32	18	1.778

Table 12-2 Mann Whitney Analysis of EMP and WFD CPUE data

Group	No. Eels	Av. CPUE	Mdn. CPUE
EMP	8	1.841	1.633
WFD	8	2.324	1.778
U	40.0		
p	0.442 ns		

Table 12-3 Mann Whitney Analysis of EMP and WFD length data (cm)

Group	No. Eels	Av. Length (cm)	Mdn. Length (cm)
EMP	1,266	47.8	47.0
WFD	128	46.8	45.8
U	76,894		
p	0.341 ns		

Table 12-4 Mann Whitney Analysis of EMP and WFD weight data (kg)

Group	No. Eels	Av. Weight (kg)	Mdn. Weight (kg)
EMP	1,266	0.203	0.171
WFD	128	0.188	0.161
U	78,257		
p	0.524 ns		

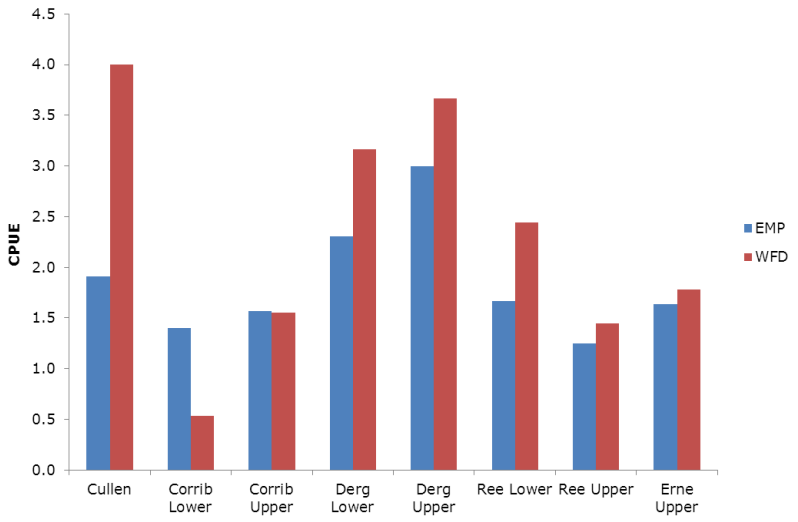


Figure 12-1 CPUE for lakes sampled by EMP and WFD

13 Lake Fyke Net Analysis

Due to the extent of lakes in Ireland and their importance as habitat for eels, an extensive fyke net programme was carried out from 2009 to 2011. Fyke nets have been used by biologists in Ireland since 1965 when Dr. Moriarty initiated a national survey on eel stocks (Moriarty, 1979). Fyke netting by the commercial fishermen began in certain locations around the same time and have been used successfully in the eel fishery up to 2009.

Fyke netting is suitable for locations where electro-fishing is not feasible such as large deep water bodies (lakes and large rivers) and saline water bodies. Fyke netting is an ideal method when biological data (length, weight, age etc.) is required as fish are kept alive and can be released afterwards. However, its use in density analysis is unclear due to the variable nature of fyke net catch per unit of effort. Areas fished using fyke nets are subject to immigration and emigration over the course of the hours fished. Size frequency data is only reliable for the size dependent fraction of the catch (eels >30/40 cm).

Over the three year period, 13 lakes were intensively fyke netted for eels. Random locations were used and all depths were sampled. The aim of the programme was to achieve at least 300 net* nights per lake, over 2 – 3 time periods. Lakes were fished from June to early September and fyke nets were set in chains of 5 nets per chain.

13.1 CPUE

The catch data for the 13 lakes is presented in Table 13-1, the variance around the mean CPUE is high (Table 13-1 and Figure 13-1). The effort required for low variability in CPUE is high. This variance highlights the need for intensive surveys when investigating changes in abundance and density of eels. Less intensive fyke net surveys should not be used to compare between different lakes as a large sampling effort is needed to get a good sample size for the comparison.

Table 13-1 Summary data on CPUE for the 13 lakes

Lake	Mean	Standard Deviation	Variance	CV
Ballynahinch	1.49	1.29	1.68	87.09
Bunaveela	0.36	0.60	0.36	167.28
Conn	2.64	2.25	5.06	85.28
Cullen	1.93	1.67	2.79	86.74
Derg	2.75	2.46	6.05	89.57
Feeagh	1.71	2.14	4.59	124.91
Inchiquin	2.24	1.71	2.93	76.25
Lwr. Corrib	1.05	1.34	1.79	127.05
Oughter	.99	1.02	1.03	103.08
Ramor	3.56	3.14	9.87	88.32
Ree	1.42	1.40	1.95	98.64
Upr. Corrib	1.57	1.20	1.44	76.39
Upr. L. Erne	1.64	1.42	2.03	88.64

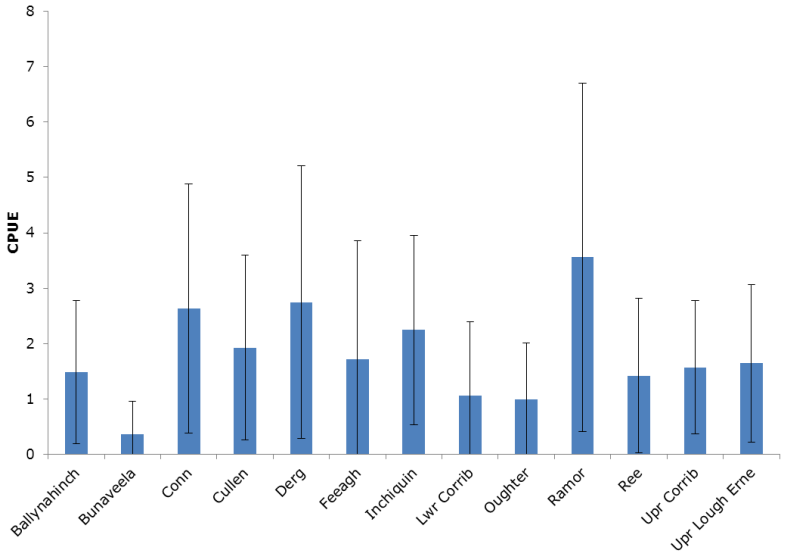


Figure 13-1 Mean catch per unit of effort and standard deviation

13.2 CPUE and Depth

Depth was recorded at all locations sampled with fyke nets and this data was analysed by catch per unit of effort. Summary data of CPUE and depth is reported in Table 13-2. Due to the presence of zeros in CPUE data, non-parametric test were used. A Kruskal Wallis test resulted in a significant difference in CPUE and depth ($H = 16.44$, $df = 4$, $n = 863$, $p<0.05$). A post hoc test was carried out to determine where the significant difference occurred. There was no significant difference in CPUE between the depth zone 0-4 m, 5-9, 10-14 and 15-19 m (a significant value of $p<0.0125$ was required under the bonferroni correction (bc), due to the four post hoc test carried out). However there was a significant difference between the 0-4 m and >20 m zones with a lower CPUE reported in the >20 m depth zone. (Table 13-3, $p<0.125$ bc).

Table 13-2 Catch per unit of effort data for the different depth zones

Depth	n	Av. CPUE	Std. Dev.	Median CPUE
0-4 m	506	2.081	2.13	1.450
5-9 m	221	1.80	2.02	1.40
10-14 m	78	1.69	1.62	1.40
15-19 m	26	1.28	1.17	1.0
>20 m	32	1.10	1.29	0.80

Table 13-3 Post hoc Mann Whitney test for cpue and different depth zones. ns = not significant, BC = bonferroni correction

Depth	Mann Whitney U	z	n	r	p
0-4: 5-9 m	51,721	-1.612	727	-	0.107 ns
0-4:10-14 m	18,059	-1.209	584	-	0.227 ns
0-4:15-19 m	5043	-2.011	532	-	0.044 ns
0.4: >20 m	5,258	-3.333	538	0.14	<0.0125 BC

13.3 CPUE and Distance to shore

Chisnall and West (1996) found a decreasing CPUE with distance offshore in Lake Waahi in New Zealand. A Kruskal Wallis analysis looking at CPUE and distance to lake shore found no significant difference ($H = 2.244$, $df = 3$; $n = 863$, $p=0.523$ ns). Further analysis looking at distance to shore or nearest island and the influence of shelter i.e. bays is being undertaken.

13.4 Case Study I: L. Derg

Lough Derg was surveyed using fyke nets over the three years of the programme (2009, 2010 and 2011). The length of eels at each depth zone was analysed and summary data is presented in Table 13-4. Lough Derg has an average depth of 7.6 m with a maximum depth of 36 m. A log transformation resulted in a normally distributed data set. A one way ANOVA was carried out and there was no significant difference in the length of eels caught in the different depth zones ($F(4, 2{,}271) = 0.218$ $p = 0.929$ ns).

Table 13-4 Length data (cm) per depth zone for Lough Derg

Depth	n	Av. Length (cm)	Std. Dev.
0-4 m	1,757	44.4	7.21
5-9 m	460	44.2	7.59
10-14 m	51	44.6	9.76
15-19 m	3	44.7	4.48
>20 m	7	45.4	3.31

For Lough Derg, the weight of eels at each depth zone was analysed, summary data are presented in Table 13-5. A log transformation resulted in normally distributed data and a One way ANOVA was carried out. There was no significant difference in weight of eels in the different depth zones ($F(4, 2128) = 1.602$, $p = 0.171$ ns).

Table 13-5 Weight data (kg) per depth zone for Lough Derg

Depth	n	Av. Weight (kg)	Std. Dev.
0-4 m	1,642	0.170	0.097
5-9 m	429	0.163	0.126
10-14 m	51	0.193	0.185
15-19 m	3	0.173	0.050
>20 m	7	0.162	0.047

13.5 Case Study II: Lough Feeagh

L. Feeagh was surveyed in 2009 and 2010. Length and weight of eels were examined to investigate the relationship with depth. Lough Feeagh has an average depth of 14.5 m with a maximum depth of 45 m. Summary data on length of eels in the different depth zones is presented in Table 13-6. A One way ANOVA was carried out after a log transformation resulted in normally distributed data. There was a significant difference in the length of eels and depth ($F(4, 1{,}000) = 7.330$, $p<0.001$). A Hochburg GT2 post hoc was carried out (due to the unequal sample sizes with the depth zones, Table 13-7). A significant difference in length was observed between the depth zones 0-4 m and 5-9 m ($p<0.001$) and between the 0-4 m and 15-19 m ($p<0.001$). The 0-4 m depth zone had a lower length value compared with the deeper depth zones.

Table 13-6 Length data (cm) per depth zone for Lough Feeagh

Depth	n	Av. Length (cm)	Std. Dev.
0-4 m	101	39.9	7.47
5-9 m	451	43.3	7.89
10-14 m	210	41.5	5.87
15-19 m	134	43.8	8.72
>20 m	109	41.6	6.19

Table 13-7 A Hochburg GT2 post hoc test was carried out on the length (cm) and depth (m) data for L. Feeagh

Depth zones	0-4 m	5-9 m	10-14 m	15-20 m	>20 m
0-4 m	-	p<0.001	p = 0.239 ns	p<0.001	p = 0.378 ns
5-9 m	p<0.001	-	p = 0.053 ns	p = 1.0 ns	p = 0.3 ns
10-14 m	p = 0.239ns	p = 0.053 ns	-	p = 0.079 ns	p = 1.0 ns
15-19 m	p<0.001	p = 1.0	p = 0.079 ns	-	p= 0.240 ns
>20 m	p = 0.378 ns	p = 0.300 ns	p = 1.0 ns	p = 0.240ns	-

Summary data for the weight of eels in the different depth zones are presented in Table 13-8. A one way ANOVA showed a significant difference in the weight of eels and depth zones ($F(4, 1{,}000)$, $p<0.001$). A Hochburg GT2 post hoc test was performed on the data. A significant difference was found between the weight of eels in the 0-4 m and all other depth zones, with smaller weight of eels caught in the shallower depth zone (Table 13-9).

Table 13-8 Weight data (kg) per depth zone for Lough Feeagh

Depth zones	n	Av. Weight (kg)	Std. Dev.
0-4 m	101	0.125	0.094
5-9 m	451	0.160	0.153
10-14 m	210	0.141	0.063
15-19 m	134	0.178	0.197
>20 m	109	0.141	0.061

Table 13-9 A Hochburg GT2 post hoc test was carried out on the weight and depth (m) data for L. Feeagh

Depth zones	0-4 m	5-9 m	10-14 m	15-20 m	>20 m
0-4 m	-	p<0.001	p<0.05	p<0.001	p<0.05
5-9 m	p<0.001	-	p=0.731 ns	p=0.864 ns	p=0.994 ns
10-14 m	p<0.05	p=0.731 ns	-	p = 0.172 ns	p = 1.0 ns
15-19 m	p<0.001	p=0.864 ns	p = 0.172 ns	-	p = 0.598 ns
>20 m	p<0.05	p=0.994 ns	p = 1.0 ns	p = 0.598 ns	-

13.6 Summary

For CPUE, there was no significant difference in CPUE between the three depths (0-4, 5-9, 10-14 and 15-19 m). However there was a significant difference between these depths and the >20 m depth zone; with a decrease in CPUE for nets in the >20 m. Yokouchi *et al.* (2009) found a higher catch per unit of effort for long lines set in >15 m of water compared with the <15 m depth zone in Lough Ennell. It is possible that due to the difficulty in setting fyke nets in deep waters that the CPUE is underestimated for the deeper zone (>20 m). Taking this into account there is the potential for similar CPUEs to be recorded for all depth zones analysed.

For Lough Derg, there was also no difference in the length and weight of eels from the different depth zones. However in Lough Feeagh, the lower depth zone 0-4 m had smaller eels in terms of both length and weight.

Due to difficulties involved in setting nets in water >20 m (health and safety and manual work involved), this data suggest that surveys covering at least three depth zone <20 m could provide a good coverage of the eel population in terms of length and weight. It is intended to investigate this application over the next three year programme. There is still a requirement to assess how to relate CPUE when modelling the density of eels. O'Neill *et al.* (2009) reported that the size bias of fyke nets for eels < 55- 60 cm means that the eels <55 cm cannot be related to density. However the catch caught by fyke nets is a proportion of the general lake

population (Hayes *et al.* 2007) but how to relate this proportion to density and abundance is still under investigation.

A lot of the current eel escapement models do not use lake data due to the difficulty in quantifying density in large deep water bodies. Verreault *et al.* 2004 estimated eel habitat for Lake Ontario but restricted depth to 10 m and less. The information gathered here could be helpful in assigning a CPUE to the different depth zones within a water body which could reflect a more accurate picture of the density within the lake rather than removing reference to the habitat >10 m.

14 Yellow Eel Silvering Rates

The main target of the National Management Plan is to ensure the escapement of silver eels (40% of historic/pristine levels). Local assessment will either be through a direct estimate of escapement at the silver eel stage (Burrishoole, Corrib, Erne and Shannon) or a modelled output from the yellow eel stage. In order to use the yellow eel data a maturation rate is required to give an indication of how many yellow eels migrate each year. In order to answer this question a Mark Recapture study was undertaken in four catchments (Burrishoole, Corrib, Erne and the Shannon). In 2009 and 2010 yellow eels were tagged with Passive Integrated Transponders (PIT). The silver eel catch was then checked for recaptures.

However it's not always possible to monitor the silver eel catch escaping from a catchment, so there is a need to be able to accurately predict how many eels from a yellow eel population will migrate. A number of morphological characteristics have been identified that indicate pre-migrant status of eel, i.e. that they should be expected to emigrate as silver eels in the next migrant season (Feunteun *et al.,* 2000; Durif *et al.,* 2005; Durif *et al.,* 2009). The changes both morphological and physiological that are undertaken by eels during the silvering process have been examined over the years (Fontaine, 1994; Pankhurst, 1982; Pankhurst and Lythgoes, 1982; Sorensen and Pankhurst 1988; Zacchei and Tavolaro, 1988). This had resulted in a number of silvering classification tools.

14.1 Silvering Classification Indices

Pankhurst's ocular index (1982) divided the silvering process into 2 stages. The index is based on the relationship between total length and the mean eye diameter.

$$\{[(A_R + B_R)/4]^2 \Pi/TL\}\ 100$$

Where A_R = Right Eye Horizontal; B_R = Right Eye Vertical, TL = Total Length.

Acou *et al.* (2005) elaborated on Pankhurst ocular index by combining it with 2 qualitative criteria's. The presence of a lateral line and the presence of dorso-ventral colour differentiation (Table 14-1). A coding system was created based on the occurrence of the three criteria's, with eels classified to the yellow, pre-silver and silver life stage. In this report we refer to the Acou classification as the Colour & Eye index.

A third index is based on four external measurements that are related to the morphological changes occurring during the silvering process (Durif *et al.* 2005; Durif *et al*. 2009). These measurements are total length, weight, length of pectoral fin and mean eye diameter. This classification can also be run excluding the pectoral fin length. In this report we refer to the Durif classification as the Silver Index.

Our first analysis was to compare the three methods for determining life stage classification (Acou *et al.,* 2005; Durif *et al.,* 2009; Feunteun *et al.,* 2000; Pankhurst, 1982).

The following was reported in the ICES Working Group 2010 Report

14.1.1 Example of the Galway Silver Eel Fishery (C. O'Leary unpublished data)

The Galway Silver Eel Fishery, Ireland comprises a weir with 14 coghill nets. It is located on the lower section of the catchment with a large lacustrine habitat upstream. The coghill nets (large funnel shaped fixed station nets operated in rivers or lake outlets) are fished throughout the dark moon phases and may be lifted during periods of very high water. This fishery was purchased by the state in 1978 and has been fished consistently since then. In 2009 a number of biological measurements were recorded for the eels caught in October and November. The silver eel catch in 2009 had an average length of 485 mm with a maximum length of 730 mm and a minimum length of 308 mm. The sex ratio of 66% female and 34% male was found. This dataset was used to compare the methods described in the previous section.

A simple approximation of silvering involves comparing mean eye diameter and total length of eel, as during the maturation process, the eye diameter of eels increase. However when mean eye diameter for yellow and silver eels are plotted there is no clear distinction between yellow eels and silver eels (Figure 14-1). A similar pattern is seen with the same data using Pankhurst's Ocular Index (Figure 14-2). There is considerable overlap between the yellow and silver eels as seen in both plots. Many of the silver eels are located under the ocular index of 6.5 indicating yellow or pre silvers eels within the silver eel catch although it should be noted that the use of 6.5 as a cut-off point may not be applicable in the Corrib, as based on this criteria 51% of silver eels captured in the Corrib would be classified as sexually immature (n = 57).

The Galway silver eels were analysed using 2 methods of the Durif classification. The first classification uses length, weight, fin length and mean eye diameter. The second classification used length, weight and mean eye diameter. Excluding the fin length in the analysis caused an over estimation of yellow and an underestimation of pre- silver and silver males (Figure 14-3). It is the opinion of the author that the more inclusive index (including fin length) gives a more accurate life stage classification.

14.1.1.1 Comparison between Colour& Eye Index and the Silver Index

A comparison was made between the two life stage criteria Colour and Eye Measurements (Acou *et al.,* 2005) and the Silver Index (with fin length; Durif *et al.,* 2009). The Colour & Eye Index underestimates the number of migrating eels when compared with the Silver Index, with 4% of eels classified as silver compared with 40% of eels under the Silver Index (Table 14-2 and Figure 14-4). The Colour & Eye Index appears to overestimate the pre silver eels with 52% of eels classified as pre-silver compared to 19% of eels under the Silver Index. However both classifications report similar numbers for the proportion of yellow eels in the silver eel catch 44% and 41% for the Colour & Eye Index and Silver Index respectively.

The high number of yellow eels in the silver eel catch was not expected. Are these eels actually silver eels indicating that both indexes are not suitable for use in the Corrib catchment? Or are these yellow eels migrating in stages with an initial move to the more productive transitional waters before completing the migration out of continental waters at a later date.

Table 14-1 Characteristics and coding of the criteria used to describe the silvering state of eels. Taken from Acou *et al.,* 2005

Criteria	Description	Modalities	Coding
Lateral Line	Presence of black corpuscles	True False	1 0
Colour Contrast	Typical blackish brown back/ silvery white belly Significant contrast between dorsal and ventral surfaces whatever the colour	True False	1 0
Eyes[1]	Pankhurst OI value	OI <6.5 6.5≤ OI ≤ 8.0 OI ≥ 8.0	0 1 2

[1]The OI value of 6.5 corresponds to the minimal silvering threshold value of Pankhurst (1982). The OI value of 8.0 corresponds to silvering threshold value defined by Marchelidon *et al.,* 1999 and Acou *et al.,* 2003 resulting from analysis of female eels.

Table 14-2 Stage classification (Silver Index (Durif *et al.,* 2009; Eye and Colour Index; Acou *et al.*, 2005) of migrating silver eels in the Corrib catchment

Life Stage	Silver Index %. Eels	Eye & Colour Index % eels
Yellow	41	44
Pre Silver	19	52
Silver	40	4

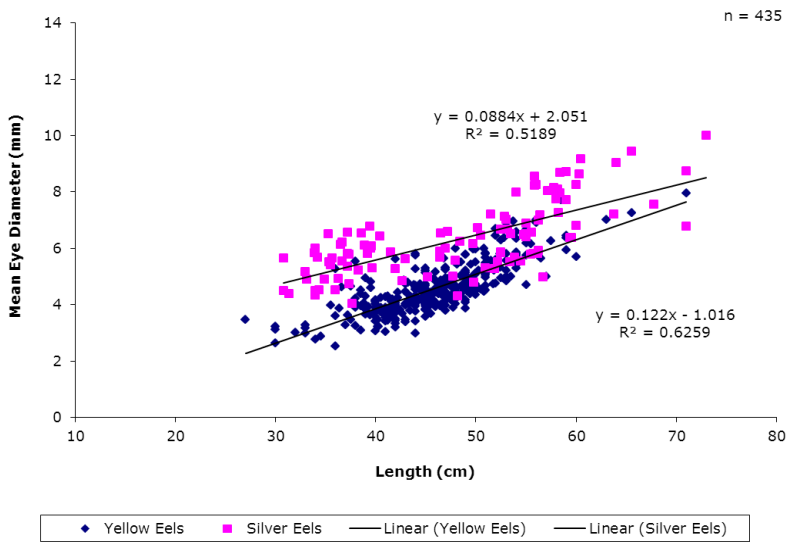


Figure 14-1 Fishery Independent yellow and fishery dependent silver eel measurements from the Corrib Catchment in 2009

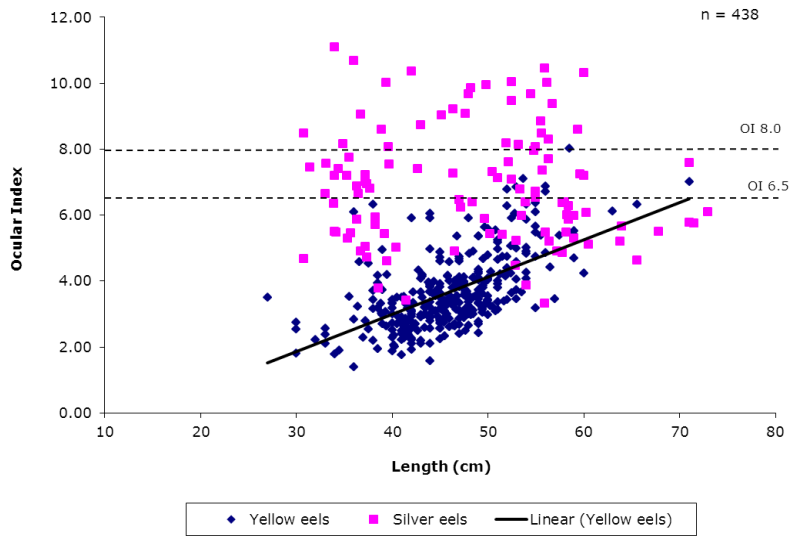


Figure 14-2 Relation between Ocular Index (OI) and total body length (cm) for yellow eels collected in the summer of 2009 (n = 327) and the silver eels collected in Autumn/Winter 2009

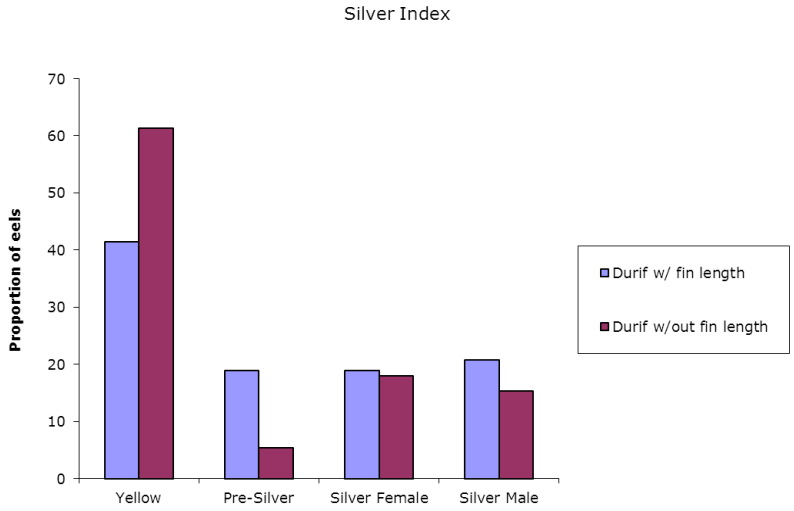


Figure 14-3 Stage classification (according to Durif *et al.* 2009) of migrating silver eels in the Corrib catchment with and without the length of the pectoral fin in the silver index

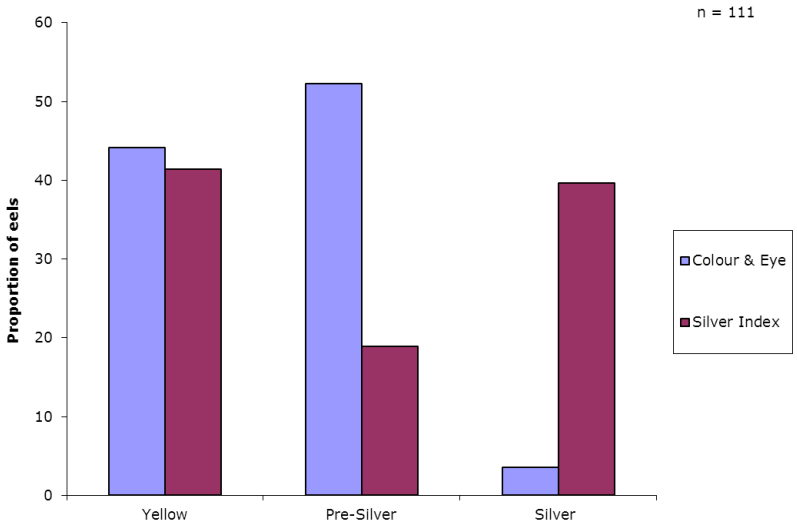


Figure 14-4 Comparison between Eye & Colour index (Acou *et al.,* 2005) and the Silver Index (Durif *et al.,* 2009). All of these eels were downstream migrants

14.2 Mark Recapture Case Study

A mark recapture experiment undertaken to determine the maturation rate of tagged yellow eels was carried out in Lough Feeagh in 2009 and 2010 (Section 5.2). The Burrishoole trapping system monitors all silver eel leaving the system, with all eels scanned for PIT tags. In 2009 and 2010, 1,045 yellow eels were tagged and released into Lough Feeagh and Lough Bunaveela. All silver eels caught in the traps were scanned for PIT tags.

14.2.1 Results

Applying the Silver Index (Durif *et al.,* 2009) to all yellow eels captured in 2009 indicates that 6% of the tagged eels in Lough Feeagh should have migrated in 2009 (life stage FIV, FV and MD, Table 14-3). However over the course of the two year mark recapture study, 26 eels matured and migrated giving a maturation rate of only 2.5% of the fyke net catch (Table 14-4). It must be taken into account that during flood conditions the traps can overflow so a small number of tagged eels could have gone undetected.

Twenty-four of the eels that migrated within the year of being tagged were not restricted to the migrating life stages (FIV, FV and MD), 50% of the eels were in the yellow eel life stage (FII) and 21% were pre silver (FIII; Table 14-5). Ten per cent of eels that waited a year before migrating were classified as Silver eels (FIV) and would have been expected to migrate within the year. The remaining 80% of the eels that waited a year were classified as yellow eels, with 10% classified as pre-silver eels.

The question must be asked how long does it take for an eel to undergo the morphological and physiological changes required to undertake the silver migration? Does it happen within a season or over a number of years? In the Burrishoole system there are tagged eels classified as yellow (FI and FII) that migrated within the year while there are tagged eels classified as silver (FIV) that waited a year before migrating. Four tagged eels were recaptured in the yellow fyke nets in 2010. One eel was classified into the silver female life stage (FV) in 2009 and reclassified as silver male in 2010 (MD; Table 14-6).

There was a slight increase in the number of eels classified to the silver life stage in the July 2009 yellow eel catch compared with the June 2009 with this number dropping for the August catch (Table 14-7). This pattern was repeated in 2010 with a higher percentage of FV and MD (Silver life stage) in the May catch compared with the August catch. Moriarty (1972) suggested that silver eels are not captured in summer fyke nets especially in August as these eels swim above the leader and will not follow it into the trap.

A silver eel targeted fyke net survey was carried out in the mouth of Lower Lough Corrib in October and November 2010. These fyke nets caught 286 eels, 54% where classified as silver (FIV and MD), 23% were classified as pre-silvers with a further 23% classified as yellow eels. This survey shows that fyke nets will catch eels classified as silver if the nets are positioned to intercept the silver eels on their migration route out of a lake.

Table 14-3 Life stage classification of eels caught in fyke nets from Lough Feeagh, using the Silver Index (Durif *et al.,* 2009)

Life stage	% 2009	Condition Factor 2009	% 2010	Condition Factor 2010
FI (yellow)	67	0.186	70	0.181
FII (yellow)	25	0.171	21	0.178
FIII (pre-silver)	3	0.164	4	0.179
FIV (silver female)	1	0.256	0	0.240
FV (silver female)	3	0.168	3	0.160
MD (silver male)	2	0.212	2	0.187

Table 14-4 Maturation rates for Burrishoole

Location	No. Tagged	No. Recaptured	Maturation Rate	Av. Condition Factor
Burrishoole 2009	546	13	2.38%	0.1926
Burrishoole 2010	472	12	2.75%	0.1834
Burrishoole Total	1,018	26	2.49%	0.1872

Table 14-5 Breakdown of life-stage of L. Feeagh eels caught in fyke nets, known to have migrated out of the system. Life stage is calculated using the Silver Index (Durif *et al.,* 2009)

Life stage	No. Migrating Eels	*% Migrating eels*	Within the Year	*% w/in year*	1 Year later	*% 1 year*
FI (yellow)	3	*10*	1	*4*	2	*29*
FII (yellow)	16	*52*	12	*50*	4	*57*
FIII (pre-silver)	5	*16*	5	*21*	0	*0*
FIV (silver female)	1	*3*	0	*0*	1	*14*
FV (silver female)	3	*10*	3	*13*	0	*0*
MD (silver male)	3	*10*	3	*13*	0	*0*

Table 14-6 Lough Feeagh non-migrating eels recaptured twice in fyke nets. Life stage is calculated using the Silver Index (Durif *et al.,* 2009)

Code	2009 Life stage	2010 Life stage	Distance travelled
0006E00B7C	FV – Silver Female	MD – Silver Male	193 m
0006E07C36	FII – Yellow	FII – Yellow	76 m
0006E0A882	FII – Yellow	FV – Silver Female	861 m
0006E001C6	FI - Yellow	FI - Yellow	1,313 m

Table 14-7 Breakdown of the Durif life stage classification by month for Lough Feeagh eels caught by fyke nets

Life stage	% June 2009	% July 2009	% Aug 2009	% May 2010	% Aug 2010
FI (yellow)	58	63	70	67	74
FII (yellow)	20	26	23	23	18
FIII (pre-silver)	2	3	4	4	4
FIV (silver female)	1	0	1	0	1
FV (silver female)	0	5	2	4	1
MD (silver male)	0	3	1	2	3

14.3 Tagged yellow eel maturation 2009- 2012

In a number of catchments where silver eel monitoring was taking place (Shannon, Corrib, Erne, Feeagh/Burrishoole); eels were tagged in the fyke net surveys with passive integrated transponder tags (PIT tag; TROVAN). In the Erne and Shannon catchments silver eels were passed through a PIT tag detector upon release from the Trap and Transport programme. The PIT detectors were assessed for accuracy in 2011. Overall, an 89% detection rate was recorded (Table 14-8). This value decreases when a large number of tagged eels are passed through the detector within a short space of time. However as the maturing tagged yellow eels are widely distributed in the population, the expected numbers per day or per ESB catch release are thought to be within the ability of the detector to detect.

Table 14-8 PIT tag accuracy test

Location	No. Tags	No. Recaptures	% Recaptured	Note
Erne	20	18	90	
Erne	45	42	93	
Erne	5	4	80	25 NUIG tags in batch
Shannon	10	9	90	1 yellow eel
Shannon	40	36	90	
Overall			89	

During the fyke net surveys only eels >30 cm were tagged; this is coupled with the bias associated with fyke net catch results in an underrepresentation of male eels. Therefore the results reported here relate to eels ≥40 cm, (female eels). The maturation rate of female yellow eels tagged in the Shannon and Erne catchments varies from 3% to 10% (Table 14-9). The data for the Shannon, Erne and Corrib have been raised to take into account the netting efficiency of the fishing locations. A nominal value of 20% was applied to the Shannon and Erne data. For the Corrib a mark recapture efficiency test was carried out in 2009 resulting in 35% of tagged eels being recaptured in the Galway Fishery (Section 15-2). The maturation rate for the Corrib is lower than the Erne and Shannon with a maturation rate of 3%.

The trap in Burrishoole is a 100% trap except under extreme flood conditions. An average maturation rate of 3% was recorded for tagged eels in Lough Feeagh. The Feeagh maturation rate is similar to the Corrib system however the results were not raised to cover non-detection. It is possible that a proportion of yellow eels went undetected. The Bunaveela maturation rate is high probably due to the position of the lake in the catchment, the eels in Bunaveela are older and it is expected that a higher proportion would mature each year compared with a lake closer to the sea.

Further work on the maturation rate of yellow eels will be undertaken over the next three years.

Table 14-9 Estimated maturation rate for female yellow eels (tagged eels >40cm).* numbers raised to take into account the efficiency of the fishery (Shannon & Erne: 20%, Corrib 35%)

Location	Year Detected	No. Tagged	No. Detected	No. Estimated	% Matured
L. Ree	2011	662	6	7	5*
Meelick bay	2011	584	5	6	5*
Upper Derg	2011	529	3	3	3*
Upr. L. Erne	2010	363	4	4	6*
Upr. L. Erne	2011	359	6	7	10*
Corrib	2009	283	3	9	3*
Feeagh	2009	330	9		3
Feeagh	2010*	321	8		2
Feeagh	2010	286	12		4
Feeagh	Total 2010†	607	20		3
Bunaveela	2009	20	3		15
Bunaveela	2010*	17	1		6
Bunaveela	2010	8	1		13
Bunaveela	Total 2010†	25	2		8

*Eels tagged in 2009 but detected in 2010.

† Sum of 2 years of tagged eels but recaptures from 2010.

15 Silver Eel Escapement

15.1 Introduction

EU Regulations (Council Regulation 1100/2007) for the recovery of the stock of European Eel requires that current spawner escapement (as silver eel) be measured against the best estimate of escapement that would have existed if no anthropogenic influences had impacted on the stock. The main aim of the regulation is for member states to increase the amount of silver eels leaving Europe to spawn. Monitoring objective 2 of the management plan is to estimate silver eel escapement. As outlined in the management plan, index sites at four catchments will be assessed annually to provide an estimate of silver eel escapement (Table 15-1). Any changes to the catch records as a result of the management actions will be visible due to the availability of historical catch records for these catchments. The four catchments are the Corrib, Erne, Shannon and the Burrishoole systems. Exploratory research was scheduled to be carried out on the Fane catchment at Lough Muckno and in Waterville.

The aim of the silver eel programme is to get quantitative estimates of silver eel escapement in order to establish current escapement and to monitor changes in these levels of escapement over time. A second objective is to collect length, weight, sex and age profiles of migrating silver eels in order to relate recruitment and yellow eel stocks to silver eel escapement. The Marine Institute monitor the Burrishoole catchment, the Electricity Supply Board and their partner NUI Galway monitor the Shannon and Erne catchments. Inland Fisheries Ireland was tasked with monitoring the Galway Fishery in the Corrib catchment and with undertaking exploratory research at Mask, Muckno and Waterville.

Table 15-1 Silver eel schedule as outlined in the National Management Plan

Catchment	Priority	2009	2010	2011	Method
Corrib	High	√		√	Coghill net/ Mark Recapture
Erne	High	√	√	√	Mark Recapture
Shannon	High	√	√	√	Coghill net/ Mark Recapture
Burrishoole	High	√	√	√	Trap
Mask	Medium		√		Coghill net/ Mark Recapture
Muckno	Medium			√	Coghill net/ Mark Recapture
Waterville	Medium			√	Fish Counter

15.2 Corrib

The Corrib catchment is ranked as number three in the country in terms of eel productivity with an estimated eel historic "pristine" productivity of 103,062 kg. It is a large system with a high proportion of wetted area tied up in productive lakes. The total wetted area is 28,869 ha split between four large lakes, Upper and Lower Lough Corrib (17,000 ha), Lough Mask (8,000 ha) and Lough Carra (1,500ha).

The Galway fishery has been a commercial fishery throughout the 20th century and detailed catch records are available since 1978. In 2009 it was fished as a scientific silver eel fishery in order to quantify the silver eel escapement leaving the Corrib system. In 2010 it was proposed to fish both the Galway fishery along with a second site located at the outflow of L. Mask. The aim of the experiment was to quantify the productivity of Lough Mask as a separate entity to the two Corrib lakes. As L. Mask is located at a greater distance from the sea it is expected to have a population dominated by females. Due to health and safety issues over the Galway fishery eel weir structure this site was not fished in 2010 or 2011.

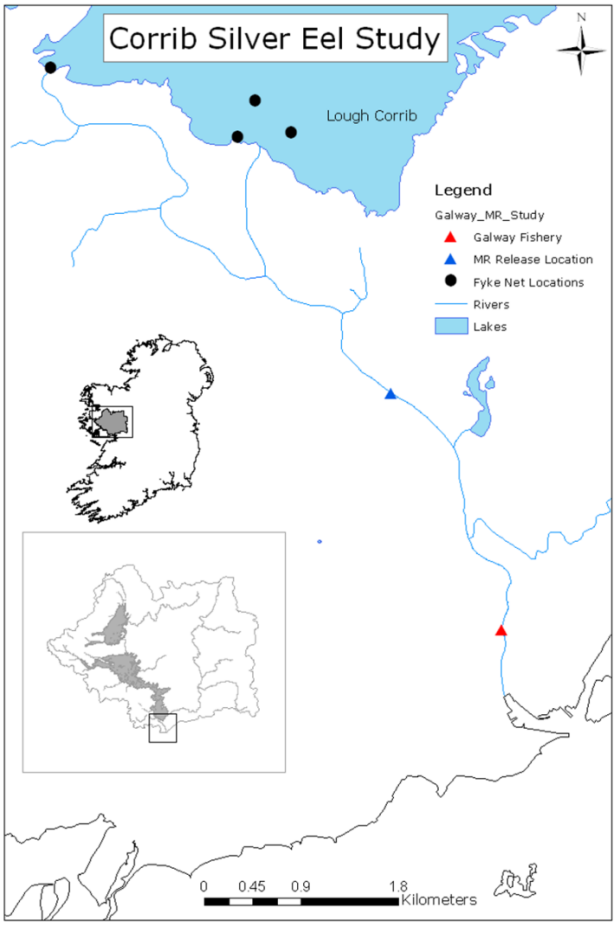


Figure 15-1 Locations of survey work carried out in the lower reaches of the Corrib system

15.2.1.1 Galway Fishery Catch

The Galway Fishery comprises a weir with 14 coghill nets. These are fished throughout the dark moon phases and may be lifted during periods of very high water. The fishery was purchased by the state in 1978 and has been fished continually since then.

The Galway Fishery silver eel weir was operated in 2009 as a scientific silver eel fishery by IFI Galway (formerly Western Regional Fisheries Board) and fished in a similar fashion to the previous commercial fishery although the catch was released downstream. Figure 15-2 shows the number of net nights and the CPUE per net night for the Galway Fishery.

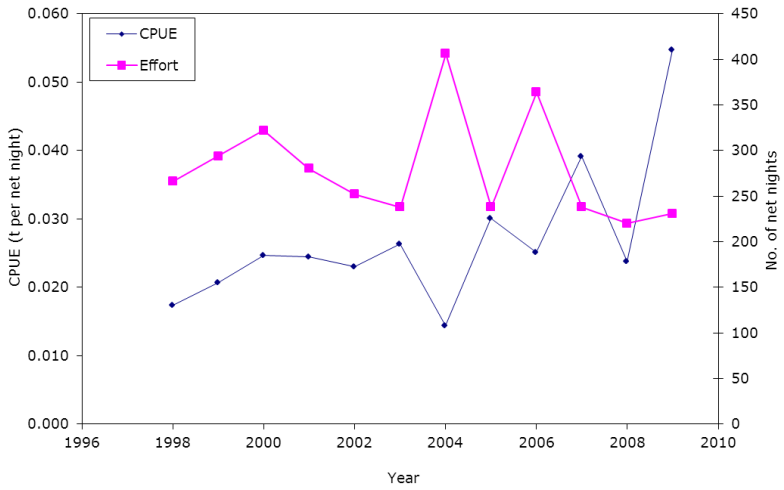


Figure 15-2 Annual CPUE and effort in net nights for the Galway silver eel fishery

All captured eels were passed through a PIT (passive integrated transponder) detector to record any maturing eels tagged in the yellow eel surveys on Lower Lough Corrib in 2009. A total catch of 12.6 tonnes of silver eels were caught from the 17th October to the 18th November with an average weight per night between 0.026 kg and 0.039 kg (Figure 15-3). This is the highest catch recorded for the Galway eel weir since 1990 when 12.05 tonnes of silvers were caught (Figure 15-4). The increase in catch in 2009 was probably contributed to by the cessation of yellow and silver eel fishing in the Corrib Catchment upstream of the Galway Fishery (reported average of 7.2 t for 2001-2007)

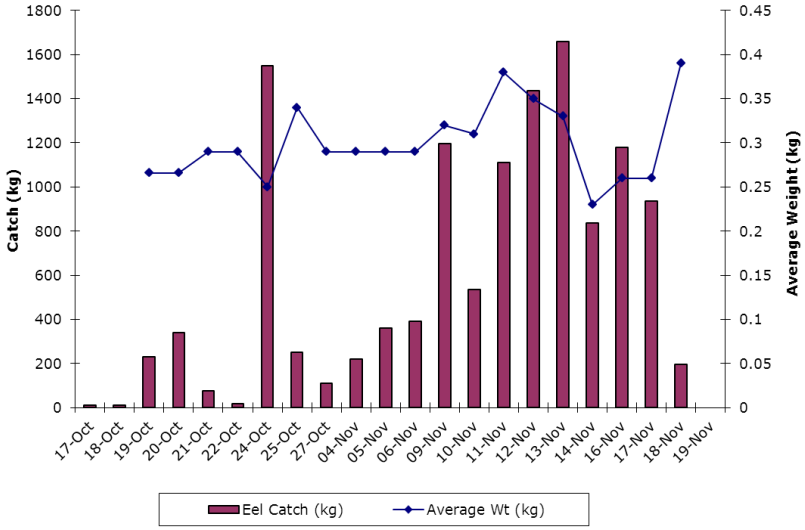


Figure 15-3 Galway fishery silver eel catch (kg) and average weight per silver eel (kg) in 2009

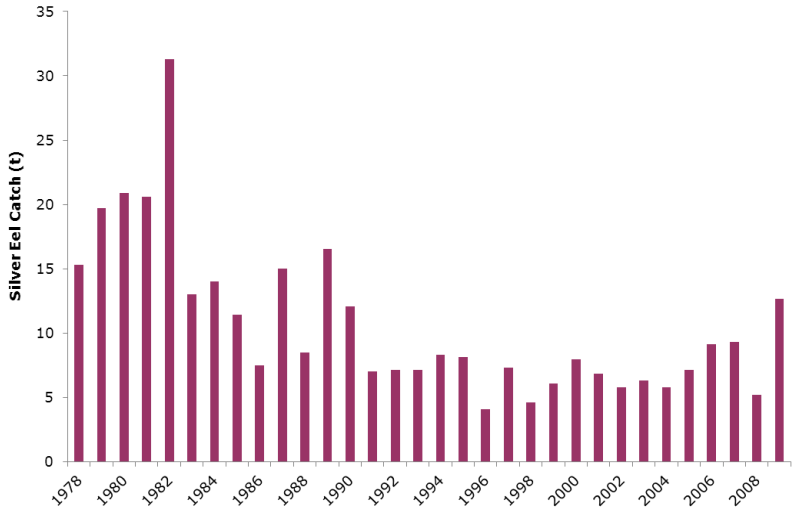


Figure 15-4 Commercial catch from Galway Weir 1978 – 2009. Note 2009 the sites was fished as a research fishery

15.2.1.2 Galway Fishery Silver Eel Escapement

To estimate the efficiency of the weir and the silver eel escapement, a Mark Recapture exercise was carried out at the Galway Fishery on two darks (October and November) with 210 and 206 eels pit-tagged after capture at the eel weir and released approx. 1 km upstream of the fishery in the Corrib River in October and November respectively (Table 15-2).

The silver eel escapement was estimated by three different methods (Table 15-3). The most appropriate may be the third method.

1. The monthly recapture rate of tagged eels was applied to the nightly catch for the relevant month (36% for October and 34% for November).
2. The average of the two recapture rates was applied to each nightly catch (35%).
3. The average of the two recapture rates (35%) was applied to the total catch (12.6 tonnes) for silver eel run.

Applying the monthly recapture rate of 36% and 34% for October and November respectively results in a total estimate of 36.13 t of silver eels escaping from the Corrib catchment in 2009 with 23.48 t of silver eels estimated to escape past the nets at the eel weir. Applying the average recapture rate of 35% implies that 23.4 t of silver eels escaped past the weir with a total escapement of 36.06 t The final method using the total catch from the weir and the average recapture rate gives an estimate of 23.48 t of silver eels escaping past the weir with a total of 36 t of silver eels escaping from the Corrib catchment. Overall, the three methods give roughly the same estimate of 36 t of silver eels escaping from the Corrib catchment. This compares to 48 t estimated current (2001-2007) production reported in the Irish EMP. Three yellow eels tagged in the summer of 2009 had matured and were also recorded by the PIT tag detector migrating as a silver eel during the autumn silver eel run.

Table 15-2 Silver eel Mark Recapture Surveys carried out at Galway fishery in 2009

Date tagged	20/10/2009	11/11/2009
No. Tagged	210	206
Total Recaptured	79	70
Aug. Dark	-	-
Sept. Dark	-	-
Oct. Dark	76	9
Nov. Dark	-	61
Dec. Dark	-	-
No. Sacrificed	53	58
Yellow Recaptures	3	0
% Recapture	36%	34%

Table 15-3 Estimated silver eel escapement for Corrib catchment

	Monthly Recapture Rate	Av. Recapture Rate (35%)	Total Recapture Rate (36%)
Capture at Weir (t)	12.65	12.65	12.65
Catch past Weir (t)	22.59	22.42	22.48
Total Escaped Eels (t)	35.23	35.70	35.13
Numbers escaped	119,822	119,157	117,248

15.2.2 Corrib Fyke Net Survey (2010 & 2011)

In early 2010 the Galway fishery structure was deemed unsafe for health and safety reasons. In order to maintain the morphological dataset collected at the Galway Fishery in 2009, fyke nets were set near the mouth of the Corrib River outflow during the silver eel season (Figure 15-1). The fyke net catch is a combination of both yellow and silver eels. In 2010, 368 eels were caught and measured for morphological measurements (Table 15-4). In 2011 only 135 eels were captured over the season.

Table 15-4 Catch per Unit of Effort for fyke nets set in Lower Lough Corrib in 2010 and 2011

Date	No Eels	Net*Nights	CPUE
07/10/2010	52	20	2.6
08/10/2010	107	20	5.35
12/10/2010	64	20	3.2
03/11/2010	92	20	4.6
04/11/2010	49	20	2.45
10/11/2010	4	20	0.2
2010	**368**	**120**	**3.07**
27/09/2011	18	20	0.9
28/09/2011	32	20	1.6
25/10/2011	20	20	1.0
26/10/2011	30	20	1.5
27/10/2011	19	20	0.95
25/11/2011	16	20	0.80
2011	**135**	**120**	**1.125**

15.2.3 Mask 2010

15.2.3.1 Catch

As outlined in the management plan Lough Mask was scheduled to be surveyed in 2010. A contracted fisherman fished the outflow of L. Mask for 6-9 nights per dark for the months of October, November and December 2010. A total catch of 2.65 tonnes (Table 15-5) was collected.

Table 15-5 Catch details from L. Mask

Month	Catch (kg)	Number Eels	Av. Weight (kg)
Oct	707	1,284	0.551
Nov	1,932	2,455	0.787
Dec	12	17	0.694
Total 2010	2,651	3,756	0.706

15.2.3.2 Lough Mask Silver Eel Escapement

To estimate the efficiency of the weir and the silver eel escapement from Lough Mask a mark recapture exercise was carried out in October and November 2010. A total of 367 eels (171 in October and 199 in November) were tagged and released 1 km upstream in Lough Mask (Table 15-6 and Figure 15-5). The recapture rate was low in both months (2% and 0.5% respectively). A geological survey of the bedrock around L. Mask shows a number of swallow holes with underground channels returning to the surface around the town of Cong. It is possible that the low recapture rate was due to tagged eels using a different outflow channel, bypassing the Cong canal and the fishing site. A number of tagged eels may have postponed migration to later in the year or to 2011 as has been found in the Erne system. However, due to the low flow and frosty conditions in December catches were small and a third mark recapture survey could not be carried out. Due to the difficulties encountered at the L. Mask site, it is currently not possible to determine a total silver eel escapement for this lough.

Table 15-6 Silver Eel Mark Recapture Study carried out in 2010 in L. Mask

Month	No Tagged	Recaptured	Efficiency %
Oct 2010	171	4	2
Nov 2010	199	1	0.5
Total	370	5	1.35

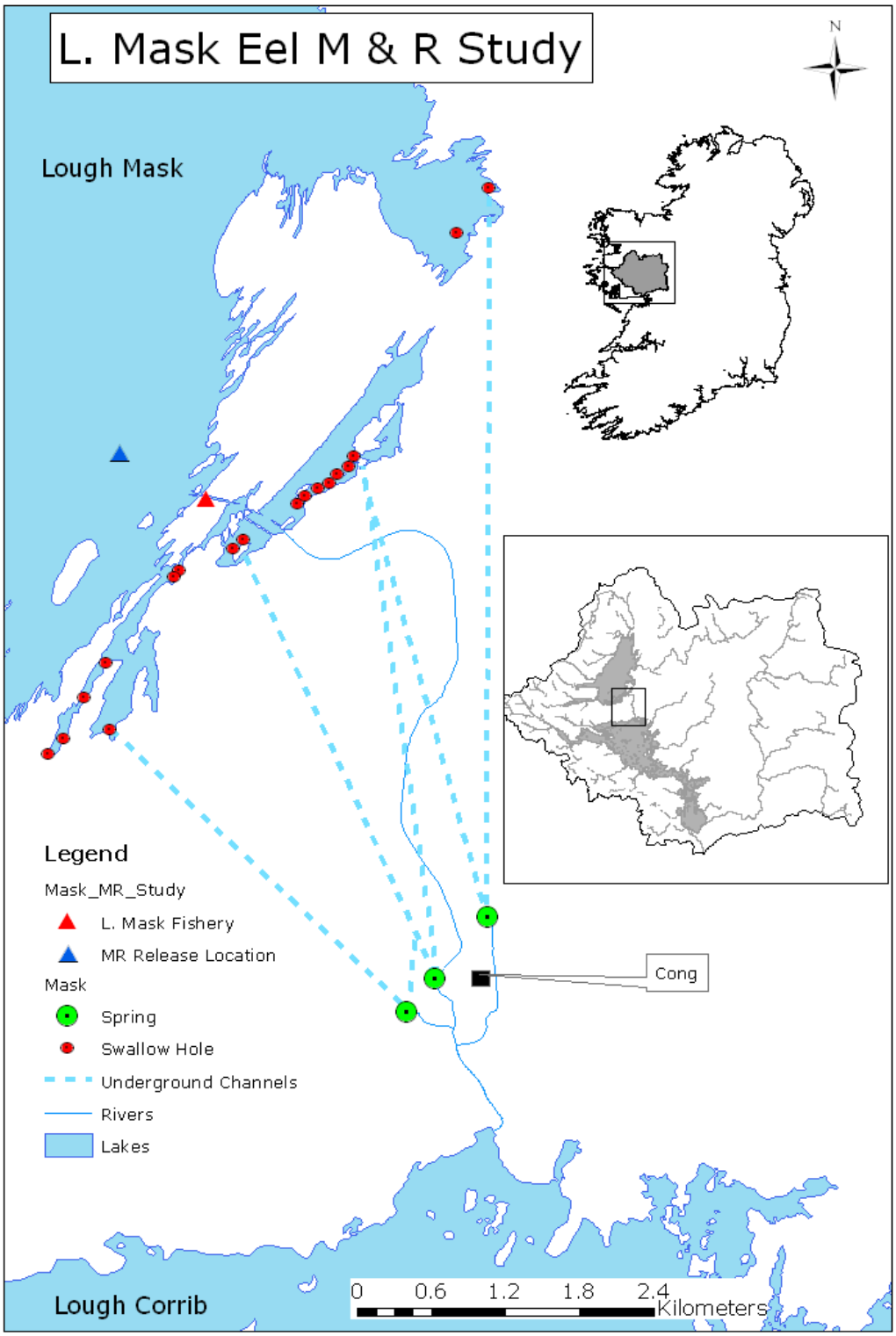


Figure 15-5 Diagram of Mark Recapture survey and rough depiction of underground channels from Lough Mask to Lough Corrib. Hydromorphology information courtesy of http://www.gsi.ie/Programmes/Groundwater/Karst+Booklet/The+western+lowlands.htm

15.2.4 Corrib Silver Eel Biology

Silver eels from the Galway fishery ranged in length from 25 cm to 81 cm and in weight from 0.041 kg to 0.933 kg (Table 15-7 and Figure 15-6). The length frequency indicates that the majority (~87%) of the eels caught at the Galway weir are females. The eels caught in the fyke nets from Lower Corrib ranged from 31 cm to 75 cm and in weight from 0.047 – 0.827 kg (Table 15-7, Figure 15-7). There are two peaks evident in the length frequency graph for the Galway fishery in 2009; this represents the male and female population. This divide is not clear in the eels caught in the fyke nets catch. Also included in Table 15-7 are the eels sampled at the Galway Fishery in 2005, 2006 and 2008. Similar length and weights were recorded for these years.

The silver eels caught upstream at Lough Mask ranged in length from 27 to 100 cm and in weight from 0.031 to 2.120 kg (Table 15-7, Figure 15-8). The smaller eels were caught in October in L. Mask with the heavier females being caught in November. There were five eels <40 cm in the fishery catch, two of these were recorded as yellow eels, the life stage of the other three is not known. Out of the eels taken for further analysis in the laboratory all eels were >50 cm.

There is no prevalence rate for the Galway fishery in 2009. The prevalence rate for *Anguillicoides crassus* for Lower Lough Corrib is 76% and 79% for 2010 and 2011. A mean intensity of 7 and 6 nematodes per eel was recorded in 2010 and 2011 (Table 15-8). The prevalence rate is slightly lower for Lough Mask with 61% recorded in 2010, along with a lower mean intensity value of 3.96 (Table 15-8).

Table 15-7 Length, weight and sex data for the Galway Fishery silver eels.* 16 eels were frozen, no fresh measurements were taken

Location	Date	Av. Length (cm)	Min. Length (cm)	Max. Length (cm)	Av. Weight (kg)	Min. Weight (kg)	Max. Weight (kg)
Corrib R.	Oct. '05	46.3	30.4	73.0	0.190	0.044	0.577
Corrib R.	Nov. '06	51.8	30.7	82.5	-	-	-
Corrib R.	Oct. '08	56.6	33.5	74.5	0.352	0.063	0.762
Corrib R.	Oct. '09	53.3	24.5	79.5	0.283	0.051	0.920
Corrib R.	Nov. '09	52.4	25.8	81.2	0.276	0.038	0.933
Corrib R.	**2009**	**52.8**	**24.5**	**81.2**	**0.280**	**0.038**	**0.933**
Lwr. Corrib	Oct.'10	51.0	30.9	75.1	0.242	0.047	0.827
Lwr. Corrib	Nov. '10	53.2	33.8	72.8	0.278	0.07	0.628
Lwr. Corrib	**2010**	**51.8**	**30.9**	**75.1**	**0.256**	**0.047**	**0.827**
Lwr. Corrib	Sep. '11	51.1	38.0	70.5	0.249	0.106	0.808
Lwr. Corrib	Oct. '11	49.8	35.0	70.5	0.239	0.066	0.626
Lwr. Corrib	Nov. '11*	-	-	-	-	-	-
Lwr. Corrib	**2011**	**50.4**	**35.0**	**70.5**	**0.244**	**0.066**	**0.808**
L. Mask	Oct. '10	69.9	26.6	99.7	0.668	0.031	2.120
L. Mask	Nov. '10	68.9	39.5	92.4	0.622	0.100	1.806
L. Mask	**2010**	**69.4**	**26.6**	**99.7**	**0.647**	**0.031**	**2.120**

Table 15-8 Summary biological data for the Corrib catchment

Location	Date	No. Eels	% female	% male	% prevalence	Mean intensity
Corrib R.	Oct. '05	382	47	53	-	-
Corrib R.	Nov. '06	202	73	27	-	-
Corrib R.	Oct. '08	115	93	-	-	-
Corrib R.	Oct. '09	53	62	38	-	-
Corrib R.	Nov. '09	57	67	33	-	-
Corrib R.	**2009**	**110**	**65**	**35**	-	-
Lwr. Corrib	Oct.'10	223	92	8	80	6.48
Lwr. Corrib	Nov. '10	145	86	14	71	8.54
Lwr. Corrib	**2010**	**368**	**89**	**11**	**76**	**7.27**
Lwr. Corrib	Sep. '11	32	94	6	75	4.88
Lwr. Corrib	Oct. '11	39	87	10	77	5.13
Lwr. Corrib	Nov. '11	16	100	0	94	11.00
Lwr. Corrib	**2011**	**87**	**92**	**7**	**79**	**6.32**
L. Mask	Oct. '10	57	100	0	56	3.87
L. Mask	Nov. '10	52	100	0	67	4.03
L. Mask	**2010**	**109**	**100**	**0**	**61**	**3.96**

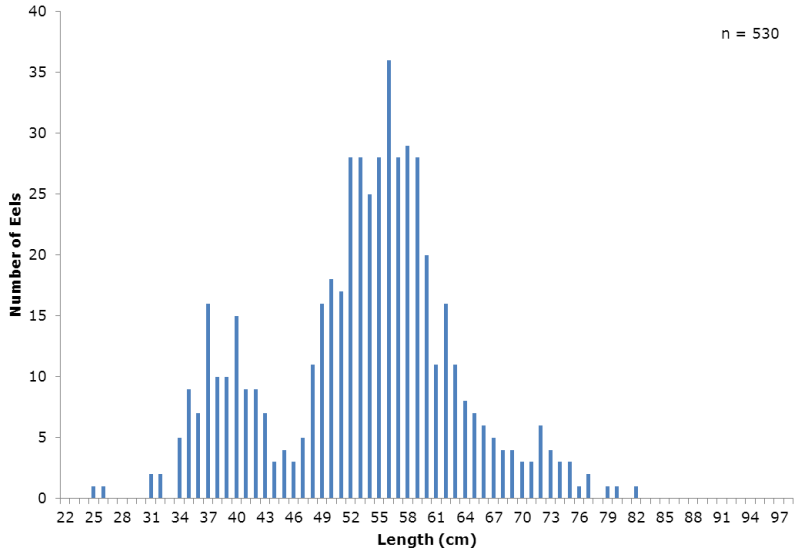


Figure 15-6 Length frequency of silver eels caught at Galway Fishery in 2009

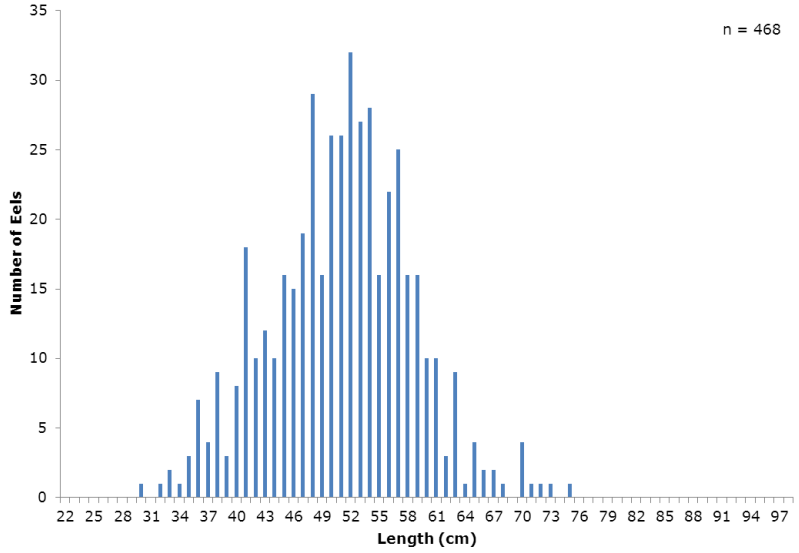


Figure 15-7 Length Frequency of silver eels caught in fyke nets in Lower L. Corrib in 2010 and 2011

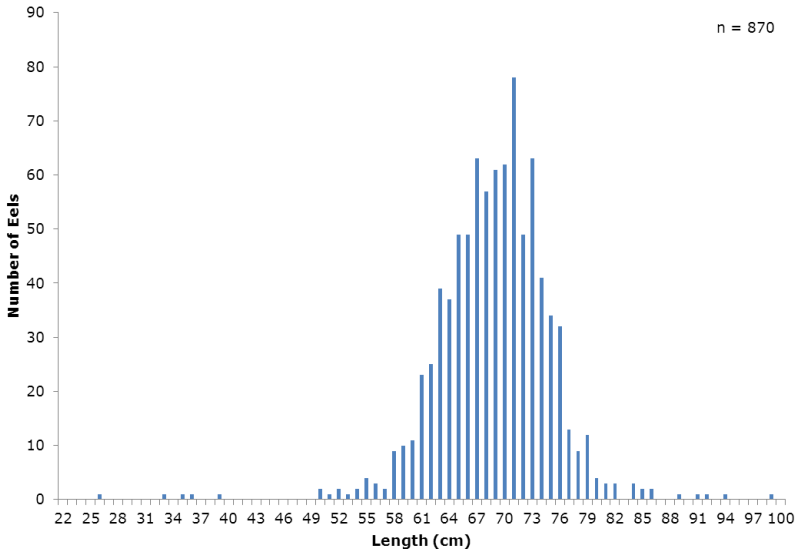


Figure 15-8 Length frequency of silver eels caught in coghill nets in the Cong canal outflow of L. Mask in 2010

15.2.5 Historical silver eel catch

Da Lafontaine *et al.* (2010) found the average size of silver eels in the St Lawrence River increased by 30% between 1997 and 2007. There also appears to be a shift in the sex ratio of silver eels sampled from the Galway fishery from the late 1970's to present (Table 15-9). The proportion of male eels in the catch has declined (Figure 15-9). It should be noted that the timing of samples can influence the results as the male eels tend to migrate early in the season with females migrating later. This is possibly due to the further distance female eels had to travel as they can be located further upstream.

Table 15-9 Historical silver eel sex ratios for Galway fishery

Year	Sex ratio (% Male)	No. Female eels	Av. Length Female eel	No. Male eels	Av. Length Male eels
2009	18	434	56.3	98	37.4
2006	17	25	52.6	5	36.7
2005	50	191	54.8	191	37.9
1989	40	60	53.1	39	36.8
1986	44	298	54.8	232	37.1
1985	50	102	55.1	103	37.7
1983	82	50	49.1	234	37.2
1982	95?	14	49.9	322	36.0
1981	78	53	50.3	188	36.0
1979	84	63	48.5	347	35.7
1978	79	24	48.4	91	36.6

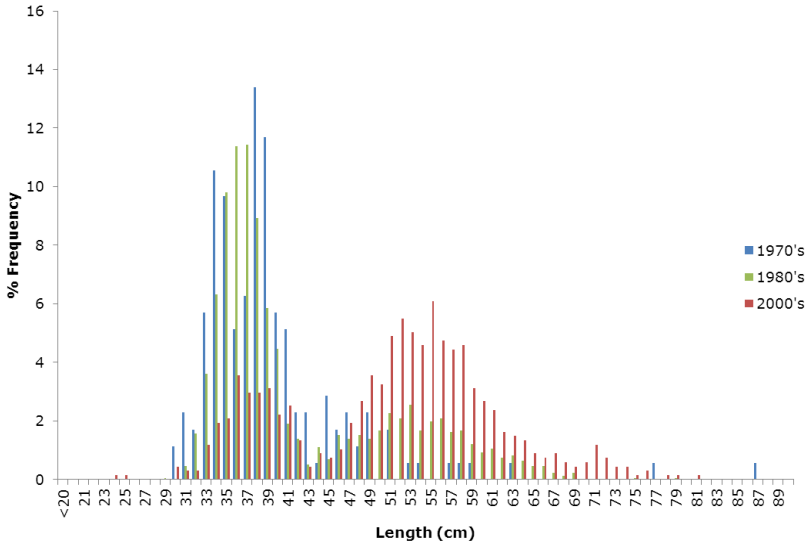


Figure 15-9 Length frequency of historical silver eel data from Galway fishery

15.3 Transboundary: Erne

All ESB trap and transport silver eel catches were scanned for the presence of tagged eels in order to determine the maturation rate of yellow eels in the Erne catchment.

15.3.1 Net Efficiency

An investigative Mark Recapture survey was carried out at the Ferny Gap site in the Lower Erne system in 2009 and in 2010. In 2009 floy tags were used and in 2010 PIT tags. The release location was also changed between years (Figure 15-10).

In 2009 three mark recapture studies were carried out in October, November and December during the silver eel migration. Each month approximately 200 silver eels were tagged with floy tags and released 2 km upstream of the nets. In total, a recapture rate of 5% was found for the three months (Table 15-10). A repeat mark recapture study was carried out the following year. In 2010 Passive Integrated Transponder (PIT) were used and the release location was changed. The October recapture rate was low with only 3 eels recaptured (Table 15-10). In November 10 eels were recaptured giving a recapture rate of 5%. The average recapture rate for the 2 years is 4%. The Roscor site downstream of Ferny gap started fishing in November 2010. Twenty five tagged eels were recaptured in November at this site giving a recapture rate of 12%. Two silver eels tagged in 2009 with floy tags delayed migration until October 2010.

The low recapture rate for this lake site, coupled with work in other catchments indicates that in order to accurately assess fishing efficiency a river site is more appropriate due to the complexities of the water flow in the lake.

Table 15-10 Mark Recapture data for the Erne catchment

Year	Month	Method	No. eels tagged	No. Recaptured	Efficiency Rate
2010	**Oct.**	PIT	210	3	1%
	Nov.	PIT	205	10	5%
2009	**Oct.**	Floy	200	10	5%
	Nov.	Floy	216	7	3%
	Dec.	Floy	201	11	5%

15.3.2 Silver eel biology

The average length of the silver eels in the Erne is between 52 cm in 2009 and 56 cm in 2010 (Table 15-11). The average weight is 0.305 kg in 2009 and 0.360 kg in 2010. The prevalence rate for the parasite *A. crassus* is 65% and 68% respectively (Table 15-12). There was a difference in the sex ratio recorded for each year with 57% of eels recorded as female in 2009 compared with 78% reported as female in 2010; this difference could be due to the smaller sample size in 2010. The length frequency graph for 2009 and 2010 combined shows the presence of both male and female eels in the catch (Figure 15-11).

Table 15-11 Length and weight data from the Lower Lough Erne site

Year	No. eels	Av. Length (cm)	Min. Length (cm)	Max. Length (cm)	Av. Wt. (kg)	Min. Wt. (kg)	Max. Wt. (kg)
2009	727	52.3	25.6	95.5	0.305	0.056	1.656
2010	480	56.4	31.7	86.2	0.360	0.063	1.330

Table 15-12 Summary biological data from the Lower Lough Erne sites

Year	No. Eels	% female	% male	% prevalence	Mean intensity
2009	110	57	43	65	8.5
2010	63	78	22	68	6.07

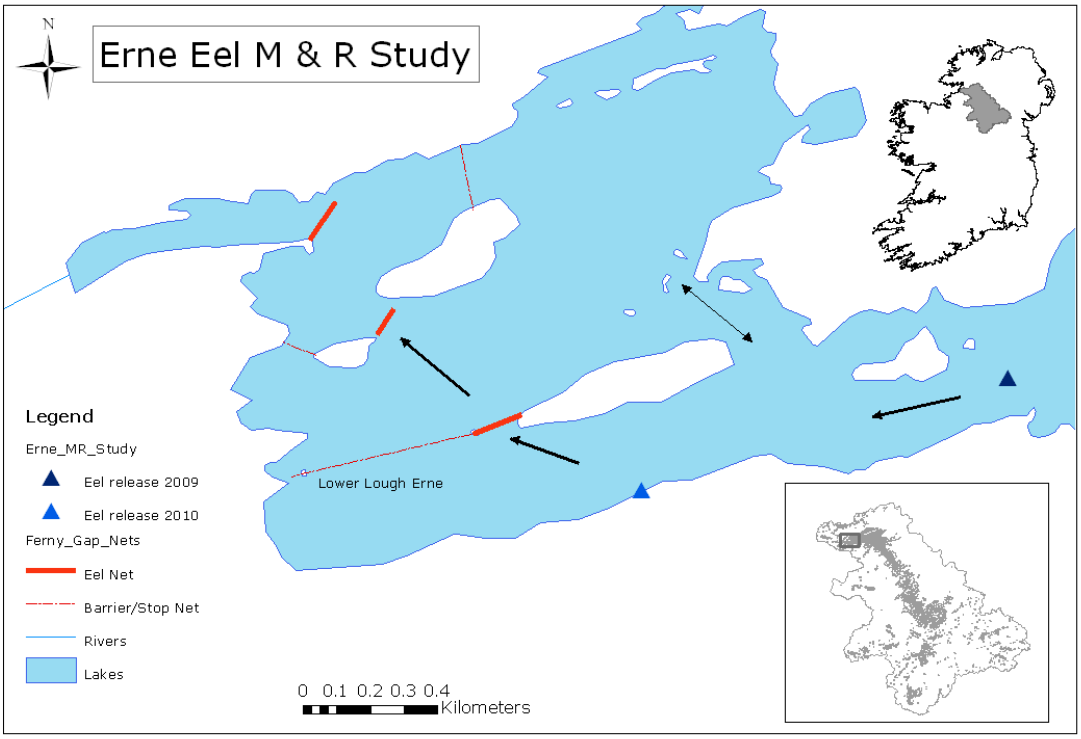


Figure 15-10 Location of mark recapture study in the Erne catchment

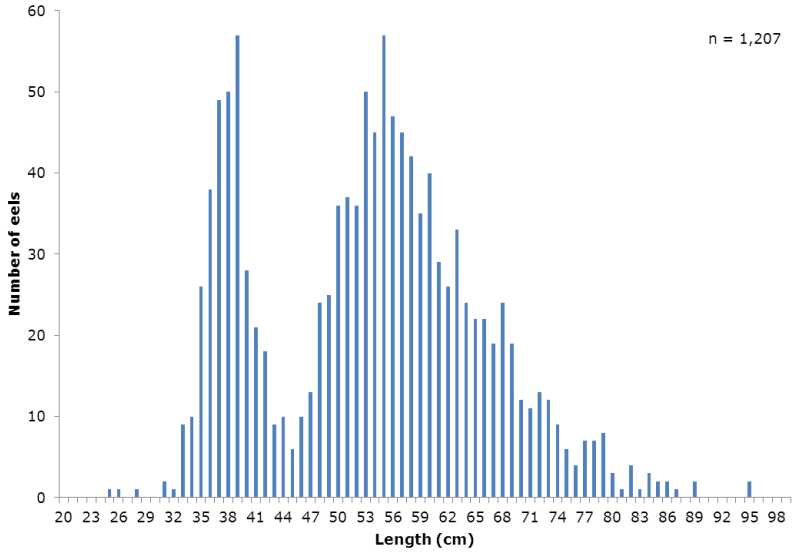


Figure 15-11 Length frequency of silver eels from Lower Lough Erne

15.4 Lough Muckno

15.4.1 Catch

A research fishery was carried out on the Clarebane River on the outflow of Lough Muckno in 2011. The site was the location of a commercial fishery until 2008. Nine nights were fished during the October dark with a catch of 277 kg, 4 nights were fished in November however only 13 kg were caught. A total catch of 290 kg of silver eels were caught for the 2011 season (Figure 15-12).

Hydrometric data courtesy of the Office of Public Works suggest that the main migration run of silver eels occurred in the month of October starting in the first week of October during the full moon as indicated by the dramatic increase in the river water depth (Figure 15-13). The contracted fishermen confirmed that recent weather patterns have resulted in one large flood early in the season which triggers the main migration run. Historically the water levels rise gradually over the course of the season with an increase in catch with the increase in flood waters. It is proposed to carry out this research fishery in 2012. The effort will be concentrated around the new moon as well as targeting the first large flood of the season.

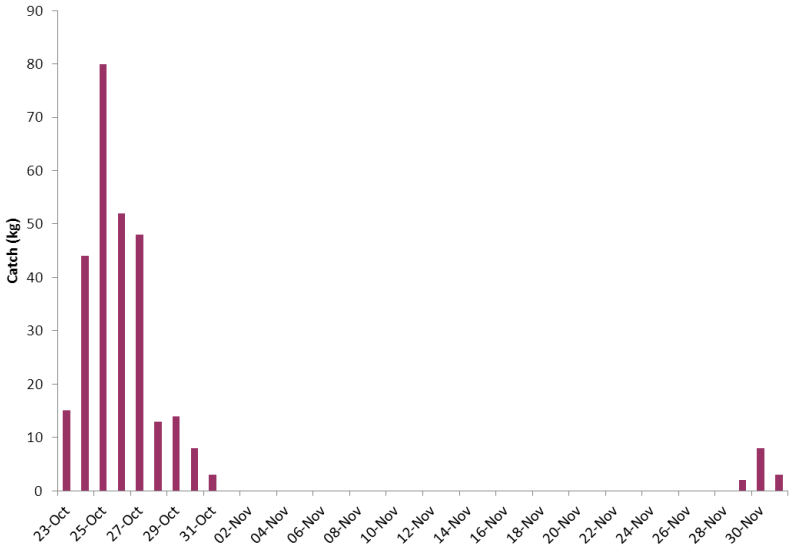


Figure 15-12 Silver eel catch from the Fane catchment 2011

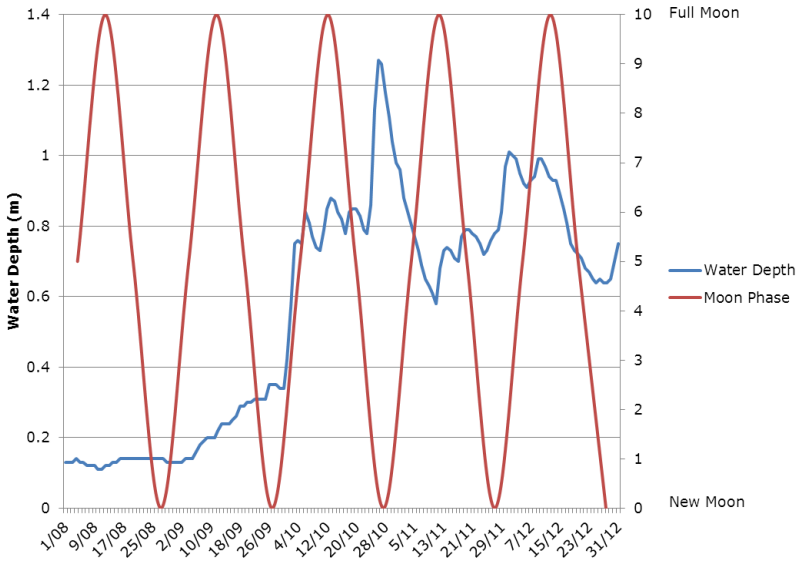


Figure 15-13 Water depth and moon cycle for the silver eel season 2011

15.4.2 Escapement

A Mark Recapture survey was carried out in the River Fane, located approximately 0.5 km downstream from the Lough Muckno outflow (Figure 15-14). Passive Integrated Transponders (PIT) tags were used to mark the eels. Eels were released at two different locations. The first release site was located in the river upstream of Lough Muckno, approximately 5 km from the fishery. The second release site was located in the lake, approximately 2 km from the fishery. Recapture rates were 31% and 15%, respectively (Table 15-13). A third release site in the Clarebane River just upstream of the fishery site is proposed for the 2012 season.

Table 15-13 Mark recapture data from the Fane catchment

Release Location	Tagged Oct.	Oct.	Nov.	Total Recaptures	% Recapture Oct.	Recapture Total Oct.
River	150	39	8	47	26	31
Lake	150	18	5	23	12	15

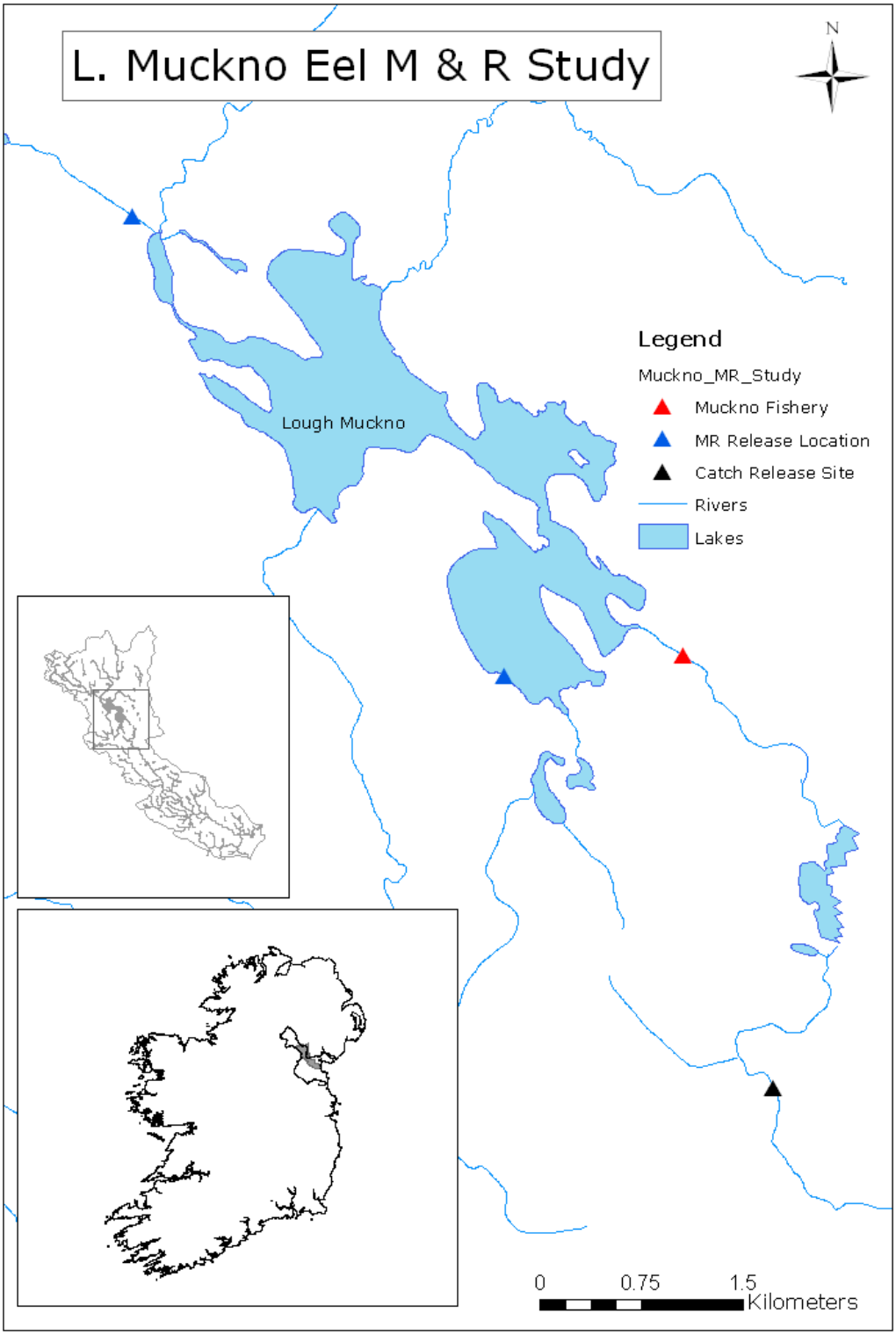


Figure 15-14 Location of Mark recapture survey in the Fane catchment

15.4.3 Silver eel biology

The silver eels in the River Fane ranged in length from 30 cm to 92 cm and in weight from 0.044 kg to 1.709 kg (Table 15-14 and Figure 15-15). There are two populations within the length frequency diagram, the first representing the male eels with the second representing the female eels.

Results showed that the sacrificed eels had a parasite prevalence rate of 28% with a mean intensity of 3.7 parasites per eel (Table 15-15). Seventy per cent of the Fane eels were male; this is in contrast with both the Corrib with 35% male in 2009 and Erne with an average of 33% male for 2009 and 2010.

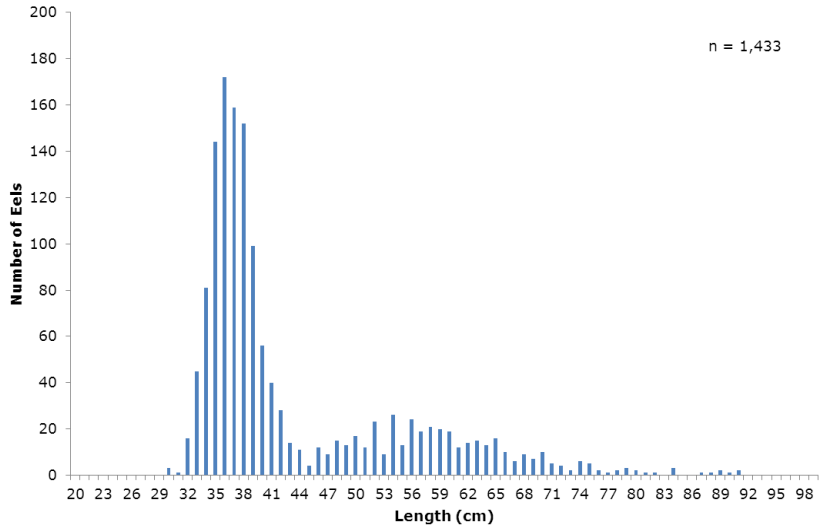


Figure 15-15 Length frequency of silver eels caught in fyke nets in the Fane river outflow of L. Muckno in 2011

Table 15-14 Length and weight data for silver eels form the River Fane

Location	Month	No. Eels	Mean length (cm)	Min. length (cm)	Max. length (cm)	Mean weight (kg)	Min. weight (kg)	Max. weight (kg)
Fane	2005	200	45.7	31.0	90.0	0.174	0.06	1.063
Muckno	Oct. '11	1,377	43.9	30.4	91.7	0.188	0.044	1.709
	Nov. '11	56	42.7	33.4	66.0	0.162	0.066	0.551
	2011	**1,433**	**43.8**	**30.4**	**91.7**	**0.187**	**0.044**	**1.709**

Table 15-15 Summary biological data of silver eels from Fane catchment

Location	Month	No. Eels	% female	% male	% prevalence *A. crassus*	Mean Intensity A. crassus	Count A. crassus
Fane	2005	100	27	73	-	-	-
Muckno	October	102	29	71	31	3.7	118
	November	56	31	69	23	3.8	49
	2011	158	30	70	28	3.7	167

15.5 Waterville

There are a large number of fish counters installed in Irish rivers around the country. While these counters are designed to count salmon it was proposed to investigate the potential of using these counters to assess the silver eel escapement. The Environment Agency in the UK undertook a similar investigation into using a resistivity counter to monitor silver eel escapement in 2010. It was decided to await the publication of this report before implementing a programme in Ireland, in order to learn from their experiences. The implementation of a similar programme in Ireland will be dependent on staff resources as the data analysis is time consuming as reported by NUIG who undertook a similar investigation using DIDSON technology.

16 Monitoring Programme: 2012 – 2015

The monitoring objectives from the National Eel Management Plan are:

1 Synthesise available information into a model based management advice tool;

2 Estimate silver Eel Escapement (in collaboration with ESB, NUIG, Marine Institute);

i. Estimate silver eel escapement indirectly using yellow eels;

3 Monitor the impact of fishery closure on yellow eel stock structure; CPUE, age and growth studies;

4 Inter-Calibration with Water Framework Sampling;

5 Compare current and historic yellow eel stocks;

6 Establish baseline data to track changes in eel stock over time;

7 Evaluate impedance of upstream colonisation: migration and water quality effects;

8 Determine parasite prevalence and eel quality (prevalence of *Anguillicoides crassus*, (swimbladder parasite) age and growth analysis).

The following sections contain a list of proposed field work for the eel monitoring programme 2012 – 2015. There is a large body of work outlined however the extent of what is achieved will be dependent of the availability of resources. Priority will be given to monitoring the recruitment of elvers to our rivers and silver eel escapement.

16.1 Elvers

Maintain and improve the national elver monitoring programme (Table 16-1)

- Introduce a 2nd site on the East coast in 2013 e.g. Boyne
- Investigate the addition of a small coastal catchment on the south coast (Kerry or Cork, preferably near an IFI base)

Table 16-1 Proposed elver monitoring locations for 2012-2015 programme

Location	Water body	Life stage	1	2.1	3	4	5	6	7	8
Ballysadare	River	Glass eel, elver, yellow	*					*	*	*
Corrib	River	Glass eel, elver, yellow	*					*	*	*
Feale	River	Glass eel, elver, yellow	*					*	*	*
Inagh	River	Glass eel, elver, yellow	*					*	*	*
Liffey	River	Glass eel, elver, yellow	*					*	*	*
Maigue	River	Glass eel, elver, yellow	*					*	*	*

16.2 Silver Eel Escapement

Table 16-2 contains the silver eel locations and the intended monitoring objectives that will be achieved.

- Carry out a 2nd year survey in Fane Catchment
    - Netting efficiency
    - Estimate escapement from catchment
    - Age/ growth/ parasite prevalence

It is intended to tender for a 2nd silver eel fishery for the years 2013 & 2014. The fishery should be located on the East coast preferably in the lower reaches of the river in a large catchment.

Table 16-2 Proposed silver eel monitoring locations for 2012-2015 programme

Location	Group	Life stage	1	2.1	3	4	5	6	7	8
Shannon	ESB	Silver	*	*			*	*	*	*
Erne	ESB	Silver	*	*			*	*	*	*
Lee	ESB	Silver	*	*			*	*	*	*
Burrishoole	MI	Silver	*	*			*	*		*
Fane	IFI	Silver	*	*			*	*		*
An other	IFI	Silver	*	*			*	*		*

16.3 Yellow Eels

See Table 16-3 for breakdown of locations and intended monitoring objectives that will be achieved.

16.3.1 Repeat Historical Lake and River surveys

- Meelick Bay, Lough Derg
- Erne Rivers/lakes
- Barrow
- Blackwater

16.3.2 Lake Surveys

- Repeat Mark recapture study of Meelick Bay
- L. Muckno
- Erne lakes e.g. L. Oughter
- Survey 3 depth zones (remove >20 m) compare with 1st 3 year programme
    - L. Ramor
    - L. Ree/ L. Derg
    - L. Feeagh
- Intensively fish some of the smaller lakes. A number of these lakes can be compared with WFD surveys. There is the potential to carry out a mark recapture study for population estimate, using a smaller and confined wetted area might result in more accurate estimates
    - Fergus catchment (Inchiquin; L. George; L. Bunny; Dromore L.; L. Fin; L. Gash)
    - Garavogue (L. Gill)
    - Ballysadare (L. Arrow)
    - Shannon (L. Key)
- The Marine Institute will continue to survey over the coming years
    - Lough Feeagh (MI)
    - Lough Bunaveela (MI)
    - Furnace (MI)

16.3.3 River

- It is intended to focus more attention on the quality of eels in riverine habitats by using the data from the WFD river sites, EREP and the Coarse Fish Unit. This data includes:
    - Morphometric analysis
    - Otolith analysis – age and growth for various locations around the country comparing age with distance to sea.
- Historical data is available for a number of river locations. The data available include CPUE, length, weight etc. The locations include:
    - River Barrow
    - River Blackwater
    - River Nore
- Eel population in canals can be investigated in cooperation with the IFI Coarse Fish Unit (CFU). The dredging operations would enable a density value to be assigned to a stretch of canal. This could be coupled with a mark recapture study. The CFU and Waterways Ireland maintain the canals and undertake numerous operations in these waterways.

16.3.4 Transitional Waters

Investigate the importance of small coastal embayment's and lagoons to the national stock. This can be accomplished in collaboration with some of the WFD transitional water surveys by increase the number of fyke nets set or by adding additional days to the survey to reach the objectives of the Eel Monitoring Programme.

- Historical data is available for
    - Waterford Estuary
    - Blackwater Estuary
    - Broadmeadow Estuary
    - South Sloblands
    - Lady's Island
    - Furnace (MI)

16.3.5 Habitat Use

Investigate the use of habitat (freshwater and transitional water) using acoustic telemetry studies. There are outstanding questions on the extent of the home range of eels as well as the seasonal migratory journey of eels between water bodies (from freshwater to transitional waters).

- Barrow catchment
- Meelick Bay, L. Derg
- Canals

Table 16-3 Proposed yellow eel monitoring locations for 2012 - 2015 programme

Location	Water body	Life stage	1	2.1	3	4	5	6	7	8
Meelick Bay, L. Derg	Lake	Yellow	*	*	*		*	*	*	*
Erne	Lake & River	Yellow	*	*	*	*	*	*	*	*
Barrow R.	River	Yellow	*	*	*	*	*	*	*	*
Blackwater	River	Yellow	*		*		*	*		*
Nore R.	River	Yellow	*		*		*	*		*
L. Ramor	Lake	Yellow	*		*			*		*
L. Ree	Lake	Yellow	*	*	*	*	*	*		*
L. Feeagh	Lake	Yellow	*	*			*	*		*
L. Gill	Lake	Yellow	*		*	*	*	*		*
L. Inchiquin	Lake	Yellow	*				*	*		*
L. Key	Lake	Yellow	*	*	*		*	*		*
Dromore L. (Fergus)	Lake	Yellow	*		*	*	*	*		*
L. Bunny	Lake	Yellow	*		*	*	*	*		*
L. Arrow	Lake	Yellow	*		*	*	*	*		*
South Sloblands	Lagoon	Yellow	*		*		*	*		*
Lady's Island	Lagoon	Yellow	*		*		*	*		*
Lough Furnace	Brackish lagoon	Yellow	*	*			*	*		*
Blackwater Estuary	T. water	Yellow	*				*	*		*

16.4 Maturation

- Shannon (PIT tag yellow eels and monitor silver eel catch)
- Erne (PIT tag yellow eels and monitor silver eel catch)
- Burrishoole (PIT tag yellow eels and monitor silver eel catch)

16.5 Age & Growth Analysis

Large body of work from last three years of Eel Monitoring Programme surveys and from the four years of WFD surveys. The otoliths of these eels are available for growth and age analysis (EMP: n = 2,400 eels; WFD: n = 1,945 eels). This analysis will benefit monitoring objective 8 referring to the quality of eels.

16.6 Eel Database

A large amount of current data has now been collected over the 1st three year programme. This data needs to be inputted into the National Eel Database. Time needs to be allotted to allow for this and for the inclusion of the outstanding historical data that came to light after the 'Eel Plan' project finished. The collation of data into the database will benefit monitoring objectives 1 and 6.

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Appendix I. Water Framework Directive Lake Surveys

Table I-1 Summary data from WFD Lake Surveys, 2010

RBD	Catchments	Lake Name	No. Nights	No. Nets	No. Eels	CPUE	Mean Length (cm)	Min. Length (cm)	Max. Length (cm)	Mean Weight (kg)	Min. Weight (kg)	Max. Weight (kg)
ERBD	Boyne	Bane	1	6	6	1.00	72.8	69.8	77.0	0.7733	0.6200	0.9680
ERBD	Boyne	Lene	1	3	1	0.33	55.6	55.6	55.6	0.2390	0.2390	0.2390
NWIRBD	Coastal	Ardderry	1	9	24	2.67	40.7	31.4	61.4	0.1357	0.0550	0.5270
NWIRBD	Lackagh	Glen	1	9	14	1.56	47.1	30.5	81.0	0.2853	0.0470	1.2800
NWIRBD	Drowes	Lattone	1	3	1	0.33	53.7	53.7	53.7	0.2380	0.2380	0.2380
NWIRBD	Erne	Macnean Lower	1	9	17	1.89	56.4	39.0	73.1	0.3735	0.0900	0.8420
NWIRBD	Erne	Macnean Upper	1	9	21	2.33	47.2	36.0	58.0	0.2018	0.0750	0.3740
NWIRBD	Erne	Erne Upper	1	18	31	1.72	49.0	38.3	60.7	0.2215	0.0960	0.4330
ShIRBD	Fergus	Atedaun	1	6	4	0.67	53.4	45.0	65.0	0.2858	0.1410	0.5270
ShIRBD	Inagh	Lickeen	1	6	23	3.83	46.7	39.2	57.0	0.1808	0.1120	0.2850
ShIRBD	Shannon Upper	Urlaur	1	6	6	1.00	67.2	54.0	81.4	0.6426	0.3260	1.2970
ShIRBD	Shannon Upper	Ree	1	36	111	3.08	46.0	34.5	59.5	0.1784	0.0650	0.4780
WRBD	Coastal	Aughrusbeg	1	9	35	3.89	43.5	31.3	71.0	0.1723	0.0720	0.6890
WRBD	Newport	Beltra	1	9	73	8.11	38.6	28.0	88.0	0.1352	0.0520	1.3140
WRBD	Garvogue	Glenade	1	6	3	0.50	50.4	47.0	56.0	0.2503	0.1880	0.3360
WRBD	Drumcliff	Glencar	1	6	8	1.33	38.0	31.7	44.0	0.1060	0.0490	0.1600
WRBD	Dawros	Kylemore	1	6	45	7.50	47.8	34.2	85.1	0.2424	0.0670	1.3640
WRBD	Corrib	Lettercraffroe	1	6	10	1.67	64.4	44.0	76.8	0.5735	0.1490	0.9960
WRBD	Corrib	Maumwee	1	6	6	1.00	55.9	40.4	64.8	0.3234	0.1070	0.5160
WRBD	Coastal	Nambrackmore	1	6	2	0.33	34.5	34.0	35.0	0.0950	0.0940	0.0960
WRBD	Kilcolgan	Rea	1	6	27	4.50	52.0	44.0	69.2	0.2809	0.1690	0.4850
WRBD	Coastal	Shindilla	1	9	22	2.44	41.1	32.2	50.0	0.1324	0.0720	0.2020

Table I-2 Summary data from WFD Lake Surveys, 2009

RBD	Catchments	Lake Name	No. Nights	No. Nets	No. Eels	CPUE	Mean Length (cm)	Min. Length (cm)	Max. Length (cm)	Mean Weight (kg)	Min. Weight (kg)	Max. Weight (kg)
ERBD	Ovoca	Tay	1	9	1	0.11	62.0	62.0	62.0	0.5090	0.5090	0.5090
ERBD	Ovoca	Dan	1	9	10	1.11	54.1	38.0	75.0	0.3269	0.0930	0.7970
NBIRBD	Fane	Muckno	3	9	3	0.33	40.7	36.0	47.0	0.1307	0.0900	0.1850
NWIRBD	Coastal	Kindrum	1	9	1	0.11	36.0	36.0	36.0	0.0820	0.0820	0.0820
NWIRBD	Coastal	Sessiagh	2	9	17	1.89	42.3	33.0	51.5	0.1438	0.0560	0.3020
NWIRBD	Coastal	Dungloe	1	9	20	2.22	40.5	31.5	52.0	0.1340	0.0620	0.3780
NWIRBD	Erne	White	1	9	1	0.11	63.5	63.5	63.5	0.4730	0.4730	0.4730
NWIRBD	Gweedore	Anure	2	9	38	4.22	42.8	31.5	62.5	0.1472	0.0620	0.3880
NWIRBD	Owenamarve	Nasnahida	1	6	2	0.33	51.0	49.0	53.0	0.2340	0.2310	0.2370
ShIRBD	Fergus	Cullaun	1	9	22	2.44	47.6	37.0	55.0	0.2081	0.1120	0.3530
ShIRBD	Fergus	Dromore	2	9	8	0.89	51.1	36.0	66.0	0.2906	0.1560	0.5920
ShIRBD	Fergus	Muckanagh	1	9	25	2.78	51.1	42.0	62.0	0.2556	0.1330	0.4560
ShIRBD	Owencashla	Caum	2	6	6	1.00	47.1	38.0	66.0	0.2333	0.0970	0.6400
ShIRBD	Shannon	Gur	2	9	8	0.89	64.6	52.0	75.0	0.5570	0.2080	0.8830
ShIRBD	Shannon	Alewnaghta	1	9	1	0.11	57.0	57.0	57.0	0.4140	0.4140	0.4140
ShIRBD	Shannon	Derg Lower	4	18	57	3.17	43.3	35.0	58.0	0.1725	0.0840	0.3940
ShIRBD	Shannon	Derg Upper	2	18	66	3.67	45.9	29.2	61.6	0.1900	0.0470	0.4500
ShIRBD	Shannon	Inchicronan	1	9	21	2.33	54.3	32.0	74.0	0.3379	0.0720	0.9450
WRBD	Ballysadare	Arrow	2	9	5	0.56	51.1	43.0	56.0	0.2216	0.1380	0.3200
WRBD	Bundorragha	Doo Lough	1	6	2	0.33	54.3	53.5	55.0	0.2380	0.2100	0.2660
WRBD	Corrib	Mask	3	27	8	0.30	49.1	40.0	61.0	0.2398	0.1140	0.4320
WRBD	Corrib	Carra	2	9	12	1.33	52.2	36.5	69.0	0.3589	0.0368	0.6660
WRBD	Fergus	Bunny	2	9	17	1.89	48.1	36.0	61.0	0.2375	0.1030	0.4660
WRBD	Moy	Cullin	1	18	48	2.67	48.7	34.0	73.4	0.2391	0.0820	0.8780

Table I-3 Summary data from WFD Lake Surveys, 2008

RBD	Catchments	Lake Name	No. Nights	No. Nets	No. Eels	CPUE	Mean Length (cm)	Min. Length (cm)	Max. Length (cm)	Mean Weight (kg)	Min. Weight (kg)	Max. Weight (kg)
ERBD	Boyne	Skeagh Upper	1	9	0	0.00	-	-	-	-	-	-
NWIRBD	Moy	Carrowmore	1	18	15	0.83	38.1	30.2	49.0	0.1203	0.0600	0.2500
NWIRBD	Erne	Corglass	1	9	9	1.00	52.7	41.0	62.0	0.2269	0.0900	0.4260
NWIRBD	Erne	Derrybrick	1	6	12	2.00	48.9	33.0	62.0	0.2418	0.0600	0.4760
NWIRBD	Coastal	Kiltooris	1	9	12	1.33	34.0	31.5	43.0	0.0763	0.0540	0.1500
NWIRBD	Easky	Easky	1	9	12	1.33	51.6	38.0	84.0	0.4053	0.1070	1.8000
NWIRBD	Leannan	Fern	1	9	30	3.33	37.6	30.0	49.0	0.1069	0.0520	0.2010
NWIRBD	Moy	Talt	1	9	3	0.33	67.8	54.0	77.0	0.6640	0.3050	0.9320
NWIRBD	Erne	Egish	1	9	1	0.11	70.5	70.5	70.5	0.4760	0.4760	0.4760
NWIRBD	Garvogue	Gill	1	18	62	3.44	44.3	32.5	75.2	0.1801	0.0590	0.8160
NWIRBD	Drowes	Melvin	1	24	74	3.08	39.2	29.0	58.1	0.1141	0.0550	0.3190
NWIRBD	Lackagh	Veagh	1	9	5	0.56	50.8	41.5	64.0	0.2532	0.1090	0.5210
NWIRBD	Ballysadare	Templehouse	1	9	6	0.67	56.1	43.2	62.2	0.3268	0.1340	0.4280
NWRBD	Gweebarra	Barra	1	9	6	0.67	38.8	29.2	46.6	0.0912	0.0390	0.1730
ShIRBD	Shannon Upper	Annaghmore	1	9	9	1.00	63.4	46.0	74.0	0.5549	0.1580	1.0500
ShIRBD	Shannon Upper	Cavetown	1	9	8	0.89	63.9	51.0	76.0	0.4371	0.2450	0.6380
ShIRBD	Shannon Lower	Meelagh	1	9	26	2.89	54.8	34.5	75.5	0.3140	0.0660	0.8580
ShIRBD	Suck	O'Flynn	1	18	19	1.06	69.0	53.3	84.0	0.4648	0.1660	0.8850
ShIRBD	Inny	Sheelin	1	18	2	0.11	57.2	49.9	64.4	0.2513	0.1250	0.3775
ShIRBD	Shannon Upper	Nanoge	1	9	4	0.44	68.1	50.3	85.0	0.7520	0.2030	1.4100
ShIRBD	Inny	Owel	1	18	1	0.06	75.8	75.8	75.8	0.7420	0.7420	0.7420
SWRBD	Coastal	Glenbeg	1	9	33	3.67	48.8	32.0	84.0	0.2552	0.0580	1.4500
SWRBD	Lee	Inniscarra	1	18	52	2.89	47.5	20.6	62.5	0.2425	0.0940	0.6510
SWRBD	Laune	Leane	3	18	30	1.67	42.5	13.5	60.0	0.1707	0.0565	0.4590
SWRBD	Caragh	Acoose	1	9	21	2.33	46.7	37.0	73.0	0.2037	0.0870	0.8500

RBD	Catchments	Lake Name	No. Nights	No. Nets	No. Eels	CPUE	Mean Length (cm)	Min. Length (cm)	Max. Length (cm)	Mean Weight (kg)	Min. Weight (kg)	Max. Weight (kg)
SWRBD	Lee	Allua	1	9	4	0.44	70.1	64.0	75.0	0.6328	0.4160	0.8400
SWRBD	Blackwater	Brin	1	6	23	3.83	45.7	30.6	54.2	0.1746	0.0410	0.2820
SWRBD	Caragh	Caragh	1	9	24	2.67	39.2	33.0	47.6	0.1155	0.0700	0.1820
SWRBD	Ovoca	Upper Lake	1	9	8	0.89	41.1	29.5	66.0	0.1349	0.0410	0.5280
WRBD	Bundorragha	Glencullin	1	6	33	5.50	43.7	28.8	70.0	0.1575	0.0410	0.5680
WRBD	Corrib	Corrib Lower	1	18	8	0.44	50.7	40.0	61.1	0.2818	0.1100	0.4545
WRBD	Corrib	Corrib Upper	1	27	28	1.04	51.8	38.5	69.0	0.2305	0.0670	0.5905

Table I-4 Summary biological data from WFD lakes, 2010.

RBD	Catchments	Lake Name	No. Eels	% Female	% Male	% Immature	% Prevalence	Mean Intensity	Parasite Count	Preferred Diet
ERBD	Boyne	Bane	5	100	0	0	0	0.00	0	*Gammarus* sp., *Asellus* sp.
ERBD	Boyne	Lene	1	100	0	0	100	1.00	1	Empty Stomachs
NWIRBD	Coastal	Ardderry	11	82	18	0	27	3.00	9	Caddisfly
NWIRBD	Lackagh	Glen	10	90	0	10	0	0.00	0	Chironomidae
NWIRBD	Drowes	Lattone	1	100	0	0	0	0.00	0	Empty Stomachs
NWIRBD	Erne	Macnean Lower	17	100	0	0	71	4.50	54	Mayfly
NWIRBD	Erne	Macnean Upper	21	95	5	0	76	3.00	48	*Asellus* sp.
ShIRBD	Fergus	Atedaun	4	100	0	0	50	1.00	2	*Asellus* sp.
ShIRBD	Inagh	Lickeen	10	100	0	0	0	0.00	0	*Asellus* sp, *Gammarus* sp.
ShIRBD	Shannon Upper	Urlaur	6	100	0	0	100	16.33	98	Empty Stomachs
WRBD	Coastal	Aughrusbeg	18	94	6	0	0	0.00	0	Empty Stomachs
WRBD	Newport	Beltra	22	77	18	5	0	0.00	0	Mollusca
WRBD	Garvogue	Glenade	3	100	0	0	0	0.00	0	Empty Stomachs
WRBD	Drumcliff	Glencar	8	63	25	12	0	0.00	0	Mollusca
WRBD	Dawros	Kylemore	14	100	0	0	0	0.00	0	Mayfly
WRBD	Corrib	Lettercraffroe	7	100	0	0	0	0.00	0	Empty Stomachs
WRBD	Corrib	Maumwee	6	100	0	0	67	6.25	25	*Gammarus* sp.
WRBD	Coastal	Nambrackmore	1	100	0	0	0	0.00	0	Empty Stomachs
WRBD	Kilcolgan	Rea	13	100	0	0	8	2.00	2	*Asellus* sp.
WRBD	Coastal	Shindilla	18	100	0	0	33	1.33	8	Mollusca

Table I-5 Summary biological data from WFD lakes, 2009.

RBD	Catchments	Lake Name	No. Eels	% Female	% Male	% Immature	% Prevalence	Mean Intensity	Parasite Count	Preferred Diet
ERBD	Ovoca	Tay	1	100	0	0	0	0.00	2	Digested material only
ERBD	Ovoca	Dan	9	100	0	0	0	0.00	0	Fish remains
NBIRBD	Fane	Muckno	2	100	0	0	0	0.00	0	Digested material only
NWIRBD	Coastal	Kindrum	1	0	100	0	0	0.00	0	Digested material only
NWIRBD	Coastal	Sessiagh	10	100	0	0	0	0.00	0	Mollusca & Caddisfly larvae
NWIRBD	Coastal	Dungloe	12	83	17	0	0	0.00	0	*Asellus*
NWIRBD	Erne	White	1	100	0	0	100	2.00	2	Digested material only
NWIRBD	Gweedore	Anure	18	89	11	0	0	0.00	0	Mollusca
NWIRBD	Owenamarve	Nasnahida	2	100	0	0	0	0.00	0	Digested material only
ShIRBD	Fergus	Cullaun	8	100	0	0	0	0.00	0	Fish remains
ShIRBD	Fergus	Dromore	6	100	0	0	0	0.00	0	*Gammarus* & fish remains
ShIRBD	Fergus	Muckanagh	11	100	0	0	0	0.00	0	*Asellus* & Mollusca
ShIRBD	Owencashla	Caum	6	100	0	0	0	0.00	0	Digested material only
ShIRBD	Shannon	Gur	7	100	0	0	0	0.00	0	Mollusca & fish remains
ShIRBD	Shannon	Alewnaghta	1	100	0	0	100	2.00	2	*Asellus*
ShIRBD	Shannon	Derg Lower	47	85	15	0	55	3.56	96	*Asellus* & fish remains
ShIRBD	Shannon	Derg Upper	66	91	9	0	52	4.15	141	*Asellus* & fish remains
ShIRBD	Shannon	Inchicronan	10	90	10	0	0	0.00	0	*Asellus*
WRBD	Ballysadare	Arrow	5	100	0	0	0	0.00	0	*Asellus* & Mollusca
WRBD	Bundorragha	Doo Lough	2	50	50	0	0	0.00	0	*Gammarus* & fish remains
WRBD	Corrib	Mask	8	100	0	0	75	2.17	13	*Asellus*
WRBD	Corrib	Carra	12	100	0	0	75	3.22	29	*Asellus* & Mollusca
WRBD	Fergus	Bunny	14	86	14	0	0	0.00	0	*Asellus, Gammarus* & fish remains
WRBD	Moy	Cullin	2	100	0	0	100	26.00	52	Fish remains

Table I-6 Summary biological data from WFD lakes, 2008.

RBD	Catchments	Lake Name	No. Eels	% Female	% Male	% Immature	% Prevalence	Mean Intensity	Parasite Count	Preferred Diet
NWIRBD	Moy	Carrowmore	15	47	40	13	0	0.00	0	Fish
NWIRBD	Erne	Corglass	6	100	0	0	83	2.60	13	*Asellus* and caddisfly
NWIRBD	Erne	Derrybrick	12	100	0	0	50	6.17	37	Caddisfly
NWIRBD	Coastal	Kiltooris	10	10	50	40	0	0.00	0	*Gammarus*
NWIRBD	Easky	Easky	10	100	0	0	0	0.00	0	Caddisfly & *Gammarus*
NWIRBD	Leannan	Fern	30	57	16	27	0	0.00	0	*Asellus*
NWIRBD	Moy	Talt	3	100	0	0	0	0.00	0	Crayfish & *Gammarus*
NWIRBD	Erne	Egish	1	100	0	0	0	0.00	0	Empty Stomachs
NWIRBD	Garvogue	Gill	32	94	0	6	72	9.30	214	Fish & *Asellus*
NWIRBD	Drowes	Melvin	74	78	7	15	0	0.00	0	*Asellus* & mayfly
NWIRBD	Lackagh	Veagh	5	100	0	0	0	0.00	0	Crayfish & fish
NWIRBD	Ballysadare	Templehouse	6	100	0	0	0	0.00	0	Caddisfly
NWRBD	Gweebarra	Barra	6	83	0	17	0	0.00	0	Caddisfly, chironomids & snails
ShIRBD	Shannon Upper	Cavetown	6	100	0	0	33	5.50	11	*Asellus*
SHIRBD	Shannon Lower	Meelagh	22	100	0	0	77	5.12	87	*Asellus* & *Gammarus*
ShIRBD	Suck	O'Flynn	7	71	14	14	14	4.00	4	*Asellus* & casddisfly
ShIRBD	Inny	Sheelin	2	100	0	0	50	15.00	15	*Asellus*
ShIRBD	Shannon Upper	Nanoge	2	100	0	0	100	9.00	18	*Asellus*
ShIRBD	Inny	Owel	1	0	100	0	0	0.00	0	Empty Stomachs
SWRBD	Coastal	Glenbeg	20	90	0	10	0	0.00	0	Fish
SWRBD	Lee	Inniscarra	5	80	0	20	0	0.00	0	Empty Stomachs
SWRBD	Laune	Leane	30	97	0	3	0	0.00	0	Snails & mayfly
SWRBD	Caragh	Acoose	21	100	0	0	0	0.00	0	*Asellus* & *Gammarus*
SWRBD	Lee	Allua	4	100	0	0	0	0.00	0	Fish
SWRBD	Blackwater	Brin	23	100	0	0	0	0.00	0	Caddisfly & *Gammarus*
SWRBD	Caragh	Caragh	23	78	0	22	0	0.00	0	*Asellus* & *Gammarus*

RBD	Catchments	Lake Name	No. Eels	% Female	% Male	% Immature	% Prevalence	Mean Intensity	Parasite Count	Preferred Diet
SWRBD	Ovoca	Upper Lake	2	100	0	0	0	0.00	0	Empty Stomachs
WRBD	Bundorragha	Glencullin	33	97	0	3	0	0.00	0	Chironomids & Beetles
WRBD	Corrib	Corrib Lower	6	100	0	0	83	8.40	42	*Asellus*, beetles & snails
WRBD	Corrib	Corrib Upper	29	100	0	0	41	6.33	76	Fish & *Asellus*

Appendix II. Water Framework Directive River Surveys

Table II-1 Summary data from WFD River Surveys, 2010

RBD	Catchment	River Name	River Site	No. Sets	No. Runs	Area (m^2)	Density (No./m^2)	No. Eels
ERBD	Ovoca	Avonbeg	Greenan Br	2	3	381.48	0.0026	1
ERBD	Boyne	Boyne	Boyne Br	1	3	936.00	0.0000	0
ERBD	Slaney	Slaney	Waterloo Br	4	3	521.63	0.0211	11
NBIRBD	Fane	Fane	Further d/s of Br in Inniskeen	3	3	375.22	0.0853	32
NWIRBD	Erne	Cullies	Br nr Kilbrackan Ho	2	3	226.50	0.0044	1
SERBD	Suir	Aherlow	Killardy Br	2	1	3248.00	0.0000	0
SERBD	Suir	Ara	Ara Br	1	1	863.60	0.0023	2
SERBD	Barrow	Barrow	Graiguenamanagh Br	4	1	31365.00	0.0007	21
SERBD	Barrow	Gowran	Br N of Goresbridge (S Channel)	2	3	214.50	0.1399	30
SERBD	Nore	Nore	Brownsbarn Br	4	1	23692.50	0.0022	51
SERBD	Nore	Nore	Quakers' Br	2	3	2184.00	0.0009	2
SERBD	Suir	Suir	Kilsheelan Br	4	1	32634.00	0.0029	95
SERBD	Suir	Suir	Knocknageragh Br	1	3	622.05	0.0016	1
SHIRBD	Shannon Upper	Ballydangan	Br u/s Shannon R. Confl	1	1	773.50	0.0000	0
ShIRBD	Shannon Upper	Shannon (Upper)	Battle Br (a)	3	1	17577.00	0.0000	0
ShIRBD	Shannon Upper	Shannon (Upper)	Battle Br (b)	3	1	6468.00	0.0000	0
ShIRBD	Shannon Upper	Shannon (Upper)	Ballyleague Br Lanesboro (a)	3	1	45628.00	0.0001	5
ShIRBD	Shannon Upper	Shannon (Upper)	Ballyleague Br Lanesboro (b)	4	1	34825.00	0.0001	3
ShIRBD	Shannon Upper	Shannon (Upper)	Athlone- Burgess Park (LHS)	4	1	44170.20	0.0001	5
ShIRBD	Shannon Upper	Shannon (Upper)	Clonmacnoise: at Jetty	4	1	37252.00	0.0001	2
SWRBD	Blackwater	Blackwater (Munster)	Lismore Br	4	1	15529.60	0.0015	23
SWRBD	Blackwater	Blackwater	Nohaval Br	2	3	2033.33	0.0015	3
SWRBD	Cummeragh	Cummeragh	Footbr. u/s Owengarriff confl	3	3	284.25	0.0035	1
SWRBD	Blackwater	Dalua	Ford and foobridge	3	3	485.25	0.0144	7

RBD	Catchment	River Name	River Site	No. Sets	No. Runs	Area (m^2)	Density (No./m^2)	No. Eels
SWRBD	Blackwater	Finisk	Modelligo Br	3	3	544.50	0.0055	3
SWRBD	Blackwater	Funshion	Br u/s Blackwater R confl	2	1	3151.00	0.0035	11
SWRBD	Lee	Lee	Leemount Br	4	1	23975.00	0.0025	59
SWRBD	Lee	Lee	Inchinossig Br	2	3	410.67	0.0049	2
SWRBD	Blackwater	Licky	Br NE of Glenlicky	2	3	318.40	0.0283	9
SWRBD	Laune	Owenreagh	Br u/s Upper Lake	4	3	1074.75	0.0177	19
SWRBD	Owvane	Owvane (Cork)	Lisheen / Piersons Br (LHS)	2	3	4339.50	0.0009	4
WRBD	Corrib	Abbert	Bridge at Bullaun	3	3	356.25	0.0000	0
WRBD	Ballysadare	Ballysadare	Ballysadare Br	4	1	7872.00	0.0034	27
WRBD	Garvogue	Bonet	1.8 km d/s Dromahaire Bridge	3	1	6326.10	0.0002	1
WRBD	Corrib	Clare	Kiltroge Castle br.	2	1	3416.40	0.0003	1
WRBD	Corrib	Clare	Corrofin Br	3	1	6118.00	0.0000	0
WRBD	Moy	Moy	Ford 2 km u/s Gweestion River	4	1	10980.67	0.0006	7
WRBD	Moy	Moy	At Bleanmore	4	1	12558.00	0.0010	12
WRBD	Moy	Moy	Cloonbaniff Br	3	3	357.75	0.0000	0
WRBD	Ballysadare	Owenmore (Sligo)	300 m u/s Unshin River confl	3	1	3196.67	0.0038	12
WRBD	Corrib	Owenriff	d/s of Lough Agraffard	3	3	304.88	0.0000	0
WRBD	Corrib	Robe	Akit Bridge	2	1	7702.50	0.0001	1
WRBD	Coastal	Screeb	d/s Loughaunfree	2	1	2499.00	0.0000	0

Table II-2 Summary data from WFD River Surveys, 2009

RBD	Catchment	River Name	River Site	No. Sets	No. Runs	Area (m^2)	Density (No./m^2)	No. Eels
ERBD	Boyne	Athboy	Br. Near Clonleasan House	2	3	266.25	0.0075	2
ERBD	Boyne	Blackwater (Kells)	Just u/s of L. Ramor	3	3	414.00	0.0290	12
ERBD	Boyne	Boyne (Boyne Br)	Boyne Br.	1	3	575.00	0.0017	1
ERBD	Boyne	Boyne (Kilcairn br)	Kilcairn Br.	4	1	5872.50	0.0000	0
ERBD	Boyne	Boyne (Railway viaduct)	Navan - Tara Mines - Viaduct	4	1	7802.67	0.0008	6
ERBD	Dargle	Dargle	1km u/s Bray Bridge	3	3	592.62	0.0591	35
ERBD	Dargle	Glencree	Br u/s Darge river confluence	3	2	341.53	0.0029	1
ERBD	Ovoca	Glenealo	Bridge d/s Upper Lake	2	3	329.67	0.0091	3
ERBD	Liffey	Liffey (Ballyward)	500 m d/s Ballyward Br	2	1	4108.00	0.0000	0
ERBD	Liffey	Liffey (Lucan)	d/s Lucan Br.	4	1	5179.20	0.0017	9
ERBD	Nanny	Nanny (Meath)	Br. @ Julianstown	3	3	504.53	0.0416	21
NBIRBD	Piedmont	Big (Louth)	Ballygoly Br.	2	3	184.18	0.0109	2
NBIRBD	Dee	Dee	Burley Br.	2	2	1050.00	0.0019	2
NBIRBD	Dee	White (Louth)	Coneyburrow Br.	2	3	263.63	0.0228	6
NWIRBD	Clady	Clady	N56 Bridge	3	3	416.67	0.0072	3
NWIRBD	Erne	Erne	Bellahillan Bridge	2	3	3615.00	0.0003	1
NWIRBD	Erne	Finn	Cumber Br	2	3	2835.00	0.0004	1
SERBD	Barrow	Barrow (Pass Br)	Pass Bridge	4	1	10905.60	0.0006	6
SERBD	Barrow	Burren	Ullard Br	2	3	187.73	0.0000	0
SERBD	Nore	Dinin (Nore)	Dinin Bridge	2	1	3389.60	0.0012	4
SERBD	Barrow	Greese	Br NE of Belan House	3	1	326.25	0.0061	2
SERBD	Nore	Kings (Kilkenny)	Kells Bridge	3	3	4100.00	0.0017	7
SERBD	Slaney	Slaney	Waterloo Bridge	1	3	846.00	0.0083	7
SERBD	Barrow	Tully stream	Soomeragh Br	1	3	177.73	0.0000	0
ShIRBD	Shannon	Ballyfinboy	Br. Just u/s Lof Lough Derg	2	3	225.00	0.0044	1
ShIRBD	Shannon	Bilboa	Br. u/s Blackboy Br. (Bilboa b)	4	3	618.13	0.0016	1

RBD	Catchment	River Name	River Site	No. Sets	No. Runs	Area (m^2)	Density (No./m^2)	No. Eels
ShIRBD	Bunratty	Broadford	Br. u/s Doon Lough	2	3	202.67	0.0444	9
ShIRBD	Caher	Caher	Br 2 km d/s of Formoyle	2	3	231.93	0.0086	2
ShIRBD	Creegh	Creegh	Drumellihy Bridge	1	3	1162.03	0.0069	8
ShIRBD	Shannon	Dead	Derraun Br.	2	3	243.00	0.0165	4
SHIRBD	Shannon	Feorish (ballyfarnon)	Bridge 1.5 km S.W. of Keadue	1	2	572.75	0.0000	0
ShIRBD	Fergus	Fergus	Poplar Bridge	2	1	4425.00	0.0002	1
ShIRBD	Annagh	Glendine	Knockloskeraun Bridge	1	3	118.28	0.1099	13
ShIRBD	Fergus	Moyree	Bridge u/s Fergus river	2	3	432.75	0.0277	12
ShIRBD	Shannon	Nenagh	Ballysoilshaun Bridge	1	3	993.60	0.0010	1
ShIRBD	Shannon	Newport (Tipperary)	Rockvale Br nr Mackney	3	2	502.00	0.0159	8
ShIRBD	Shannon	Owvane	Br. u/s (SE of) Loghill	3	3	616.50	0.2125	131
ShIRBD	Feale	Owveg (Kerry)	Owveg Br.	2	3	249.40	0.0000	0
ShIRBD	Shannon	Shannon (Upper)	Ballyleague Br. - Lanesborough	4	1	34737.50	0.0001	4
ShIRBD	Shannon	Tyshe (Ardfert)	West Br. Ardfert @ Friary	1	3	195.63	0.7719	151
SWRBD	Argideen	Argideen	Footbridge u/s of Kilamaloda Br.	3	3	547.13	0.0585	32
SWRBD	Blackwater	Awbeg (Buttevant)	Kilcummer Br.	2	1	3792.00	0.0018	7
SWRBD	Bandon	Bandon	Murragh Br.	3	1	5542.60	0.0002	1
SWRBD	Blackwater	Blackwater (Munster) (Killavullen Br.)	Killvullen Bridge	5	1	21840.00	0.0000	1
SWRBD	Blackwater	Blackwater (Munster) (Nohaval Br)	Nohaval Bridge	2	1	2029.20	0.0010	2
SWRBD	Blackwater	Bride (Waterford)	Footbridge N of Ballynella	3	1	4754.40	0.0011	5
SWRBD	Blackwater	Funshion	Brackbaun Br	3	3	405.00	0.0000	0
WRBD	Corrib	Black (Shrule)	Bridge at Kilshanvy	2	3	270.13	0.0074	2
WRBD	Dunneill	Dunneill	Donagbintrine Bri	3	3	503.75	0.0695	35
WRBD	Easky	Gowlan	Ford u/s Easky River confl	2	3	549.88	0.0000	0
WRBD	Corrib	Nanny (Tuam)	u/s Weir Bridge	1	3	727.38	0.0000	0
WRBD	Corrib	Owenbrin	Bridge u/s Lough Mask	3	3	519.00	0.0000	0

RBD	Catchment	River Name	River Site	No. Sets	No. Runs	Area (m^2)	Density (No./m^2)	No. Eels
WRBD	Kinvarra	Owendalulleegh	Br. SE of Killafeen	2	3	476.25	0.0210	10
WRBD	Ballysadare	Unshin	Riverstown Bridge	3	1	329.33	0.0000	0

Table II-3 Summary data from WFD River Surveys, 2008

RBD	Catchment	River Name	River Site	No. Sets	No. Runs	Area (m^2)	Density (No./m^2)	No. Eels
ERBD	Liffey	Dodder	Footbridge, Beaver Row	3	3	570.00	0.0509	29
ERBD	Liffey	Liffey (Kilcullen)	Kilcullen Br	3	1	8680.00	0.0003	3
ERBD	Liffey	Ryewater	Kildare Br	3	3	638.33	0.0282	18
ERBD	Vartry	Vartry	Newrath Br	2	3	1110.00	0.0018	2
NBIRBD	Blackwater	Blackwater (Monaghan)	Newmills Br	2	3	2968.00	0.0020	6
NWIRBD	Erne	Annalee	0.2km d/s Cavan R confl	3	3	2656.80	0.0011	3
NWIRBD	Clonmany	Ballyhallan (Clonmany)	Bridge u/s Clonmany River	1	3	177.00	0.0734	13
NWIRBD	Burnfoot	Burnfoot	Bridge in Burnfoot	2	3	247.04	0.0364	9
NWIRBD	Clady	Cronaniv Burn	Bridge u/s Dunlewy Lough	2	3	265.20	0.0000	0
NWIRBD	Erne	Dromore	Br in Ballybay	1	3	801.00	0.0012	1
NWIRBD	Eany Water	Eany Water	Just d/s Eany Beg/More confl	2	3	6023.70	0.0008	5
NWIRBD	Erne	Erne (Belturbet)	Kilconny Belturbet (RHS)	2	2	5587.20	0.0036	20
NWIRBD	Leannan	Glaskeelan	Bridge W. of Roshin (Lough Gartan)	2	3	228.30	0.0000	0
NWIRBD	Owentocker	Owentocker	500 m d/s Bridge in Ardara	3	3	422.70	0.0166	7
NWIRBD	Erne	Swanlinbar	0.6km d/s Swanlinbar Br	3	3	348.75	0.0115	4
NWIRBD	Swilly	Swilly	Swilly Br (near Breenagh)	2	3	320.96	0.0062	2
NWIRBD	Erne	Waterfoot	Letter Br	3	3	397.13	0.0000	0
SERBD	Suir	Anner	Drummon Br	2	3	1760.00	0.0034	6
SERBD	Nore	Ballyroan	Gloreen Br	2	3	439.50	0.0023	1
SERBD	Owenavorragh	Banoge	Br u/s Owenavorragh R confl	2	3	646.00	0.2291	148
SERBD	Slaney	Clody	Ford (Br) 3km u/s Bunclody	3	3	776.67	0.0039	3
SERBD	Colligan	Colligan	Br nr Killadangan	2	3	2464.00	0.0032	8
SERBD	Slaney	Douglas (Ballon)	Sragh Br	2	3	387.50	0.0206	8
SERBD	Suir	Duag	Br u/s Ballyporeen	2	3	372.60	0.0161	6
SERBD	Stream	Duncormick	(W) Br nr Duncormick Rly St	2	3	471.67	0.0594	28

RBD	Catchment	River Name	River Site	No. Sets	No. Runs	Area (m^2)	Density (No./m^2)	No. Eels
SERBD	Nore	Glory	Br E of Raheen	2	3	666.00	0.0075	5
SERBD	Mahon	Mahon	ENE of Seafield Ho	1	3	1836.00	0.0022	4
SERBD	Suir	Multeen	Ballygriffin Br	2	3	2100.00	0.0000	0
SERBD	Suir	Nier	Br. ENE of Ballymacarby	4	3	702.00	0.0185	13
SERBD	Nore	Nore (Quaker)	Quakers' Br	2	3	1560.00	0.0006	1
SERBD	Nore	Nuenna	Br d/s Clomantagh	2	3	361.67	0.0000	0
SERBD	Owenavorragh	Owenavorragh	Br N of Ballinamona	1	3	1280.00	0.0227	29
SERBD	Suir	Suir (Knocknageragh)	Knocknageragh Br	1	3	614.80	0.0000	0
SERBD	Slaney	Urrin	Buck's Br	2	3	535.50	0.0093	5
ShIRBD	Shannon Upr	Boor	Br NW of Kilbillaghan	2	3	460.80	0.0043	2
ShIRBD	Shannon Lwr	Bow	Bow River Br	2	3	492.30	0.0203	10
ShIRBD	Bunratty	Broadford	Just u/s South Branch confl -	2	3	288.00	0.0069	2
ShIRBD	Shannon Lwr	Brosna (Clonony)	Clonony Br (NW of canal)	4	1	8800.00	0.0001	1
ShIRBD	Shannon Lwr	Brosna (Pollagh)	0.5km NW of Pollagh	4	1	12432.00	0.0001	1
ShIRBD	Shannon Upr	Camlin	Bridge W. of Lisnabo	2	3	2801.67	0.0000	0
ShIRBD	Shannon Lwr	Clodiagh (Tullamore)	Br at Rahan	2	3	1200.80	0.0008	1
ShIRBD	Shannon Upr	Cross	Bridge u/s Shannon River	1	3	1091.20	0.0000	0
ShIRBD	Shannon Est Sth	Deel (Newcastlewest)	Bridge near Balliniska	2	3	1720.00	0.0012	2
ShIRBD	Feale	Feale	Br ENE of Duagh Ho	4	1	9765.00	0.0006	6
ShIRBD	Shannon Upr	Feorish	Bridge 1.5 km S.W. of Keadue	1	1	17511.75	0.0000	0
ShIRBD	Fergus	Fergus (Clonroad)	Bridge near Clonroad House	3	1	10068.80	0.0032	32
ShIRBD	Shannon Lwr	Glenfelly Stream	Br 3km E of Longford	1	3	274.95	0.0000	0
ShIRBD	Bunratty	Gourna	Br u/s Owenogarney R confl	2	3	340.50	0.0117	4
ShIRBD	Shannon Lwr	Graney	Caher Br, S of L.Graney	3	3	434.53	0.0046	2
SHIRBD	Inny	Inny (Mountnugent)	Mountnugent Br	1	3	1372.58	0.0000	0
ShIRBD	Inny	Inny (Oldcastle)	Br 1 km S of Oldcastle	1	3	258.00	0.0000	0
ShIRBD	Inny	Inny (Shrule)	Shrule Br	4	1	7144.00	0.0006	4

RBD	Catchment	River Name	River Site	No. Sets	No. Runs	Area (m^2)	Density (No./m^2)	No. Eels
ShIRBD	Shannon Lwr	Kilcrow	Ballyshrule Bridge	2	3	2815.20	0.0014	4
ShIRBD	Shannon Lwr	Little (Cloghan)	Br 2km SW of Cloghan	1	3	171.00	0.0000	0
ShIRBD	Shannon Lwr	Little Brosna	Riverstown Br	2	1	2130.00	0.0000	0
ShIRBD	Shannon Est Sth	Maigue	at Castleroberts_Br	4	3	14682.80	0.0030	44
ShIRBD	Shannon Upr	Scramoge	Bridge N.E. of Riverdale	2	1	2939.10	0.0003	1
ShIRBD	Shannon Upr	Shannon (Battlebridge)	Battle Br	5	1	20916.00	0.0004	8
ShIRBD	Shannon Lwr	Silver (Kilcormac)	Lumcloon Br	2	1	997.75	0.0000	0
ShIRBD	Feale	Smearlagh	Ford u/s Feale R confl (LHS)	2	3	3526.40	0.0020	7
ShIRBD	Suck	Suck (Ballyforan)	Ballyforan Bridge	4	1	12172.00	0.0005	6
ShIRBD	Suck	Suck (Cloondacarra)	Cloondacarra Bridge	2	3	1922.80	0.0005	1
ShIRBD	Shannon Lwr	Tullamore	Bridge SW of Ballycowen bridge	2	3	1281.25	0.0000	0
ShIRBD	Tyshe	Tyshe	Br nr Banna House	2	3	202.50	1.0963	222
SWRBD	Laune	Flesk	Flesk Br, S of Killarney LHS	3	1	7440.00	0.0009	7
SWRBD	Glashaboy	Glashaboy	Ballyvorisheen Br	2	3	363.00	0.0441	16
SWRBD	Laune	Gweestin	Gweestin Br	2	3	1092.00	0.0027	3
SWRBD	Lee	Lee (Inchinossig)	Inchinossig Br	2	3	2080.00	0.0000	0
SWRBD	Maine	Maine	Maine Br (Lower)	3	3	5248.00	0.0143	75
SWRBD	Lee	Martin	Bawnafinny Br	2	3	307.40	0.0163	5
SWRBD	Laune	Owenreagh	Br u/s Upper Lake	2	3	10580.00	0.0017	18
SWRBD	Maine	Shanowen	Ford (Br) u/s Maine R confl	2	3	623.33	0.0834	52
SWRBD	Womanagh	Womanagh	S of Ballyhonock Lough	1	3	618.00	0.0049	3
WRBD	Ballinglen	Ballinglen	Ballinglen Bridge	3	3	471.33	0.0594	28
WRBD	Moy	Behy	Behy Bridge	1	3	806.00	0.0000	0
WRBD	Bunowen	Bunowen	Tully Bridge	2	1	2520.00	0.0000	0
WRBD	Moy	Castlebar	Br 2.5 km d/s Castlebar	1	3	632.00	0.0807	51
WRBD	Moy	Clydagh	Br NW Ardvarney	2	3	466.50	0.0021	1
WRBD	Moy	Deel (Crossmolina)	Bridge at Castle Gore	3	3	5943.20	0.0019	11

RBD	Catchment	River Name	River Site	No. Sets	No. Runs	Area (m^2)	Density (No./m^2)	No. Eels
WRBD	Glenamoy	Glenamoy	Glenamoy Bridge	2	3	2183.60	0.0128	28
WRBD	Srahmore	Glennamong	Bridge u/s Lough Feeagh	3	3	691.50	0.0043	3
WRBD	Moy	Moy (Cloonbaniff)	Cloonbaniff Br	2	3	658.50	0.0000	0
WRBD	Moy	Tubbercurry	Br just u/s Moy River	1	3	319.65	0.0031	1

Table II-4 Summary length, weight data from WFD River Surveys, 2010

RBD	Catchment	River Name	River Site	Mean Length (cm)	Min. Length (cm)	Max. Length (cm)	Mean Weight (kg)	Min. Weight (kg)	Max. Weight (kg)
ERBD	Ovoca	Avonbeg River	Greenan Br	27.5	27.5	27.5	0.0260	0.0260	0.0260
ERBD	Slaney	Slaney	Waterloo Br	29.7	16.6	35.1	0.0491	0.0070	0.0850
NBIRBD	Fane	Fane	Further d/s of Br in Inniskeen	27.0	13.4	54.6	0.0566	0.0035	0.3235
SERBD	Suir	Ara River	Ara Br	29.1	27.8	30.4	0.0483	0.0380	0.0585
SERBD	Barrow	Barrow	Graiguenamanagh Br	36.0	18.3	68.5	0.1086	0.0090	0.5490
SERBD	Barrow	Gowran	Br N of Goresbridge (S Channel)	26.3	13.5	48.7	0.0430	0.0045	0.2390
SERBD	Nore	Nore	Brownsbarn Br	27.2	9.9	40.7	0.0417	0.0015	0.1190
SERBD	Nore	Nore	Quakers' Br	24.4	18.5	30.3	0.0355 (n=1)	0.0355 (n=1)	0.0355 (n=1)
SERBD	Suir	Suir	Kilsheelan Br	29.9	14.7	69.9	0.0617	0.0045	0.7230
SERBD	Suir	Suir	Knocknageragh Br	30.9	30.9	30.9	0.0500	0.0500	0.0500
ShIRBD	Shannon Upper	Shannon (Upper)	Ballyleague Br Lanesboro (a)	52.5	43.0	62.4	0.2674	0.1230	0.4740
ShIRBD	Shannon Upper	Shannon (Upper)	Ballyleague Br Lanesboro (b)	46.6	21.8	62.0	0.2483	0.0110	0.3940
ShIRBD	Shannon Upper	Shannon (Upper)	Athlone- Burgess Park (LHS)	46.2	26.6	63.0	0.1789	0.0200	0.4200
ShIRBD	Shannon Upper	Shannon (Upper)	Clonmacnoise: at Jetty	53.4	48.5	58.2	0.2803	0.1975	0.3630
SWRBD	Blackwater	Blackwater (Munster)	Lismore Br	27.0	12.8	57.0	0.0507	0.0060	0.3130
SWRBD	Blackwater	Blackwater	Nohaval Br	37.7	34.5	41.6	0.0910	0.0700	0.1310
SWRBD	Cummeragh	Cummeragh	Footbr. u/s Owengarriff confl	16.7	16.7	16.7	0.0065	0.0065	0.0065
SWRBD	Blackwater	Dalua	Ford and foobridge	24.3	14.6	32.6	0.0244 (n=5)	0.0045 (n=5)	0.062 (n=5)
SWRBD	Blackwater	Finisk	Modelligo Br	20.1	16.0	24.0	0.01325 (n=2)	0.0050 (n=2)	0.0215 (n=2)
SWRBD	Blackwater	Funshion	Br u/s Blackwater R confl	28.5	9.1	36.1	0.0514	0.0095	0.0935
SWRBD	Lee	Lee	Leemount Br	25.9	9.1	56.8	0.0381	0.0015	0.3180

RBD	Catchment	River Name	River Site	Mean Length (cm)	Min. Length (cm)	Max. Length (cm)	Mean Weight (kg)	Min. Weight (kg)	Max. Weight (kg)
SWRBD	Lee	Lee	Inchinossig Br	57.6	56.5	58.7	0.3060	0.2940	0.3180
SWRBD	Blackwater	Licky	Br NE of Glenlicky	21.1	9.2	32.5	0.0219	0.0010	0.0790
SWRBD	Laune	Owenreagh	Br u/s Upper Lake	22.4	12.6	35.4	0.0203	0.0030	0.0750
SWRBD	Owvane	Owvane (Cork)	Lisheen / Piersons Br (LHS)	25.9	19.7	34.2	0.0328	0.0130	0.0680
WRBD	Ballysadare	Ballysadare	Ballysadare Br	46.4	20.6	64.4	0.1869	0.0125	0.4680
WRBD	Garvogue	Bonet	1.8 km d/s Dromahaire Bridge	33.2	33.2	33.2	0.0460	0.0460	0.0460
WRBD	Moy	Moy	Ford 2 km u/s Gweestion River	34.6	18.2	46.2	0.0963	0.0600	0.1970
WRBD	Moy	Moy	At Bleanmore	28.6 (n=11)	16.3 (n=11)	41 (n=11)	0.0485 (n=11)	0.0055 (n=11)	0.1145 (n=11)
WRBD	Ballysadare	Owenmore (Sligo)	300 m u/s Unshin River confl	38.7	22.8	53.8	0.1255	0.0170	0.3600
WRBD	Corrib	Robe	Akit Bridge	71.0	71.0	71.0	0.5700	0.5700	0.5700

Table II-5 Summary length, weight data from WFD River Surveys, 2009

RBD	Catchment	River Name	River Site	Mean Length (cm)	Min. Length (cm)	Max. Length (cm)	Mean Weight (kg)	Min. Weight (kg)	Max. Weight (kg)
ERBD	Boyne	Athboy	Br. Near Clonleasan House	42.5	37.8	47.2	0.123	0.084	0.162
ERBD	Boyne	Blackwater (Kells)	Just u/s of L. Ramor	20.1	10.8	36.5	0.016	0.002	0.071
ERBD	Boyne	Boyne (Boyne Br)	Boyne Br.	30.7	30.7	30.7	0.045	0.045	0.045
ERBD	Boyne	Boyne (Railway viaduct)	Navan - Tara Mines - Viaduct	37.8	28.9	53.4	0.104	0.032	0.285
ERBD	Dargle	Dargle	1km u/s Bray Bridge	17.0	10.3	29.7	0.010	0.002	0.034
ERBD	Dargle	Glencree	Br u/s Darge river confluence	41.6	41.6	41.6	0.103	0.103	0.103
ERBD	Ovoca	Glenealo	Bridge d/s Upper Lake	22.8	21.7	23.4	0.019	0.016	0.022
ERBD	Liffey	Liffey (Lucan)	d/s Lucan Br.	36.8	21.2	60.0	0.137	0.015	0.534
ERBD	Nanny	Nanny (Meath)	Br. @ Julianstown	21.4	10.6	36.7	0.024	0.002	0.095
NBIRBD	Piedmont	Big (Louth)	Ballygoly Br.	12.7	12.4	13.0	0.003	0.003	0.004
NBIRBD	Dee	Dee	Burley Br.	27.3	23.0	31.5	0.040	0.022	0.058
NBIRBD	Dee	White (Louth)	Coneyburrow Br.	30.0	16.6	37.6	0.048	0.008	0.092
NWIRBD	Clady	Clady	N56 Bridge	26.1	15.0	36.6	0.035	0.005	0.071
NWIRBD	Erne	Erne	Bellahillan Bridge	28.5	28.5	28.5	0.037	0.037	0.037
NWIRBD	Erne	Finn	Cumber Br	32.6	32.6	32.6	0.051	0.051	0.051
SERBD	Barrow	Barrow (Pass Br)	Pass Bridge	51.4	46.0	58.0	0.241	0.152	0.348
SERBD	Nore	Dinin (Nore)	Dinin Bridge	30.0	14.7	46.5	0.065	0.005	0.168
SERBD	Barrow	Greese	Br NE of Belan House	40.8	32.1	49.5	0.124	0.050	0.198
SERBD	Nore	Kings (Kilkenny)	Kells Bridge	36.0	25.6	46.0	0.103	0.026	0.224
SERBD	Slaney	Slaney	Waterloo Bridge	30.4	21.2	36.0	0.057	0.015	0.094
ShIRBD	Shannon	Ballyfinboy	Br. Just u/s Lof Lough Derg	33.7	33.7	33.7	0.053	0.053	0.053
ShIRBD	Shannon	Bilboa	Br. u/s Blackboy Br. (Bilboa b)	28.0	28.0	28.0	0.036	0.036	0.036
ShIRBD	Bunratty	Broadford	Br. u/s Doon Lough	27.1	15.2	46.9	0.041	0.005	0.165
SHIRBD	Caher	Caher	Br 2 km d/s of Formoyle	33.7	31.5	35.9	0.060	0.059	0.061
ShIRBD	Creegh	Creegh	Drumellihy Bridge	26.3	17.1	34.5	0.035	0.009	0.065

RBD	Catchment	River Name	River Site	Mean Length (cm)	Min. Length (cm)	Max. Length (cm)	Mean Weight (kg)	Min. Weight (kg)	Max. Weight (kg)
ShIRBD	Shannon	Dead	Derraun Br.	33.6	25.7	48.0	0.099	0.022	0.294
ShIRBD	Fergus	Fergus	Poplar Bridge	38.0	38.0	38.0	0.083	0.083	0.083
ShIRBD	Annagh	Glendine	Knockloskeraun Bridge	19.4	10.9	36.4	0.017	0.002	0.074
ShIRBD	Fergus	Moyree	Bridge u/s Fergus river	30.6	19.2	45.6	0.061	0.011	0.176
ShIRBD	Shannon	Nenagh	Ballysoilshaun Bridge	29.5	29.5	29.5	0.043	0.043	0.043
ShIRBD	Shannon	Newport (Tipperary)	Rockvale Br nr Mackney	38.7	24.9	50.7	0.109	0.021	0.220
ShIRBD	Shannon	Owvane	Br. u/s (SE of) Loghill	17.8	7.9	35.7	0.013	0.001	0.100
ShIRBD	Shannon	Shannon (Upper)	Ballyleague Br. - Lanesborough	44.6	35.4	53.5	0.151	0.068	0.226
ShIRBD	Shannon	Tyshe (Ardfert)	West Br. Ardfert @ Friary	16.1	8.2	34.6	0.008 (n=150)	0.001 (n=150)	0.066 (n=150)
SWRBD	Argideen	Argideen	Footbridge u/s of Kilamaloda Br.	23.9	13.4	34.6	0.026	0.004	0.078
SWRBD	Blackwater	Awbeg (Buttevant)	Kilcummer Br.	28.5	11.9	40.2	0.056	0.003	0.110
SWRBD	Bandon	Bandon	Murragh Br.	27.0	27.0	27.0	0.059	0.059	0.059
SWRBD	Blackwater	Blackwater (Munster) (Killavullen Br.)	Killvullen Bridge	24.5	24.5	24.5	0.025	0.025	0.025
SWRBD	Blackwater	Blackwater (Munster) (Nohaval Br)	Nohaval Bridge	28.7	25.5	31.8	0.039	0.030	0.048
SWRBD	Blackwater	Bride (Waterford)	Footbridge N of Ballynella	22.9	15.3	35.5	0.033	0.004	0.094
WRBD	Corrib	Black (Shrule)	Bridge at Kilshanvy	50.0	48.2	51.7	0.186	0.119	0.254
WRBD	Dunneill	Dunneill	Donagbintrine Bri	24.4	10.0	34.6	0.028	0.001	0.070
WRBD	Kinvarra	Owendalulleegh	Br. SE of Killafeen	31.8	21.9	47.6	0.067	0.017	0.230

Table II-6 Summary length, weight data from WFD River Surveys, 2008

RBD	Catchment	River Name	River Site	Mean Length (cm)	Min. Length (cm)	Max. Length (cm)	Mean Weight (kg)	Min. Weight (kg)	Max. Weight (kg)
ERBD	Liffey	Dodder	Footbridge, Beaver Row	25.57	7.00	59.50	0.045	0.001	0.379
ERBD	Liffey	Liffey (Kilcullen)	Kilcullen Br	60.00	57.50	63.80	0.433	0.331	0.544
ERBD	Liffey	Ryewater	Kildare Br	32.19	8.00	53.20	0.083 (n=17)	0.011 (n=17)	0.268 (n=17)
ERBD	Vartry	Vartry	Newrath Br	15.50	10.00	21.00	0.011	0.002	0.020
NBIRBD	Blackwater	Blackwater (Monaghan)	Newmills Br	32.1 (n=5)	24.5 (n=5)	40.2 (n=5)	0.095 9 (n=5)	0.02 (n=5)	0.285 (n=5)
NWIRBD	Erne	Annalee	0.2 km d/s Cavan R confl	47.17	35.20	63.10	0.246	0.085	0.533
NWIRBD	Clonmany	Ballyhallan (Clonmany)	Bridge u/s Clonmany River	22.39	12.90	28.60	0.018	0.003	0.040
NWIRBD	Burnfoot	Burnfoot	Bridge in Burnfoot	19.74	11.50	29.10	0.016	0.003	0.052
NWIRBD	Erne	Dromore	Br in Ballybay	54.50	54.50	54.50	0.292	0.292	0.292
NWIRBD	Eany Water	Eany Water	Just d/s Eany Beg/More confl	34.30	20.00	53.50	0.039 (n=4)	0.008 (n=4)	0.099 (n=4)
NWIRBD	Erne	Erne (Belturbet)	Kilconny Belturbet (RHS)	44.21	21.50	56.50	0.179	0.021	0.460
NWIRBD	Owentocker	Owentocker	500 m d/s Bridge in Ardara	29.86	21.20	37.00	0.048	0.014	0.076
NWIRBD	Erne	Swanlinbar	0.6km d/s Swanlinbar Br	34.80	30.00	42.10	0.069	0.044	0.108
NWIRBD	Swilly	Swilly	Swilly Br (near Breenagh)	16.00	12.80	19.20	0.007	0.003	0.011
SERBD	Suir	Anner	Drummon Br	29.97	24.20	37.90	0.043	0.021	0.101
SERBD	Nore	Ballyroan	Gloreen Br	37.20	37.20	37.20	0.109	0.109	0.109
SERBD	Owenavorragh	Banoge	Br u/s Owenavorragh R confl	22.10 (n=146)	9.00 (n=146)	39.50 (n=146)	0.024 (n=144)	0.001 (n=144)	0.116 (n=144)
SERBD	Slaney	Clody	Ford (Br) 3km u/s Bunclody	28.03	22.60	34.30	0.039	0.016	0.067
SERBD	Colligan	Colligan	Br nr Killadangan	23.81	13.50	33.80	0.029	0.004	0.058
SERBD	Slaney	Douglas (Ballon)	Sragh Br	26.94	13.50	44.00	0.043	0.005	0.114
SERBD	Suir	Duag	Br u/s Ballyporeen	26.20	6.20	33.90	0.045	0.016	0.065
SERBD	Stream	Duncormick	(W) Br nr Duncormick Rly St	14.26	8.10	28.50	0.008	0.001	0.039
SERBD	Nore	Glory	Br E of Raheen	28.70	21.40	38.30	0.047	0.016	0.093
SERBD	Mahon	Mahon	ENE of Seafield Ho	32.80	8.60	64.50	0.187 (n=3)	0.002 (n=3)	0.520 (n=3)

RBD	Catchment	River Name	River Site	Mean Length (cm)	Min. Length (cm)	Max. Length (cm)	Mean Weight (kg)	Min. Weight (kg)	Max. Weight (kg)
SERBD	Suir	Nier	Br. ENE of Ballymacarby	23.24	12.50	43.50	0.031	0.005	0.140
SERBD	Nore	Nore (Quaker)	Quakers' Br	46.60	46.60	46.60	0.156	0.156	0.156
SERBD	Owenavorragh	Owenavorragh	Br N of Ballinamona	26.89	7.70	48.70	0.047	0.001	0.201
SERBD	Slaney	Urrin	Buck's Br	29.22	21.40	34.70	0.051	0.015	0.084
ShIRBD	Shannon Upr	Boor	Br NW of Kilbillaghan	31.80	29.50	34.10	0.046	0.035	0.057
ShIRBD	Shannon Lwr	Bow	Bow River Br	33.29	27.60	42.10	0.066	0.031	0.123
ShIRBD	Bunratty	Broadford	Just u/s South Branch confl -	19.55	18.20	20.90	0.012	0.009	0.015
ShIRBD	Shannon Lwr	Brosna (Clonony)	Clonony Br (NW of canal)	60.00	60.00	60.00	0.337	0.337	0.337
ShIRBD	Shannon Lwr	Brosna (Pollagh)	0.5km NW of Pollagh	68.00	68.00	68.00	0.665	0.665	0.665
ShIRBD	Shannon Lwr	Clodiagh (Tullamore)	Br at Rahan	46.10	46.10	46.10	0.141	0.141	0.141
ShIRBD	Shannon Est Sth	Deel (Newcastlewest)	Bridge near Balliniska	44.30	41.60	47.00	0.142	0.116	0.167
ShIRBD	Feale	Feale	Br ENE of Duagh Ho	26.92	14.10	33.60	0.047	0.004	0.082
ShIRBD	Fergus	Fergus (Clonroad)	Bridge near Clonroad House	30.80	13.60	58.00	0.075 (n=28)	0.005 (n=28)	0.334 (n=28)
ShIRBD	Bunratty	Gourna	Br u/s Owenogarney R confl	13.13	7.10	24.40	0.008	0.001	0.028
ShIRBD	Shannon Lwr	Graney	Caher Br, S of L.Graney	36.20	36.20	36.20	0.074	0.074	0.074
ShIRBD	Inny	Inny (Shrule)	Shrule Br	49.93	29.50	76.10	0.326	0.041	0.900
ShIRBD	Shannon Lwr	Kilcrow	Ballyshrule Bridge	50.80	42.30	60.10	0.274	0.139	0.431
ShIRBD	Shannon Est Sth	Maigue	at Castleroberts_Br	26.24	9.20	46.50	0.045 (n=42)	0.003 (n=42)	0.186 (n=42)
ShIRBD	Shannon Upr	Scramoge	Bridge N.E. of Riverdale	48.60	48.60	48.60	0.174	0.174	0.174
ShIRBD	Shannon Upr	Shannon (Battlebridge)	Battle Br	43.14	25.00	59.30	0.147	0.025	0.302
ShIRBD	Feale	Smearlagh	Ford u/s Feale R confl (LHS)	24.94	13.60	31.80	0.026	0.004	0.054
ShIRBD	Suck	Suck (Ballyforan)	Ballyforan Bridge	40.75	31.20	56.00	0.117	0.036	0.277
ShIRBD	Tyshe	Tyshe	Br nr Banna House	13.68	6.90	32.40	0.006	0.001	0.065
SWRBD	Laune	Flesk	Flesk Br, S of Killarney LHS	21.93	13.90	35.50	0.021	0.003	0.065
SWRBD	Glashaboy	Glashaboy	Ballyvorisheen Br	26.76	11.40	38.40	0.035	0.002	0.101
SWRBD	Laune	Gweestin	Gweestin Br	30.80	26.90	34.60	0.075	0.062	0.088

RBD	Catchment	River Name	River Site	Mean Length (cm)	Min. Length (cm)	Max. Length (cm)	Mean Weight (kg)	Min. Weight (kg)	Max. Weight (kg)
							(n=2)	(n=2)	(n=2)
SWRBD	Maine	Maine	Maine Br (Lower)	18.14	2.00	35.50	0.020	0.001	0.097
SWRBD	Lee	Martin	Bawnafinny Br	35.24	19.30	55.20	0.118	0.012	0.366
SWRBD	Laune	Owenreagh	Br u/s Upper Lake	21.59	9.60	48.30	0.029	0.001	0.227
SWRBD	Maine	Shanowen	Ford (Br) u/s Maine R confl	20.69	10.50	41.40	0.018	0.002	0.112
SWRBD	Womanagh	Womanagh	S of Ballyhonock Lough	20.60	16.30	24.50	0.040	0.028	0.050
WRBD	Ballinglen	Ballinglen	Ballinglen Bridge	22.58	11.30	33.10	0.025	0.003	0.071
WRBD	Moy	Castlebar	Br 2.5 km d/s Castlebar	27.54	13.40	51.00	0.051	0.003	0.232
WRBD	Moy	Clydagh	Br NW Ardvarney	52.10	52.10	52.10	0.211	0.211	0.211
WRBD	Moy	Deel (Crossmolina)	Bridge at Castle Gore	46.19	33.10	64.40	0.210	0.065	0.669
WRBD	Glenamoy	Glenamoy	Glenamoy Bridge	23.76	12.40	33.00	0.026	0.002	0.067
WRBD	Srahmore	Glennamong	Bridge u/s Lough Feeagh	30.97	28.50	33.60	0.048	0.038	0.066
WRBD	Moy	Tubbercurry	Br just u/s Moy River	55.90	55.90	55.90	0.248	0.248	0.248

Table II-7 Summary biological data from WFD River Surveys, 2010

RBD	Catchment	River Name	River Site	No. Eels	% Female	% Male	% Immature	% Prevalence	Mean Intensity	Parasite Count	Preferred Diet
WRBD	Ballysadare	Ballysadare	Ballysadare Br	8	100	0	0	0	0	0	*Asellus* & Mayfly
NBIRBD	Fane	Fane	Further d/s of Br in Inniskeen	3	67	33	0	33	2	2	Empty Stomachs
SERBD	Barrow	Gowran	Br N of Goresbridge (S Channel)	8	12	0	88	0	0	0	Empty Stomachs
SERBD	Nore	Nore	Brownsbarn Br	30	3	27	70	53	2.81	45	Mayfly & Caddisfly
SERBD	Suir	Suir	Kilsheelan Br	26	19	46	35	31	2.63	21	Mayfly & Caddisfly
ShIRBD	Shannon Upper	Shannon (Upper)	Ballyleague Br Lanesboro (a)	4	100	0	0	75	2.67	8	*Asellus*
ShIRBD	Shannon Upper	Shannon (Upper)	Ballyleague Br Lanesboro (b)	3	67	0	33	33	18	18	Empty Stomachs
SWRBD	Blackwater	Blackwater (Munster)	Lismore Br	22	9	9	82	27	2.83	17	Caddisfly larvae
SWRBD	Lee	Lee	Leemount Br	29	3	52	45	0	0	0	Mayfly & Caddisfly
SWRBD	Blackwater	Licky	Br NE of Glenlicky	1	0	0	100	0	0	0	Mayfly

Table II-8 Summary biological data from WFD River Surveys, 2009

RBD	Catchment	River Name	River Site	No. Eels	% Female	% Male	% Immature	% Prevalence	Mean Intensity	Parasite Count	Preferred Diet
ERBD	Boyne	Athboy	Br. Near Clonleasan House	2	100	0	0	0	0.00	0	*Gammarus*
ERBD	Boyne	Blackwater (Kells)	Just u/s of L. Ramor	12	8	33	59	25	3.67	11	Digested Material only
ERBD	Boyne	Boyne (Boyne Br)	Boyne Br.	1	0	100	0	100	1.00	1	*Asellus*
ERBD	Boyne	Boyne (Railway viaduct)	Navan - Tara Mines Viaduct	6	33	67	0	0	0.00	0	Digested Material only
ERBD	Dargle	Dargle	1km u/s Bray Bridge	35	0	0	100	0	0.00	0	*Asellus*
ERBD	Dargle	Glencree	Br u/s Darge river confluence	1	100	0	0	0	0.00	0	Empty
ERBD	Ovoca	Glenealo	Bridge d/s Upper Lake	3	0	67	33	0	0.00	0	Insect remains
ERBD	Liffey	Liffey (Lucan)	d/s Lucan Br.	9	22	78	0	75	8.83	53	*Asellus* & Caddisfly
ERBD	Nanny	Nanny (Meath)	Br. @ Julianstown	21	0	52	48	0	0.00	0	Isopods
NBIRBD	Piedmont	Big (Louth)	Ballygoly Br.	2	0	0	100	0	0.00	0	Digested Material only
NBIRBD	Dee	White (Louth)	Coneyburrow Br.	6	0	50	50	0	0.00	0	*Asellus* & *Gammarus*
NWIRBD	Clady	Clady	N56 Bridge	3	33	0	67	0	0.00	0	Caddisfly larvae
NWIRBD	Erne	Erne	Bellahillan Bridge	1	0	100	0	100	3.00	3	Empty
SERBD	Barrow	Barrow (Pass Br)	Pass Bridge	6	100	0	0	83	2.20	11	Crayfish
SERBD	Nore	Dinin (Nore)	Dinin Bridge	4	50	50	0	25	2.00	2	Digested Material Only
SERBD	Barrow	Greese	Br NE of Belan House	2	100	0	0	100	2.50	5	Crayfish
SERBD	Nore	Kings (Kilkenny)	Kells Bridge	7	29	57	14	71	3.00	15	*Asellus* &

RBD	Catchment	River Name	River Site	No. Eels	% Female	% Male	% Immature	% Prevalence	Mean Intensity	Parasite Count	Preferred Diet
											Gammarus
SERBD	Slaney	Slaney	Waterloo Bridge	7	0	86	14	0	0.00	0	Caddisfly & Oligochaetes
ShIRBD	Shannon	Ballyfinboy	Br. Just u/s L of Lough Derg	1	0	100	0	0	0.00	0	Digested Material only
ShIRBD	Shannon	Bilboa	Br. u/s Blackboy Br. (Bilboa b)	1	0	100	0	0	0.00	0	Empty
ShIRBD	Bunratty	Broadford	Br. u/s Doon Lough	9	0	44	56	44	1.75	7	*Asellus* & *Gammarus*
ShIRBD	Caher	Caher	Br 2 km d/s of Formoyle	2	0	100	0	0	0.00	0	*Gammarus* & Caddisfly
ShIRBD	Creegh	Creegh	Drumellihy Bridge	8	0	63	37	0	0.00	0	*Insect remains*
ShIRBD	Shannon	Dead	Derraun Br.	4	25	75	0	50	1.50	3	Digested Material Only
ShIRBD	Fergus	Fergus	Poplar Bridge	1	100	0	0	0	0.00	0	Empty
ShIRBD	Annagh	Glendine	Knockloskeraun Bridge	13	0	31	69	8	1.00	1	*Asellus* & *Gammarus*
ShIRBD	Fergus	Moyree	Bridge u/s Fergus river	12	41	41	18	0	0.00	0	*Asellus* & *Gammarus*
ShIRBD	Shannon	Nenagh	Ballysoilshaun Bridge	1	0	100	0	0	0.00	0	*Gammarus*
ShIRBD	Shannon	Owvane	Br. u/s (SE of) Loghill	30	0	27	73	7	1.00	2	*Gammarus* & Mayfly
ShIRBD	Shannon	Shannon (Upper)	Ballyleague Br. – Lanesborough	4	75	25	0	50	8.00	16	*Asellus* & *Gammarus*
ShIRBD	Shannon	Tyshe (Ardfert)	West Br. Ardfert @ Friary	49	0	43	57	0	0.00	0	*Gammarus* & Caddisfly
SWRBD	Argideen	Argideen	Footbridge u/s of Kilamaloda Br.	32	0	53	47	0	0.00	0	*Asellus* & Mollusca

RBD	Catchment	River Name	River Site	No. Eels	% Female	% Male	% Immature	% Prevalence	Mean Intensity	Parasite Count	Preferred Diet
SWRBD	Blackwater	Awbeg (Buttevant)	Kilcummer Br.	7	14	57	29	0	0.00	0	*Gammarus* & Simuliidae
SWRBD	Bandon	Bandon	Murragh Br.	1	0	100	0	0	0.00	0	Empty
SWRBD	Blackwater	Blackwater (Munster) (Killavullen Br.)	Killvullen Bridge	1	0	100	0	100	1.00	1	Empty
SWRBD	Blackwater	Blackwater (Munster) (Nohaval Br)	Nohaval Bridge	2	0	100	0	0	0.00	0	Digested Material only
SWRBD	Blackwater	Bride (Waterford)	Footbridge N of Ballynella	5	0	40	60	0	0.00	0	*Asellus* & *Gammarus*
WRBD	Corrib	Black (Shrule)	Bridge at Kilshanvy	2	100	0	0	0	0.00	0	Digested Material only
WRBD	Dunneill	Dunneill	Donagbintrine Bri	35	0	74	26	0	0.00	0	*Asellus* & *Gammarus*
WRBD	Kinvarra	Owendalulleegh	Br. SE of Killafeen	10	30	60	10	0	0.00	0	Mayfly & *Asellus*

Table II-9 Summary biological data from WFD River Surveys, 2008

RBD	Catchment	River Name	No. Eels	% Female	% Male	% Immature	% Prevalence	Mean Intensity	Parasite Count	Preferred Diet
ERBD	Liffey	Dodder	27	11	19	70	0	0.00	0	*Asellus*
ERBD	Liffey	Liffey (Kilcullen)	3	100	0	0	0	0.00	0	Crayfish
ERBD	Liffey	Ryewater	17	70	18	12	0	0.00	0	*Asellus* & *Gammarus*
ERBD	Vartry	Vartry	1	0	0	100	0	0.00	0	*Asellus*
NBIRBD	Blackwater	Blackwater (Monaghan)	6	83	0	17	50	3.00	9	*Gammarus*
NWIRBD	Erne	Annalee	3	100	0	0	0	0.00	0	*Asellus,* caddisfly & fish
NWIRBD	Clonmany	Ballyhallan (Clonmany)	13	0	8	92	0	0.00	0	Fish
NWIRBD	Burnfoot	Burnfoot	9	0	0	100	11	1.00	1	*Gammarus* & caddisfly
NWIRBD	Eany Water	Eany Water	5	20	40	40	0	0.00	0	Fish, *Asellus* & mayfly
NWIRBD	Erne	Erne (Belturbet)	16	81	6	13	69	5.55	61	Caddisfly & *Gammarus*
NWIRBD	Owentocker	Owentocker	7	0	43	57	0	0.00	0	Oligochaetes
NWIRBD	Erne	Swanlinbar	4	50	25	25	50	2.50	5	Empty Stomachs
NWIRBD	Swilly	Swilly	2	0	0	100	0	0.00	0	*Gammarus* & caddisfly
SERBD	Nore	Ballyroan	1	0	100	0	0	0.00	0	*Gammarus*
SERBD	Owenavorragh	Banoge	148	4	17	79	2	1.67	5	*Gammarus*
SERBD	Slaney	Clody	3	0	33	67	0	0.00	0	Caddisfly & *Gammarus*
SERBD	Colligan	Colligan	8	0	0	100	0	0.00	0	Empty Stomachs
SERBD	Slaney	Douglas (Ballon)	7	57	14	29	29	1.50	3	*Gammarus* & mayfly
SERBD	Suir	Duag	5	40	0	60	60	1.00	3	Mayfly & *Gammarus*
SERBD	Stream	Duncormick	28	0	7	93	0	0.00	0	*Asellus*, *Gammarus* & beetles
SERBD	Nore	Glory	5	40	20	40	100	1.20	6	*Gammarus*
SERBD	Mahon	Mahon	3	0	33	67	33	-	-	Insect remains
SERBD	Nore	Nore (Quaker)	1	100	0	0	0	0.00	0	Beetles
SERBD	Owenavorragh	Owenavorragh	29	3	0	97	41	-	-	*Asellus*, *Gammarus* & fish
SERBD	Slaney	Urrin	5	0	80	20	0	0.00	0	*Gammarus*

RBD	Catchment	River Name	No. Eels	% Female	% Male	% Immature	% Prevalence	Mean Intensity	Parasite Count	Preferred Diet
ShIRBD	Shannon Upr	Boor	2	50	0	50	50	3.00	3	Empty Stomachs
ShIRBD	Shannon Lwr	Bow	10	20	30	50	0	0.00	0	*Gammarus* & beetles
ShIRBD	Bunratty	Broadford	2	0	0	100	50	2.00	2	*Gammarus*
ShIRBD	Shannon Lwr	Brosna (Clonony)	1	100	0	0	100	14.00	14	*Asellus* & *Gammarus*
ShIRBD	Shannon Lwr	Brosna (Pollagh)	1	100	0	0	100	8.00	8	*Asellus* & *Gammarus*
ShIRBD	Shannon Lwr	Clodiagh (Tullamore)	1	100	0	0	0	0.00	0	*Asellus* & fish
ShIRBD	Shannon Est Sth	Deel (Newcastlewest)	2	100	0	0	0	0.00	0	Empty Stomachs
ShIRBD	Feale	Feale	6	0	67	33	0	0.00	0	Mayfly & *Gammarus*
ShIRBD	Fergus	Fergus (Clonroad)	31	29	3	68	10	1.00	3	*Asellus*, caddisfly & beetles
ShIRBD	Bunratty	Gourna	4	0	0	100	0	0.00	0	*Gammarus* & chironomids
ShIRBD	Shannon Lwr	Graney	2	50	0	50	0	0.00	0	Caddisfly & *Gammarus*
ShIRBD	Shannon Lwr	Kilcrow	4	100	0	0	75	3.00	9	*Asellus*, *Gammarus* & caddisfly
ShIRBD	Shannon Est Sth	Maigue	42	14	5	81	12	1.60	8	*Asellus*, mayfly & caddisfly
ShIRBD	Shannon Upr	Scramoge	1	100	0	0	100	1.00	1	*Asellus* & *Gammarus*
ShIRBD	Shannon Upr	Shannon (Battlebridge)	8	88	0	12	50	2.50	10	Caddisfly, mayfly & *Gammarus*
ShIRBD	Feale	Smearlagh	7	0	0	100	0	0.00	0	Mayfly & *Gammarus*
ShIRBD	Suck	Suck (Ballyforan)	6	100	0	0	67	4.25	17	*Asellus* & *Gammarus*
ShIRBD	Tyshe	Tyshe	49	4	12	84	0	0.00	0	*Gammarus* & chironomids
SWRBD	Laune	Flesk	7	0	29	71	14	1.00	1	*Gammarus*
SWRBD	Glashaboy	Glashaboy	16	6	0	94	0	0.00	0	Mayfly, caddisfly & *Gammarus*
SWRBD	Laune	Gweestin	3	0	67	33	0	0.00	0	Empty Stomachs
SWRBD	Maine	Shanowen	55	2	24	74	0	0.00	0	*Gammarus*
SWRBD	Laune	Owenreagh	18	6	0	94	0	0.00	0	Mayfly & beetles
WRBD	Ballinglen	Ballinglen	28	0	0	100	0	0.00	0	*Gammarus* & mayfly
WRBD	Moy	Castlebar	51	16	12	72	2	2.00	2	*Asellus* & *Gammarus*
WRBD	Moy	Clydagh	1	100	0	0	0	0.00	0	Empty Stomachs
WRBD	Moy	Deel (Crossmolina)	11	82	18	0	55	2.50	15	Empty Stomachs

RBD	Catchment	River Name	No. Eels	% Female	% Male	% Immature	% Prevalence	Mean Intensity	Parasite Count	Preferred Diet
WRBD	Glenamoy	Glenamoy	27	0	41	59	0	0.00	0	Mayfly, caddisfly & *Gammarus*
WRBD	Srahmore	Glennamong	3	0	0	100	0	0.00	0	Stonefly, caddisfly & chironomids
WRBD	Moy	Tubbercurry	1	100	0	0	0	0.00	0	Empty Stomachs

Appendix III. Water Framework Directive Transitional Water Surveys

Table III-1 Summary data from WFD Transitional Water Surveys, 2010

RBD	Catchment	T. Water	No. Nets	No. Eels	CPUE	Mean Length (cm)	Min. Length (cm)	Max. Length (cm)
ERBD	Ovoca	Avoca Estuary	9	9	1.00	33.4	28.0	51.0
ERBD	Vartry	Broad Lough	12	1	0.08	46.2	46.2	46.2
ERBD	Broadmeadow	Broadmeadow Water	12	4	0.33	51.0	36.5	70.0
ERBD	Liffey	Lower Liffey	6	0	0.00	-	-	-
ERBD	Rogerstown	Rogerstown	12	2	0.17	31.8	25.5	38.0
ERBD	Liffey	Tolka	12	1	0.08	52.0	52.0	52.0
ERBD	Liffey	Upper Liffey	6	3	0.50	33.0	32.3	33.6
SERBD	Barrow / Nore	Upper Barrow Nore	6	21	3.50	46.8	30.0	67.0
SERBD	Suir / Nore	Barrow Suir Nore	12	21	1.75	42.5	28.1	57.8
SERBD	Barrow	Upper Barrow	12	26	2.17	44.0	27.0	78.0
SERBD	Nore	New Ross Port	12	140	11.67	38.6	21.0	62.0
SERBD	Nore	Nore	12	13	1.08	42.7	32.0	66.5
SERBD	Suir	Lower Suir	12	84	7.00	41.7	25.0	64.0
SERBD	Suir	Middle Suir	18	55	3.06	35.6	23.0	51.0
SERBD	Suir	Upper Suir	6	2	0.33	30.3	28.6	32.0
ShIRBD	Coastal	Lough Gill	12	5	0.42	31.3	27.0	40.0
SWRBD	Coastal	Drongawn Lough	12	20	1.67	46.6	33.0	58.6
SWRBD	Glashaboy	Glashaboy	6	0	0.00	-	-	-
SWRBD	Coastal	Harpers Island	6	1	0.17	60.0	60.0	60.0
SWRBD	Roughty	Inner Kenmare	12	3	0.25	45.2	44.5	46.5
SWRBD	Lee	Lough Mahon	18	2	0.11	41.0	40.0	42.0
SWRBD	Lee	Lower Lee	9	0	0.00	-	-	-

RBD	Catchment	T. Water	No. Nets	No. Eels	CPUE	Mean Length (cm)	Min. Length (cm)	Max. Length (cm)
SWRBD	Owennacurra	North Channel Great Island	12	1	0.08	51.0	51.0	51.0
SWRBD	Owennacurra	Owenacurra	6	1	0.17	37.0	37.0	37.0
SWRBD	Lee	Upper Lee	9	2	0.22	44.8	26.0	63.5

Table III-2 Summary data from WFD Transitional Water Surveys, 2009

RBD	Catchment	T. Water	No. Nets	No. Eels	CPUE	Mean Length (cm)	Min. Length (cm)	Max. Length (cm)
ERBD	Boyne	Boyne	24	26	1.08	36.74	26.10	57.60
NBIRBD	Castletown	Castletown	12	18	1.50	35.57	24.50	53.20
NBIRBD	Coastal	Inner Dundalk	6	1	0.17	31.50	31.50	31.50
NWIRBD	Coastal	Durnesh	6	6	1.00	44.00	33.50	57.50
NWIRBD	Coastal	Inch lough	12	29	2.42	37.88	13.50	66.00
NWIRBD	Erne	Erne	12	3	0.25	38.83	31.00	50.50
NWIRBD	Gwebarra	Gweebarra	18	6	0.33	34.37	27.20	40.50
NWIRBD	Coastal	Swilly	24	1	0.04	40.20	40.20	40.20
NWIRBD	Eask	Inner Donegal Bay	18	6	0.33	-	-	-
SERBD	Coastal	Lady's Island	12	44	3.67	39.53	28.60	59.50
SERBD	Coastal	North Slob Channel	3	13	4.33	41.46	26.00	63.00
SERBD	Coastal	Tacumshin	6	17	2.83	33.10	29.00	37.50
SERBD	Stream	Bridgetown	12	7	0.58	35.70	26.50	48.70
SWRBD	Bandon	Lower Bandon	18	2	0.11	23.50	12.50	34.50
SWRBD	Bandon	Upper Bandon	6	6	1.00	40.68	28.40	58.60
SWRBD	Slaney	Lower Slaney	33	13	0.39	36.82	26.80	66.50
SWRBD	Slaney	Upper Slaney	12	3	0.25	34.60	32.70	38.50
WRBD	Coastal	Lough an Aibhinn	12	26	2.17	41.20	10.00	63.00
WRBD	Coastal	Lough an tSaile	12	40	3.33	48.01	33.00	72.10
WRBD	Coastal	Lough Muree	12	4	0.33	53.50	37.00	68.90
WRBD	Coastal	Bridge Lough	12	20	1.67	34.00	29.00	43.00
WRBD	Coastal	Camus	36	10	0.28	46.70	31.90	71.00
WRBD	Coastal	Kinvara	12	0	0.00	-	-	-

Table III-3 Summary data from WFD Transitional Water Surveys, 2008

RBD	Catchment	T. Water	No. Nets	No. Eels	CPUE	Mean Length (cm)	Min. Length (cm)	Max. Length (cm)
ERBD	Ovoca	Avoca	12	20	1.67	39.7	28.0	50.2
ERBD	Vartry	Broad Lough	15	2	0.13	46.4	45.7	47.0
ERBD	Broadmeadow Water	Broadmeadow Water	15	6	0.40	40.3	32.2	56.4
ERBD	Liffey	Lower Liffey	6	4	0.67	47.3	32.0	67.2
ERBD	Liffey	Upper Liffey	6	4	0.67	58.1	33.2	93.5
ERBD	Stream	Rogerstown	12	23	1.92	36.0	28.0	50.2
ERBD	Tolka	Tolka	9	12	1.33	43.0	32.5	53.6
SERBD	Colligan	Colligan	12	0	0.00	-	-	-
ShIRBD	Feale	Cashen	18	21	1.17	34.7	28.2	48.6
ShIRBD	Shannon Est South	Deel	9	2	0.22	34.3	19.6	49.0
ShIRBD	Feale	Feale	12	30	2.50	38.4	29.1	63.5
ShIRBD	Fergus	Fergus	21	6	0.29	41.8	34.0	55.2
ShIRBD	Lee	Lee (Tralee)	6	0	0.00	-	-	-
ShIRBD	Shannon Lower	Limerick Docks	12	18	1.50	38.2	27.5	64.0
ShIRBD	Shannon	Lower Shannon	36	6	0.17	41.3	34.0	48.0
ShIRBD	Shannon	Upper Shannon	12	3	0.25	45.0	32.0	60.0
ShIRBD	Shannon Est South	Maigue	12	0	0.00	-	-	-
SWRBD	Glashaboy	Glashaboy	3	16	5.33	34.6	28.9	48.1
SWRBD	Coastal	Harper's Island	6	0	0.00	-	-	-
SWRBD	Ilen	Ilen	18	0	0.00	-	-	-
SWRBD	Croanshagh	Kilmakilloge Harbour	12	5	0.42	45.8	34.0	64.0
SWRBD	Coastal	Lake Kilkeran	6	12	2.00	31.9	28.5	36.0
SWRBD	Glashaboy	Lough Mahon	9	0	0.00	-	-	-
SWRBD	Blackwater	Lower Blackwater	24	39	1.63	39.3	26.0	58.0
SWRBD	Blackwater	Upper Blackwater	9	28	3.11	34.3	23.0	56.5
SWRBD	Argideen	Argideen	12	0	0.00	-	-	-

RBD	Catchment	T. Water	No. Nets	No. Eels	CPUE	Mean Length (cm)	Min. Length (cm)	Max. Length (cm)
SWRBD	Lee	Lower Lee	6	0	0.00	-	-	-
SWRBD	Lee	Upper Lee	6	8	1.33	52.7	43.0	60.0
SWRBD	Coastal	North Channel Greater Island	12	2	0.17	46.3	42.0	50.5
SWRBD	Owenacurra	Owenacurra	6	1	0.17	56.5	56.5	56.5
WRBD	Ballysadare	Ballysadare Estuary	9	1	0.11	45.8	45.8	45.8
WRBD	Kinvara	Bridge Lough	6	0	0.00	-	-	-
WRBD	Corrib	Corrib Estuary	9	3	0.33	48.6	36.3	55.6
WRBD	Erriff	Erriff Estuary	9	3	0.33	32.0	30.6	33.3
WRBD	Garavogue	Garavogue Estuary	9	1	0.11	32.0	32.0	32.0
WRBD	Coastal	Loch an tSaile	6	5	0.83	32.7	30.0	37.5
WRBD	Coastal	Loch Tanai	6	5	0.83	39.9	34.2	43.5
WRBD	Moy	Moy Estuary - Ballina	18	7	0.39	37.1	13.5	51.0
WRBD	Srahmore	Newport Estuary	9	2	0.22	32.0	31.0	33.0
WRBD	Glenamoy	Sruwaddacon Estuary	12	31	2.58	29.8	24.5	34.0
WRBD	Owenmore	Tullaghan Estuary	9	0	0.00	-	-	-
WRBD	Owenwee	Westport Estuary	18	0	0.00	-	-	-

Table III-4 Summary biological data from Transitional Water Surveys, 2010

RBD	Catchment	T. Water	No. Eels	% Female	% Male	% Immature	% Prevalence	Mean Intensity	Parasite Count	Preferred Diet
SERBD	Suir	Middle Suir	1	0	100	0	100	7.00	7	Empty Stomach

Table III-5 Summary biological data from WFD Transitional Water Surveys, 2009

RBD	Catchment	T. Water	No. Eels	% Female	% Male	% Immature	% Prevalence	Mean Intensity	Parasite Count	Preferred Diet
ERBD	Boyne	Boyne	25	36	64	0	40	5.60	56	Crab & Fish
NBIRBD	Castletown	Castletown	16	25	75	0	0	0.00	0	Fish and Crab
NBIRBD	Coastal	Inner Dundalk	1	0	100	0	0	0.00	0	Fish
NWIRBD	Coastal	Durnesh	6	67	33	0	0	0.00	0	Crab & Fish
NWIRBD	Coastal	Inch lough	32	37	63	0	0	0.00	0	Fish
NWIRBD	Erne	Erne	3	33	67	0	67	2.50	5	Shrimp
NWIRBD	Gwebarra	Gweebarra	6	33	67	0	0	0.00	0	Fish
SERBD	Coastal	Lady's Island	30	53	47	0	0	0.00	0	Shrimp & Mollusca
SERBD	Coastal	North Slob Channel	12	50	50	0	67	6.63	53	Shrimp & Fish
SERBD	Coastal	Tacumshin	7	0	100	0	86	3.83	23	Shrimp & Mollusca
SERBD	Stream	Bridgetown	7	29	71	0	0	0.00	0	Crab & Shrimp
SWRBD	Bandon	Lower Bandon	2	0	100	0	0	0.00	0	Shrimp
SWRBD	Bandon	Upper Bandon	6	33	67	0	0	0.00	0	Fish
SWRBD	Slaney	Lower Slaney	13	15	85	0	54	4.86	34	Empty Stomachs
SWRBD	Slaney	Upper Slaney	3	0	100	0	0	0.00	0	Fish, Shrimp & Crab
WRBD	Coastal	Lough an Aibhinn	16	88	12	0	38	2.17	13	Fish
WRBD	Coastal	Lough Muree	4	75	25	0	0	0.00	0	Fish
WRBD	Coastal	Bridge Lough	17	6	94	0	0	0.00	0	Shrimp & Fish
WRBD	Coastal	Camus	8	50	50	0	25	24.50	49	Fish

Table III-6 Summary biological data from WFD Transitional Water Surveys, 2008

RBD	Catchment	T. Water	No. Eels	% Female	% Male	% Immature	% Prevalence	Mean Intensity	Parasite Count	Preferred Diet
ERBD	Ovoca	Avoca	20	50	5	45	0	0.00	0	Oligocheates
ERBD	Vartry	Broad Lough	2	100	0	0	0	0.00	0	Crab
ERBD	Broadmeadow Water	Broadmeadow Water	6	33	67	0	0	0.00	0	Shrimp & crab
ERBD	Stream	Rogerstown	10	60	10	30	0	0.00	0	Crab
ERBD	Liffey	Upper Liffey	4	25	0	75	50	1.50	3	Empty Stomachs
ERBD	Liffey	Lower Liffey	4	100	0	0	0	0.00	0	Fish, shrimp & crab
ERBD	Tolka	Tolka	9	89	11	0	0	0.00	0	Fish & crab
ShIRBD	Feale	Cashen	21	29	10	61	0	0.00	0	Fish & shrimp
ShIRBD	Shannon Est South	Deel	2	50	0	50	50	1.00	1	*Gammarus*
ShIRBD	Feale	Feale	21	48	33	19	0	0.00	0	Fish & *Gammarus*
ShIRBD	Fergus	Fergus	9	78	11	11	33	5.00	15	*Gammarus*
ShIRBD	Shannon Lower	Limerick Docks	7	29	43	28	57	4.50	18	*Gammarus* & fish
ShIRBD	Shannon	Lower Shannon	6	83	0	17	17	11.00	11	Fish & crab
SWRBD	Glashaboy	Glashaboy	16	56	19	25	0	0.00	0	*Gammarus* & crab
SWRBD	Croanshagh	Kilmakilloge Harbour	5	100	0	0	0	0.00	0	Crab
SWRBD	Coastal	Lake Kilkeran	12	8	92	0	0	0.00	0	Shrimp
SWRBD	Blackwater	Upper Blackwater	28	11	71	18	32	8.22	74	*Gammarus*
SWRBD	Lee	Upper Lee	8	100	0	0	0	0.00	0	Shrimp & fish
SWRBD	Coastal	North Channel Greater Island	2	100	0	0	0	0.00	0	Shrimp & crab
SWRBD	Owenacurra	Owenacurra	1	100	0	0	0	0.00	0	Fish
WRBD	Ballysadare	Ballysadare Estuary	1	100	0	0	0	0.00	0	Crab
WRBD	Corrib	Corrib Estuary	2	100	0	0	100	15.33	46	Empty

RBD	Catchment	T. Water	No. Eels	% Female	% Male	% Immature	% Prevalence	Mean Intensity	Parasite Count	Preferred Diet
										Stomachs
WRBD	Erriff	Erriff Estuary	3	0	100	0	0	0.00	0	Fish
WRBD	Coastal	Loch an tSaile	5	20	40	40	40	3.50	7	*Gammarus* & fish
WRBD	Coastal	Loch Tanai	5	100	0	0	80	2.00	8	Shrimp
WRBD	Moy	Moy Estuary - Ballina	1	0	100	0	0	0.00	0	Empty Stomach
WRBD	Srahmore	Newport Estuary	2	0	50	50	0	0.00	0	Fish
WRBD	Glenamoy	Sruwaddacon Estuary	31	0	52	48	0	0.00	0	Shrimp, fish & crab

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