The status and distribution of lamprey and shad in the Slaney and Munster Blackwater SACs

Irish Wildlife Manuals No. 14

AN ROINN COMHSHAOIL, OIDHREACHTA AGUS RIALTAIS ÁITIÚIL
DEPARTMENT OF THE ENVIRONMENT, HERITAGE
AND LOCAL GOVERNMENT

The status and distribution of lamprey and shad in the Slaney and Munster Blackwater SACs

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Citation:
King J. J. and Linnane S. M. (2004) The status and distribution of lamprey and shad in the Slaney and Munster Blackwater SACs. *Irish Wildlife Manuals*, No. 14. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland.

Cover photo: Brook lamprey by Eddie Dunne © NPWS

Irish Wildlife Manuals Series Editor: F. Marnell

ISSN 1393 - 6670

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Acknowledgements

The work presented here was undertaken in the period April 2003 – March 2004 by the authors with funding provided by National Parks and Wildlife Service of the Dept. of Environment, Heritage and Local Government.

All of the survey work was carried out in the catchments of the Slaney and Munster Blackwater and the CEOs of the Eastern and Southern Regional Fisheries Boards, in whose fisheries jurisdictions the respective catchments lie, are thanked for their support for this project. Surveys were undertaken with the support and assistance of the local staff of each of the two Regional Boards – Mr. Martin Kelly, Mr. Joe Morris and their staff on the Slaney and Mr. Michael Fawl and his staff on the Munster Blackwater. Mr. Connor Gilsenan B.Sc. provided assistance on the juvenile lamprey surveys.

Thanks are also due to the commercial salmon netsmen and women operating on the estuaries of both main channels for provision of shad by-catch samples and for anecdotal information on lamprey. The assistance with shad by-catch has been on-going in both catchments since 2000 and provides a very important source of information. The liaison of the netsmen with the local Regional Fisheries Board staff in this regard is vital to the success of this activity.

Staff in CFB have used various sampling strategies for juvenile lamprey, using electric fishing, and the strategy employed in this project was developed following discussions between the authors and Dr. Bridget Lehane and Dr. David Lyons.

Access to the NPWS database material on lamprey, compiled by Kurz and Costello, was provided by Dr. F. Marnell, NPWS. Unpublished material in CFB relating to juvenile lamprey was provided by Dr. W. Roche, for the Slaney, and Ms. K. Delanty, for the Munster Blackwater. Records of juvenile lamprey encountered in benthic sampling in streams by Environmental Protection Agency (EPA) personnel was provided by Mr. K Clabby and Mr. J. Lucey of the EPA.

Executive Summary

- Central Fisheries Board (CFB) was commissioned by National Parks and Wildlife Service (NPWS) to carry out investigations on the status and distribution of shad and lamprey in the Slaney and Munster Blackwater SACs.

- The project was undertaken in the period 1.4.2003 – 31.3.2004.

- An extensive sampling programme for both fish groups was undertaken in both SACs working with staff of the Southern and Eastern Regional Fisheries Boards.

- Juvenile river/brook lamprey were widespread in the Slaney SAC while a substantial number of sites in the Munster Blackwater indicated an absence of this taxon.

- Density values of juvenile river/brook lamprey were generally higher in the Slaney than in the Blackwater SAC.

- Juvenile sea lamprey were substantially more widespread and numerous in the Munster Blackwater SAC than in the Slaney.

- Spawning of sea lamprey was observed in the main channels of both SACs.

- The findings provide cause for concern on the status of sea lamprey in the Slaney SAC.

- A substantial population of adult river lamprey was encountered in the Slaney estuary in autumn surveys. This result was not reflected in the Munster Blackwater estuary.

- Adult shad were taken during scientific sampling in the Munster Blackwater on one occasion. No shad were taken on the Slaney in the CFB survey programme.

- Both allis and twaite shad were taken in both SACs by commercial salmon netsmen and made available to the CFB survey team. These netsmen remain the most significant source of information and material for shad in Ireland – as is the case in the UK.

- No juvenile shad were taken during estuarine surveys in the two estuaries.

- The status of both shad species is considered to be very vulnerable in both SACs, but particularly in the Slaney.

1. Introduction

The scientific literature of the past 40 years relating to shad and lamprey in Irish waters is scant. The study of Kurz and Costello (1999) was important in drawing together known information on occurrences of the three lamprey forms: sea lamprey (*Petromyzon marinus* L.), river lamprey (*Lampetra fluviatilis* Bloch) and the brook lamprey (*Lampetra planeri* L.). More recently, Kelly and King (2001) reviewed aspects of lamprey ecology and conservation relevant to Ireland as well as including some direct observations of their own. The Central Fisheries Board has carried out a wide range of catchment-based fish surveys in recent years. The majority have focused on status of salmon and trout with non-target species being recorded on a relative abundance scale. Recent surveys of this nature have given greater attention to adult and juvenile lamprey encountered and have provided the basis for distribution mapping of lamprey in these catchments (W. K. Roche, unpublished data; K. Delanty, unpublished data). The increased attention being given to *Annex II* species of the Habitats Directive, including lampreys, has led to a recognition of the importance of collecting data on these groups and has also highlighted, in the majority of cases, the paucity of data on these groups.

The Habitats Directive is administered in Ireland by the National Parks and Wildlife Service (NPWS) under the Minister for Environment, Heritage and Local Government. However, the presence of fish species, including salmon in freshwater, shad and lampreys, in *Annex II* points to a role for the Minister for Communications, Marine and Natural Resources. This linkage is enshrined in the Irish implementing legislation relating to the Habitats Directive (S.I. No. 94 of 1997). The linkage has found a practical reflection in the close working of NPWS and the Fisheries Boards in relation to developing soundly based boundaries for SACs relating to Atlantic salmon in freshwater. NPWS has also provided support to scientific investigations of the Central Fisheries Board (CFB) on a variety of 'conservation fish' species including the shad and lamprey cited in the Habitats Directive.

In 2002 the CFB commenced a focused study on lamprey populations in the River Nore SAC in Kilkenny city in the context of a major flood relief scheme. This investigation, commissioned by the Office of Public Works (OPW), developed a substantial baseline on juvenile lamprey population structure and density in sedimenting areas of the River Nore in the city prior to commencement of major excavation works impacting on the river bed, its margins and the riparian zone (King J.J & D.O. Lyons, unpublished data). The study required development of appropriate sampling strategies for adult and juvenile lamprey. Work on this project in 2003 focused on the River Nore and some of its principal tributaries outside the area of the flood scheme works at Kilkenny, building upon the database compiled and examining further sampling strategies for juvenile lamprey.

Bracken and Kennedy (1967) reported on large populations of shad using the estuaries of the south-east – the Suir, Nore and Barrow – as spawning grounds. Little systematic work has been done on these populations in the intervening years. However, the continuing

presence of spawning populations of twaite shad in the R. Barrow is confirmed through rod-caught fish taken as 'specimens' at St. Mullins and recorded in the annual reports of the Irish Specimen Fish Committee. Since 2000 CFB, working closely with colleagues in the Regional Fisheries Boards (RFBs), has obtained samples of both twaite and allis shad from several of the large estuaries in the south-east. The samples came from by-catch of licensed inshore commercial salmon netsmen, operating drift, draft or snap-nets. The support of the netsmen and their liaison with the RFB staff permitted collection of samples and their storage in refrigerated conditions until examination.

Discussions between CFB and NPWS confirmed that a series of strategies were appropriate for status assessment of different life history stages of both shad and lamprey. It was apparent that such strategies required to be developed and field tested to assess their robustness as surveillance and monitoring techniques relevant to implementation of the Habitats Directive. A requirement of the directive was that designated species continued to enjoy favourable ecological status within candidate SACs. A prerequisite to this demanded a knowledge of the species' status at the time of designation, with information on the distribution of the species within the SAC and some indication of population size and its use of habitat. In 2003 NPWS embarked on generating this baseline information and commissioned the CFB to undertake investigations in the SACs of the Slaney and Munster Blackwater to asses the use of each SAC by the designated fish species, twaite shad (*Alosa fallax* Lacepede) and the three taxa of lamprey.

2. Materials and Methods

2.1 Lamprey Investigations

A range of sampling strategies was available in regard to lamprey life history stages, with some strategies being highly seasonal. Evidence of spawning activity came from direct observation of aggregations of mating animals and from physical disturbance of the bed in gravelled areas to produce depressions, nests or redds within which the eggs are laid. As both brook and river lamprey spawn in the March-April period, stream walking was undertaken in selected channels in both catchments with a view to observing and recording spawning activity. In the Slaney catchment particular attention was given to those channels, designated as part of the proposed SAC, in which staff of the Eastern Regional Fisheries Board had previously encountered lamprey spawning activity. In view of channel width, the majority of direct observation of sea lamprey spawning sites was made by boat. Long segments of the main channel in both SACs were traversed by boat during July, when water levels and clarity, combined with light conditions, permitted direct observation to the river bed and allowed enumeration of spawning sites. This was augmented by direct observation from the bank or from bridges at specific locations in the main channels of the Slaney and the Munster Blackwater.

Fyke nets were used to intercept autumn upstream migrating river lamprey. Nets were set overnight in the estuarine reaches of the main channels of both the Slaney and Munster Blackwater during the September – October 2003 period. Additional information was compiled from the contents of fyke nets operated by licensed eel fishermen in the Slaney main channel. Fish captured were measured (fork length) in millimetres. Fyke nets were set in trains of three nets each, tied end-to-end and weighted to the channel bed. Nets had two sets of cones, with seven chambers in each, and a central linking leader net. Both leader and opening ring had a height of 60cm. Mesh size throughout was 10mm.

The principal tool used to sample for juvenile lamprey or ammocoetes was electric fishing. A backpack unit (Safari Research 550d) was used with an electrified net and trailing cathode to create an electric field that stunned juvenile lamprey and drew them from the sediment. A single-pass technique was used in which a consistent effort of one minute fishing, in pulses, per metre length of sediment was applied. The area fished varied depending on the extent of fine-grained bed material and suitable water depth available at any site. The area fished was measured in all cases, permitting estimation of a ‘minimum density estimate’ after Crisp, Mann and Mc Cormack (1974). All juveniles captured were anaesthetised with dilute Phenoxyethanol to permit measurement of fork length in millimetres. These fish were then immersed in fresh water to permit recovery prior to returning them to the sampling site. The sampling approach permitted a recording of presence/absence as well as facilitating collection of population structure and minimum density data. A total of 71 sites on the Slaney SAC and 88 sites on the Munster Blackwater SAC were surveyed in this manner. At each site note was made of the general habitat conditions including nature of bed material, diversity features in the bed such as tree roots or submerged vegetation and extent of overhead cover provided by tree canopy

or overhanging marginal vegetation. The electric fishing programme was undertaken over the period July – October 2003. A further 59 sites on the Munster Blackwater and 6 sites on the Slaney were examined during this period and deemed unsuitable for fishing due to unsuitable substrate type, excessive water depth, access problems due to overgrowth or simply that the channel was dried up.

In addition to the spot electric fishing, detailed sampling involving repeat fishing was undertaken at Castlehyde on the Munster Blackwater main channel and on two tributaries of the Slaney - at Coolattin Estate on the Derry and at the first bridge on the Derreen upstream of its confluence with the Slaney. In each case, five contiguous enclosures were isolated by weighted, fine-mesh, heavy-duty nets. The enclosures measured 4m in length and were of *circa* 1 m width, dependant on the nature of the site. At each site the selection of enclosure location was based on visual similarity of bed type and general habitat features. Fishing effort was standardised at 1 minute per metre of channel length. Four passes were made in each enclosure, with a five-minute rest period after each sampling effort. Fish from each pass were retained separately for enumeration and measurement of length (mm, fork length). On completion of the electric fishing, a push net was used to scrape through the upper 50-100mm of sediment in each enclosure. This process served to ascertain the presence of further juveniles, including the very small young-of-the-year.

In all cases, use was made of hand-held GPS instruments (Model Garmin eTrex Summit) to record site location and permit linkage of site to maps for GIS analysis. Identification of juvenile lamprey followed Gardiner (2002).

2.2. Shad Investigations

Sampling for adult twaite shad was undertaken in the estuaries of both SACs in the period from late May – early July using gill nets. The nets were operated as floating or fixed drift nets or as draft nets. Initially, a 'herring net' of circa 100 m length and 27 mm square mesh (108 mm in the round)) was employed. However, this was very susceptible to damage and was replaced by a net of larger mesh and heavier fibre. This latter net had a length of 100 m when fully employed and had a mesh size of 40 mm square (160 mm in the round or 6"). A total of 25 netting efforts were undertaken on the Slaney estuary, between Wexford Harbour and the mouth of the Boro River. In the Munster Blackwater, 15 netting efforts were undertaken between the Hut Pool at Cappoquin and the Broads of Clashmore.

When set, the nets were monitored and serviced continuously to ensure that adult Atlantic salmon and other non-target species could be released as soon as possible. Netting operations were undertaken in those locations where it was considered feasible to do so, subject to influence of tidal conditions and submerged obstructions. Choice of sampling location was also influenced by the experiences of, and anecdotal information from, local commercial netsmen and anglers and local Regional Fisheries Board staff. Sampling in the Slaney was confined, for the lost part, to those areas downstream of King's Island as shad had not been taken by the commercial draftsmen upstream of that point. Similarly,

angling records on the Munster Blackwater indicated the presence of twaite shad in the Hut Pool, upstream of Cappoquin, in the most upstream freshwater areas of the tidal channel. Thus netting was attempted up to this location.

The autumn fyke netting for adult river lamprey in each of the estuaries was combined with fine-mesh beach seining to sample for young twaite shad, either 0+ (young-of-the-year) or 1+ year old fish as per Aprahamian, Lester and Aprahamian (1998). The beach seine used was 30 m in length with 30 m length of rope at either end. Mesh size was 4 mm square (16 mm in-the-round). Both sampling techniques yielded a range of fish species as by-catch. This information was relevant to compiling fish community listings for these transitional waters, as required under the Water Framework Directive.

In all cases where nets were set use was made of hand-held GPS instruments (Model Garmin eTrex Summit) to record site location and permit linkage of site to maps for GIS analysis.

Commercial netsmen fishing for Atlantic salmon in both estuaries contact shad as by-catch and have, in recent years, retained some of this material for examination by CFB. This process has been facilitated by officers of the two Regional Fisheries Boards. An information leaflet on shad was circulated to commercial netsmen in both estuaries as part of the present study and officers of the Eastern and Southern Regional Fisheries Boards again acted as contact points to receive samples and store them in frozen conditions pending examination. This source of information has also been used with success in England (Aprahamian et al 1998, Anon 2000) and Scotland (Maitland and Lyle 2001).

Shad collected were measured for fork length, weight and samples of scale material retained for ageing. In addition, dead fish were dissected to establish gender, condition and weight of gonad material, feeding habit and gill raker count. Data was stored in a database being compiled by CFB.

Shad were allocated to species based on gill raker counts, following Wheeler (1969).

Plate 1: Shad survey - MBW

Plate 2: Shad survey - Slaney

Plate 3: Shad survey - Slaney

3. Results

3.1. Lamprey Investigations on R. Slaney

Plate 4: River lamprey

3.1.1. Juvenile lamprey distribution

A total of 71 sites within the SAC were electric fished for juvenile lamprey (Figure 3.1). 10 yielded no juvenile lamprey. Of the 34 sites fished in the main River Slaney one, only, contained no juvenile lamprey. Among the 35 sites fished in the tributary channels 25% contained no juvenile lamprey. Almost all the juvenile lamprey taken were identified as river / brook lamprey. Juvenile sea lamprey were recorded in the River Bann and the Derreen River, in small numbers in both channels. No juvenile sea lamprey were captured in the sites examined on the main Slaney channel.

Population structure, based on a pooling of data from all sites on a channel, varied among the different channels. Some displayed a strong presence of young-of-the-year, hatched in spring 2003, while this age group was not recorded in others. The modal length range for this group was 2.0 – 2.5 cm in the majority of larger channels although a smaller length mode of 1.5 cm was recorded in the Glasha. Modal peaks were noted at the 5 cm and 7 cm sizes in some channels. Those with a prominent 0+ year class generally also displayed at least one further modal peak. In general, few juveniles larger than 10 cm were recorded. The population in the Derreen River differed in that it displayed no 0+ fish and its structure was strongly skewed towards larger sizes with a modal peak at 11.5 cm. Juvenile lamprey of 14 cm were recorded in the Derreen – the largest size recorded in this survey of the Slaney catchment.

Population density (no. juveniles / m^2), as minimum density values, showed a very wide spread throughout the Slaney main channel (Figure 3.2), as well as throughout the individual river tributaries (Figure 3.3). The highest density on the Slaney main channel was 55 fish / m^2. However, the majority of values were considerably lower, lying in the range 5 – 15 / m^2. In the tributary channels, a wide range of values was recorded in the Bann and Derry Rivers while values were more consistent in the Derreen.

River Slaney main channel: Sites in the main Slaney channel were examined as two clusters – one set of sites in more upland areas upstream of Baltinglass and a second set between Bunclody and Enniscorthy (Figure 3.1). The composite population structure was dominated by a modal peak in the 4.5 cm – 7.5 cm range. There was clear evidence of recruitment of young-of-the-year. The upper size range tapered off dramatically at 10 cm. When examined as separate clusters, differences were evident between the two sets of data (Figures 3.4A & 3.4B). The series from the headwaters displayed a broad range of size groups, from 1.5 cm to 12.5 cm. Fish in the 3 – 4.5 cm size range were indicative of spawning having occurred in this area in the previous year. However, there was little evidence of a significant spawning effort in 2003. Larger size groups were well represented with a significant number of fish in the 9 – 11 cm range. In contrast, the sample from the lower reaches was dominated by smaller, younger size groups. There was a substantial presence of young-of-the-year fish (2.5 – 3.5 cm). This data set was collected early October 2003, somewhat later in the season than the headwater set, and this may account for the relatively larger modal size for young-of-year compared to other sites. This sample was dominated by a modal peak of 4.5 – 6 cm length fish. Very few fish in excess of 9 cm were taken in this area. All of the juvenile material examined in the Slaney main channel sites was identified as river / brook lamprey. Thus no sea lamprey juveniles were recorded, despite the occurrence of sea lamprey redds at a number of sites, particularly downstream of Clohamon.

River Bann: Seven sites were fished on the Bann, two of which yielded no juvenile lamprey. The population was dominated by juvenile river / brook lamprey with juvenile sea lamprey accounting for circa 1% of the numbers captured. The population structure of the pooled data indicated the presence of a sizeable population of 0+ juveniles, indicative of successful spawning of river/brook lamprey in this channel (Figure 3.5). The majority of fish were in the 4 – 7.5 cm range but a significant number of larger fish were also taken. This general pattern was broadly replicated at the individual fishing sites. Young-of-the-year fish were taken at the five sites containing ammocoetes, albeit as single fish in three cases. The sites near Camolin and Hollyfort Crossroads yielded relatively large numbers of this age group and are identified as being downstream of spawning locations. Population density fluctuated widely between sites (Figure 3.3). Two yielded zero density while one had 197 juveniles / m^2. Of the five sites with juvenile lamprey, density exceed 5 / m^2 in all cases and exceeded 20 / m^2 in three of the five.

Derry River: Twelve sites were fished on the Derry, three of which yielded no juvenile lamprey. The population was dominated by juvenile river / brook lamprey with juvenile sea lamprey accounting for circa 1.5 % of the numbers captured. The population structure of the pooled data indicated the presence of a small population of 0+ juveniles, indicative

of some degree of successful spawning of river/brook lamprey in this channel in 2003. The population structure appeared more homogeneous than the Bann, with a broad spread of lengths in the 4 – 10.5 cm size range. There was a prominent modal peak at 7 cm. However, it is likely that the size distribution spanned a number of age groups (Figure 3.6). The population structure differed among the individual sites surveyed as a set in Coolattin with 0+ age fish recorded in some, but not all, sites fished. Population density fluctuated widely between sites but not to the extreme extent shown in the Bann. Three sites yielded zero density. Of the remainder, four had density values of circa 5 / m^2 and two had densities in excess 10 / m^2.

Derreen River: Ten sites were fished on the Derreen, one of which yielded no juvenile lamprey. The population was composed entirely of juvenile river / brook lamprey with no juvenile sea lamprey captured. The population structure of the pooled data indicated that no 0+ juveniles were present, suggesting no spawning of river / brook lamprey in this channel in recent years. The majority of fish were in the 9.5 – 12 cm range but a significant number of smaller fish in the 7 – 8.5 cm range were also captured (Figure 3.7). This general pattern was broadly replicated at the individual fishing sites. Population density fluctuated between sites ranging from zero density to 7 individuals / m^2.

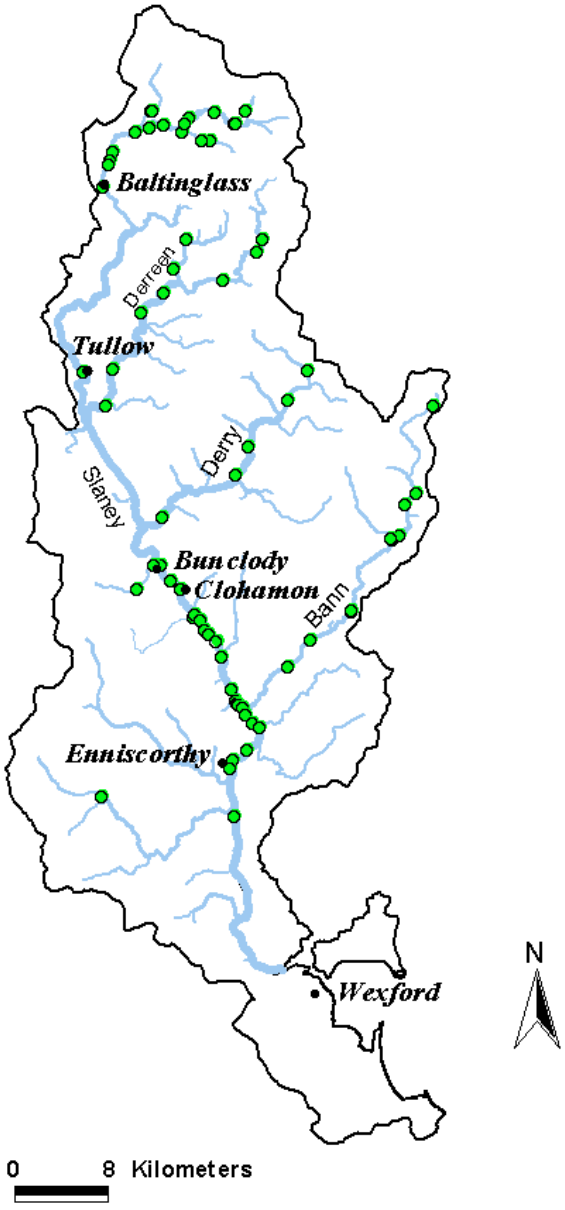
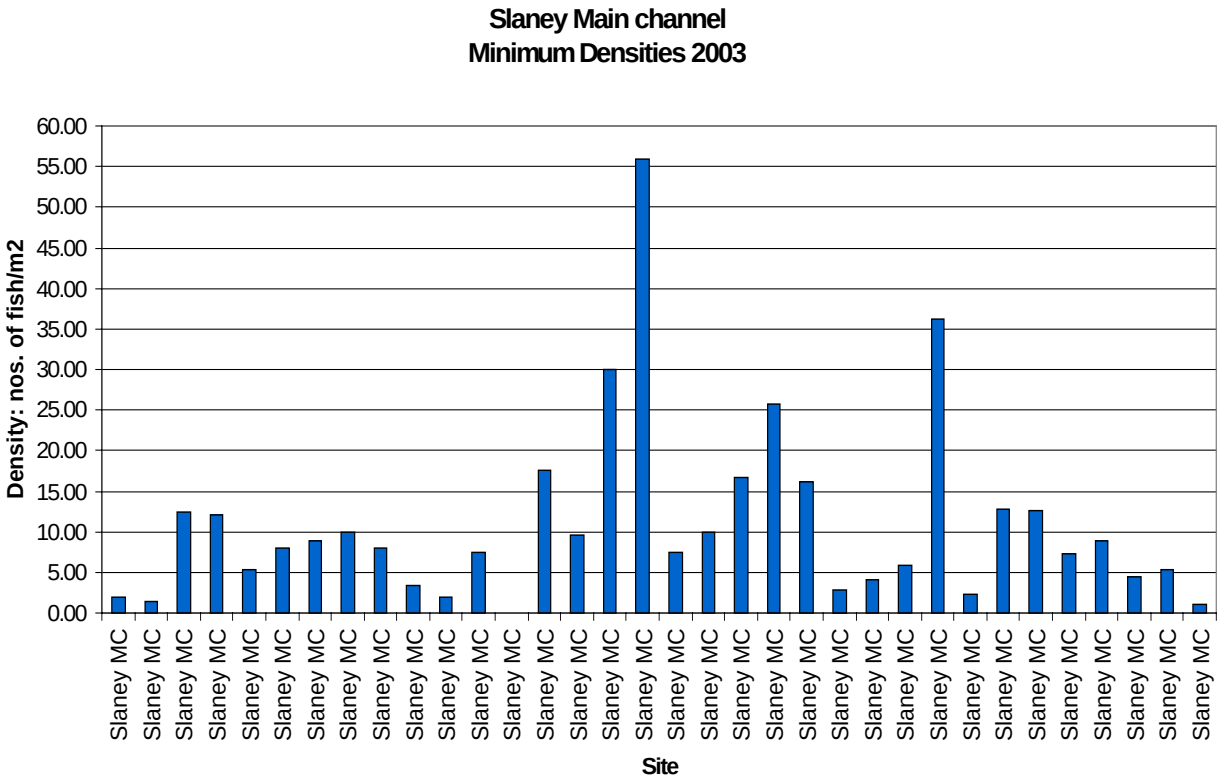
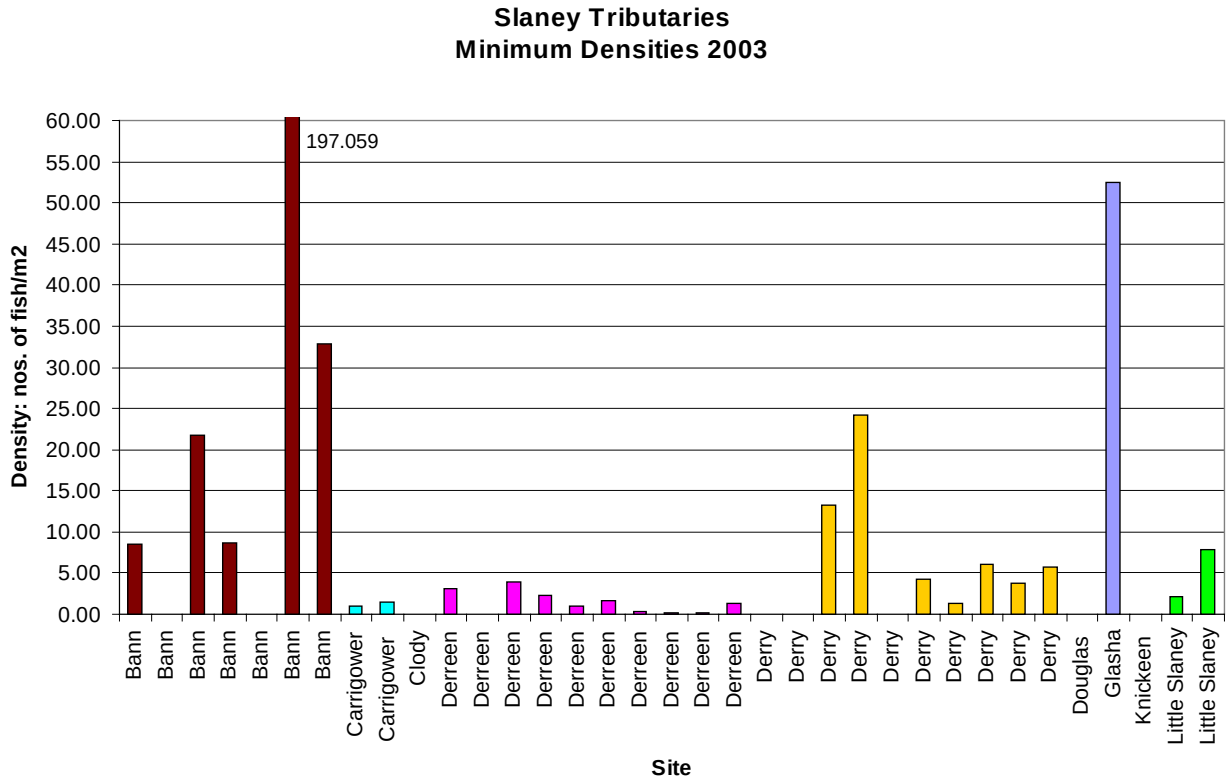
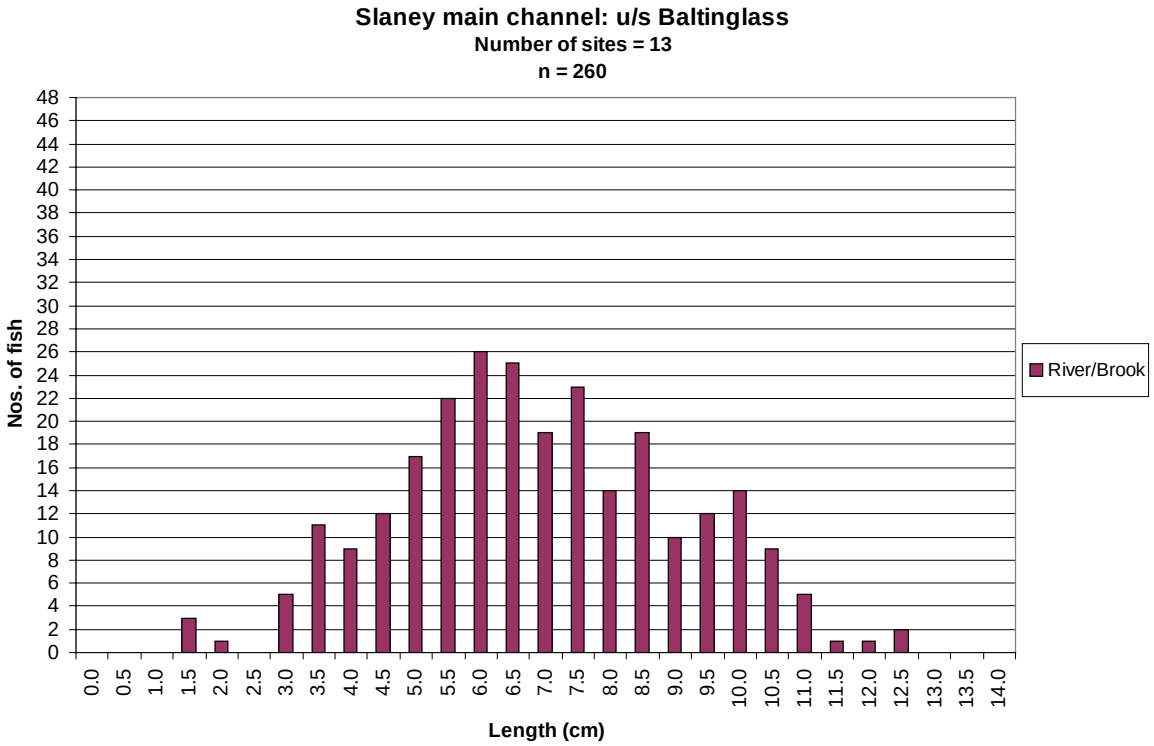


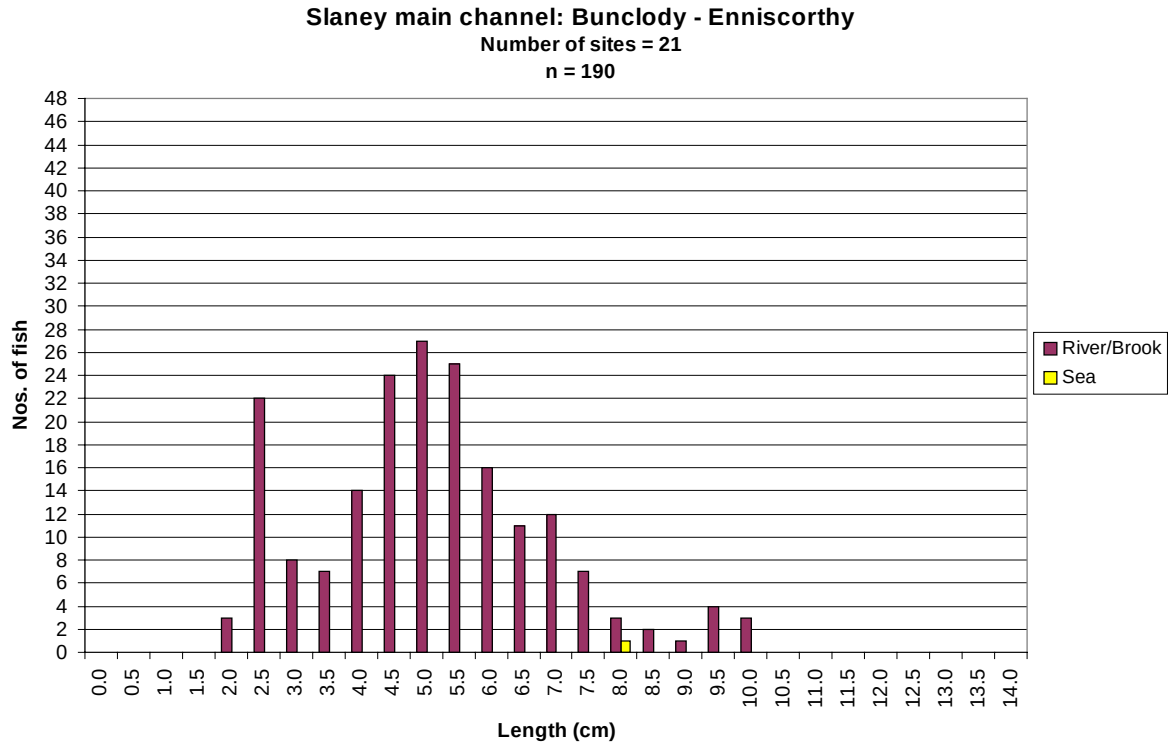
Figure 3.1: Map of Slaney showing electric spot-fishing sites 2003





Figures 3.2 and 3.3: Minimum densities of lamprey juveniles on the Slaney main channel and the Slaney tributaries





Figures 3.4A & 3.4B: River Slaney length – frequency distributions : **A**. upstream of Baltinglass; **B**. Bunclody to Enniscorthy

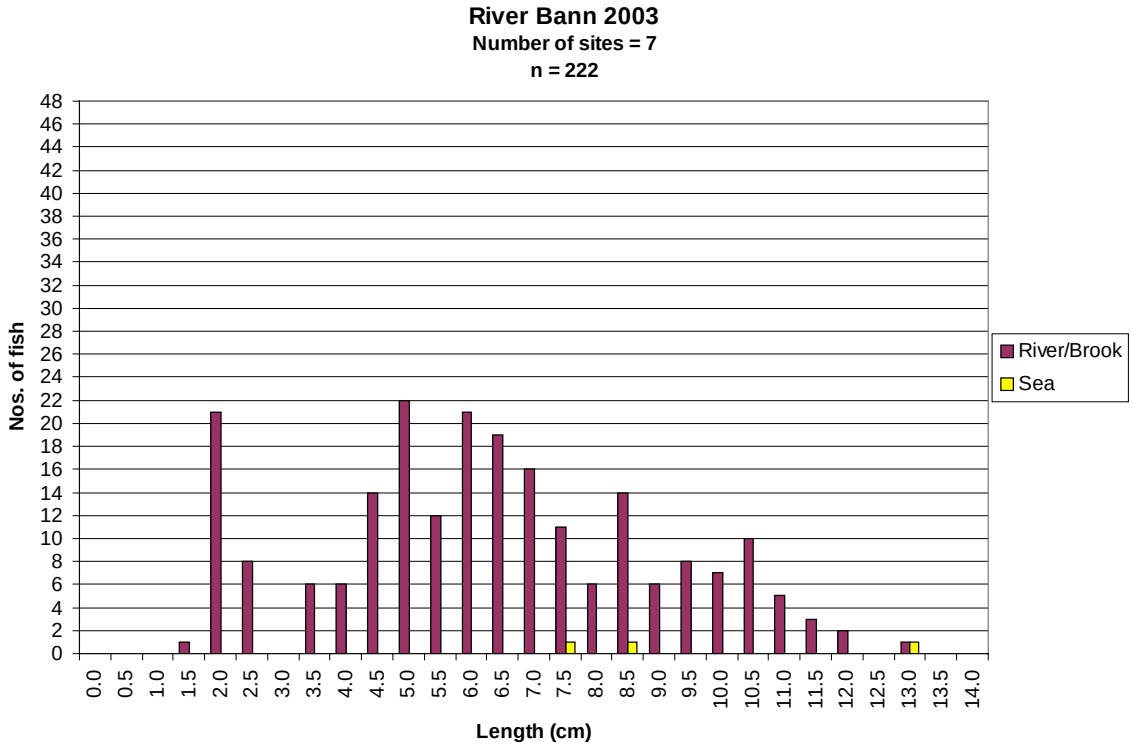


Figure 3.5: River Bann length-frequency distribution

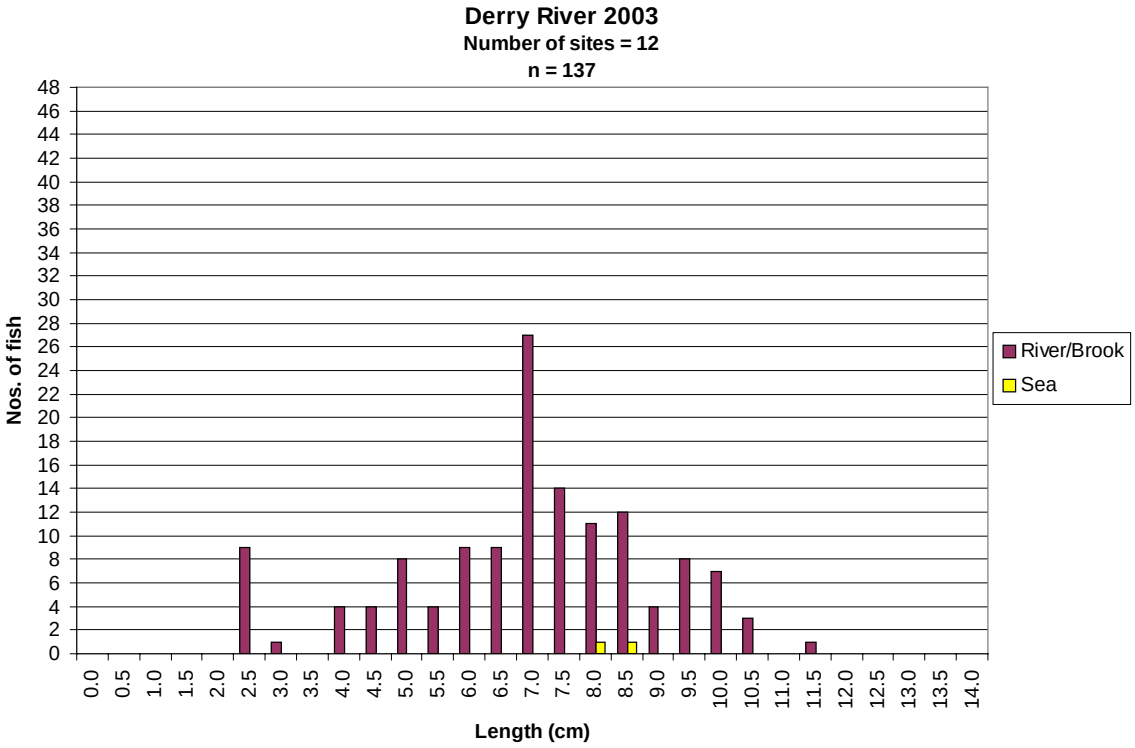
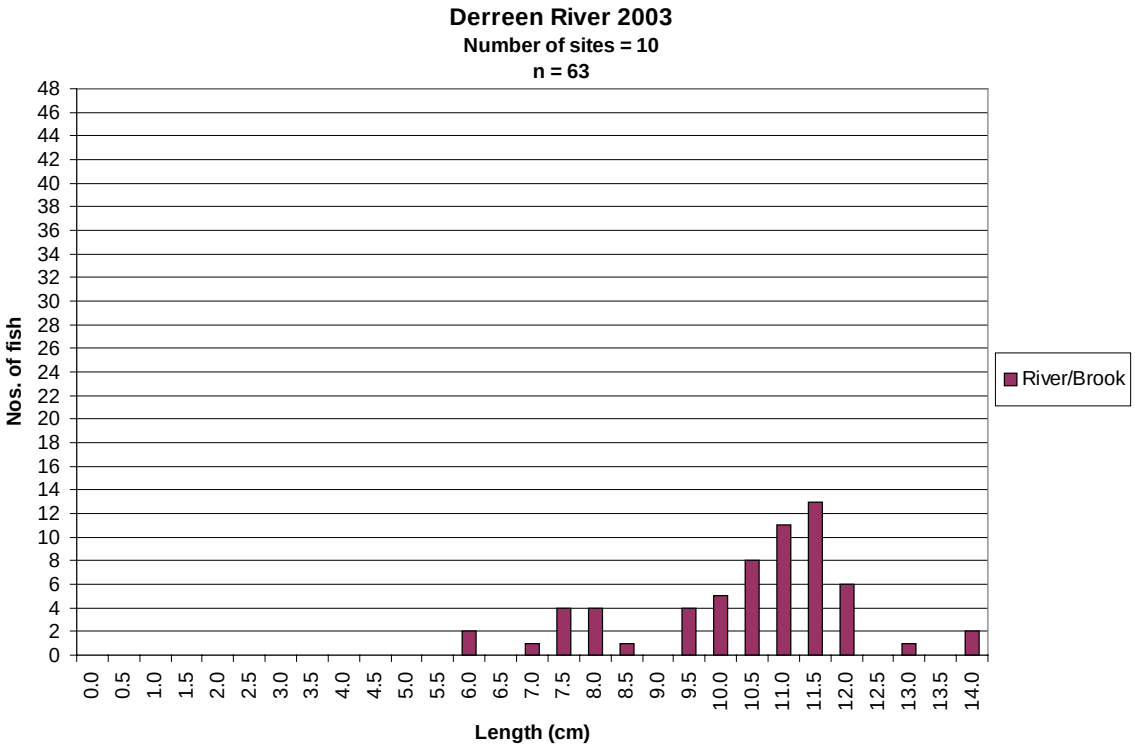


Figure 3.6: Derry River length-frequency distribution



19**Figure 3.7:** Derreen River length-frequency distribution

3.1.2 Investigations of lamprey spawning

Sea lamprey: Direct observation was used to observe and record locations and extent of sea lamprey spawning (Figure 3.8). A number of sites were observed from the riverbank and from bridges on the 7th and 8th July 2003 between Bunclody and Enniscorthy. A single redd was recorded at the main road bridge at Bunclody. Redds, in clusters, were noted at several sites downstream of Clohamon, including clusters at Scarawalsh Bridge and at the upstream end of the tidal limit immediately above Enniscorthy. A total of 10 redds were counted via bank and bridge observations between Bunclody and Enniscorthy.

In addition long segments of the main channel between Baltinglass and Scarawalsh Bridge were examined by boat over the period 15-16th July 2003. A number of areas with suitable bed type for sea lamprey, based on observations in other channels, were observed. No sea lamprey spawning sites were recorded by boat in any area upstream of Clohamon Weir. In contrast, clusters of sea lamprey redds or nests were observed in the gravel beds a short distance downstream of this weir and in a series of similar gravel beds downstream to Ballycarney. A total of 22 redds were counted by boat in this sector downstream of Clohamon (Figure 3.9).

River and Brook Lamprey spawning: Direct observation was also used in an attempt to observe and record locations and extent of river and brook lamprey spawning. Segments of the Bann, the Derry, the Derreen and the Slaney main channel were examined by walking from bridge to bridge over the period 12th - 14h May 2003. Three spent brook lamprey were collected at Iron Bridge above Tuckmill on the 12th May and 1 spent brook lamprey was collected below the road bridge at Tuckmill. Two river lamprey redds were visible upstream of Bann Bridge on the 13th May and four brook lamprey redds were observed on the River Bann between Waterworks and Hollyfort on the 14th May. Only two river lamprey spawning sites were encountered in the entire catchment, one at Carrickslaney on the main Slaney channel and the other downstream of Doran's Bridge on the River Bann, both on the 12th May.

A major site of river lamprey spawning was recorded downriver of Aghade Bridge on the Slaney by officers of the Eastern Regional Fisheries Board. Officers of that Board observed a large number of river lamprey acting in apparent unison to excavate the gravels and prepare the bed area for spawning activity. A large number of fish were engaged in this activity, observed on 17-18th April 2003, with in excess of 20 fish active in each of approximately 20 nest sites.

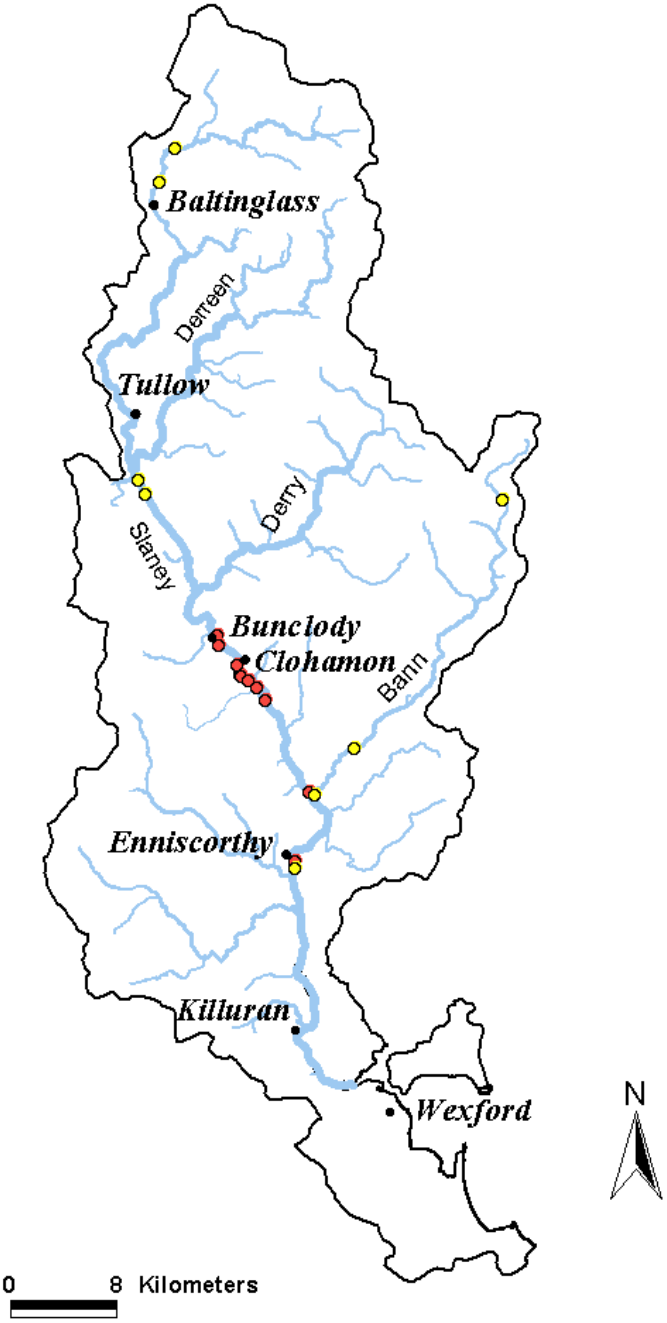


Figure 3.8: Map of Slaney showing distribution of lamprey redds 2003

- Sea lamprey redds
- River/Brook lamprey redds

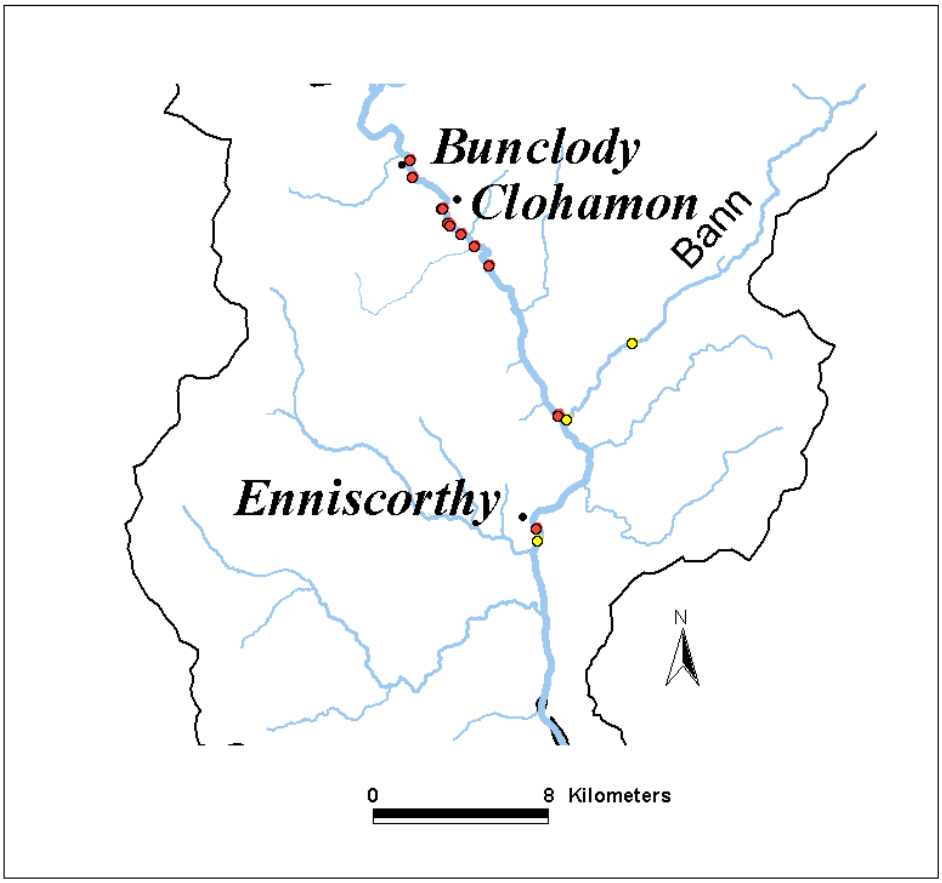


Figure 3.9: Lamprey redds encountered downstream of Clohamon

- Sea lamprey redds
- River/Brook lamprey redds

3.1.3. Investigations of adult lamprey – current and previous studies

The estuarine sampling carried out in early September 2003 yielded river lamprey in fyke nets set adjacent to the river crossings at Edermine and at Killurin. The small sample taken ranged in length from 30 to 32 cm (Figure 3.10).

A further series of 17 fyke netting operations were undertaken for adult lamprey over the period 15th October – 3rd December 2003 between Edermine and Killurin. All efforts were successful and yielded between 1 and 12 individuals per sampling effort. The largest number of individuals captured in any one operation was 54 upstream at Ballyhoge on 4th November 2003.

A total of 124 river lamprey were captured in the autumn nettings. Lengths ranged between 28 and 36 cm with modal peak at 32 cm (Figure 3.11). Comparison with netting surveyed carried out in autumn 2001 by CFB, augmented by by-catch material from commercial eel netsmen, indicated a similar size range for upstream migrating adult fish (FIG river lamprey) although the range of sizes was more uniformly spread over the range 29 cm to 34 cm. The sampling in 2001 was conducted both in the estuarine Slaney and in the riverine channel upstream of Enniscorthy. Sampling was carried out at Scarawalsh Bridge, upstream of the weir at Clohamon and at Tullow in the October – December 2001 period. Adult river lamprey were taken at Scarawalsh ad at Clohamon in October sampling, indicating that lampreys were moving through the estuary and into freshwater.

The small cluster of fish in the19 – 23 cm range (Figure 3.12) were taken in spring fyke netting operations (March 2002) in the Slaney estuary.

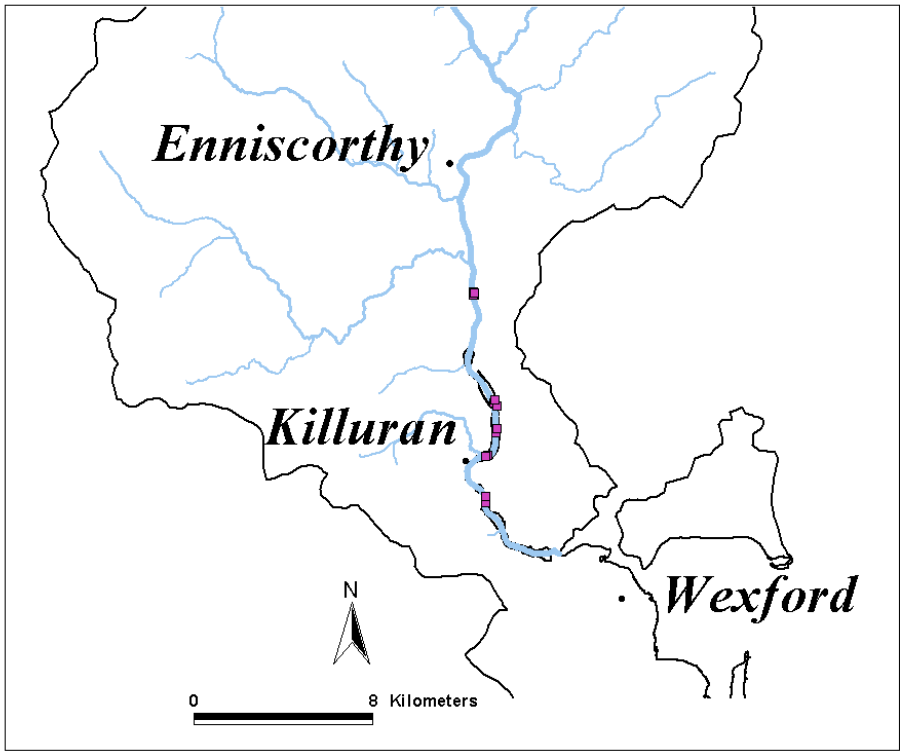
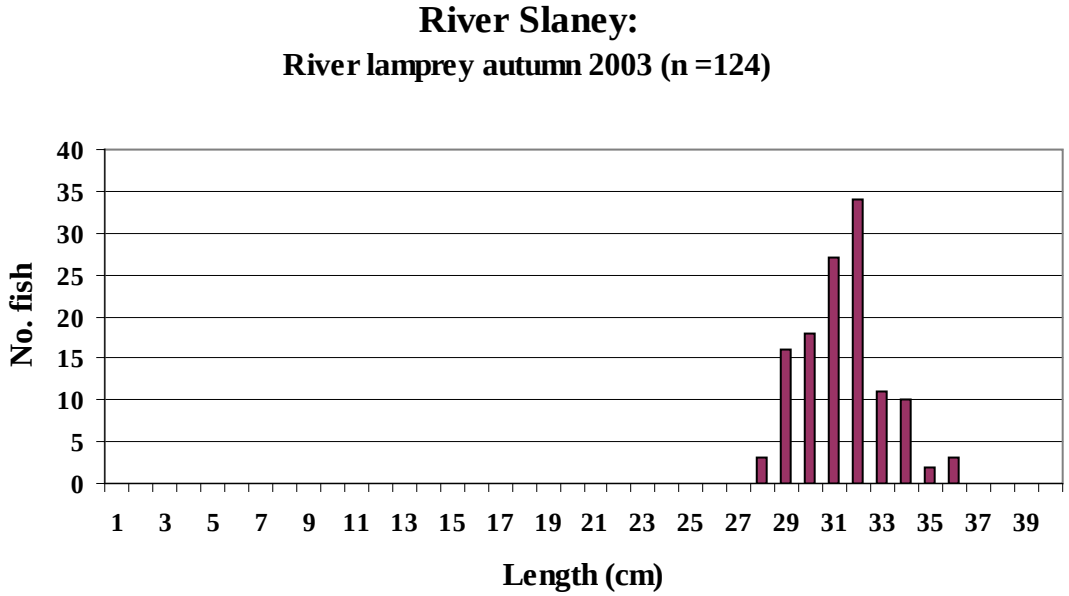
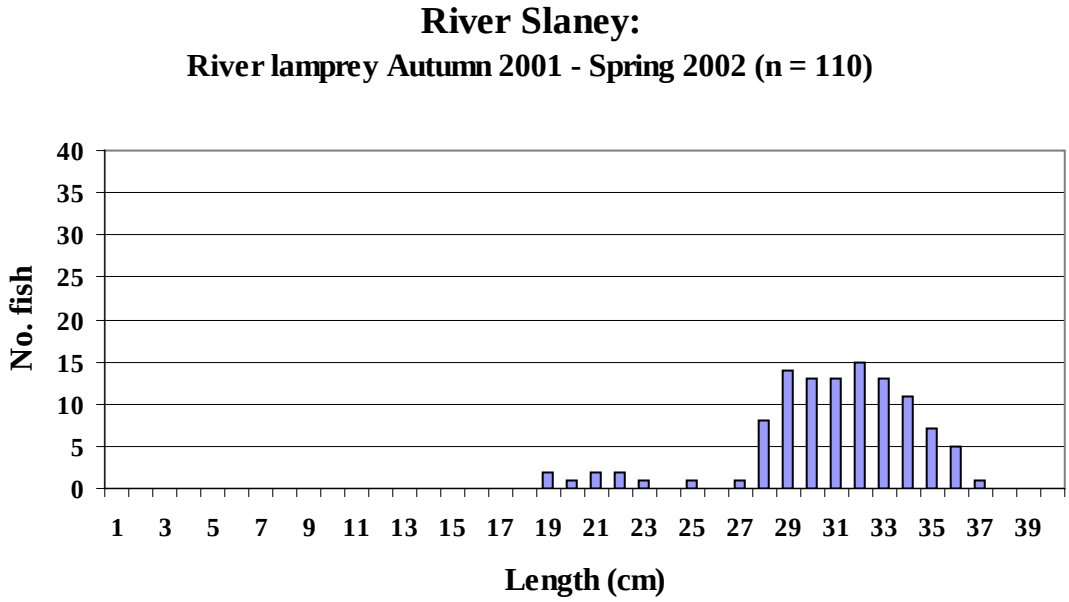


Figure 3.10: Map of Slaney lower reaches showing fyke netting sites 2003





Figures 3.11 and 3.12: Adult river lamprey in Slaney fyke nets – length-frequencies 2001/2 *vs* 2003

3.1.4 Archival material:

The principal sources of archival material were the material compiled by Kurz and Costello (1999), unpublished data of the Central Fisheries Board and unpublished material of the Environmental Protection Agency (EPA).

The report of Kurz and Costello (1999) reflected the synthesis of a larger database on records of lamprey distribution in Ireland. Extracts from this database, pertinent to the catchments under examination in the present study, were made available by National Parks and Wildlife. The sources of information included Fisheries Board personnel, aquatic scientists and commercial netsmen. A total of 19 individual reports related to the Slaney catchment, including three entries from the Urin and Boro tributaries which lie outside the area of the SAC. Four related to estuarine sightings of *P. marinus* and *L. fluviatilis* made by commercial salmon netsmen covering an unspecified period up to 1995. Records of *L. fluviatilis* from three locations on the Slaney main channel in 1991 are considered to relate to spawning movements or post-spawning fish.

3.2 Lamprey Investigations on R. Munster Blackwater

3.2.1. Juvenile Lamprey investigations

A total of 88 sites were electric fished for juvenile lamprey over 29 channels (Figure 3.13). 26 sites yielded no juvenile lamprey. Of the 18 sites fished on the main River Blackwater two, only, contained no juvenile lamprey. Among the 70 sites fished in the tributary channels 34% contained no juvenile lamprey. The majority of juvenile lamprey taken were identified as river / brook lamprey. Juvenile sea lamprey were recorded in many of the channels, including the main Blackwater channel and made up approximately one-sixth of the overall recorded population across the catchment.

Population structure, based on a pooling of data from all sites on a channel, varied among the different channels. Only 5 channels displayed a strong presence of young-of-the-year, hatched in Spring 2003, while this age group was not recorded in others. The modal length range for this group was 2.0 – 3.0 cm in 3 of the channels while the smaller length mode of circa 1.5 cm was recorded only in the Blackwater and Dalua channels. Those with a prominent 0+ year class generally also displayed at least one further modal peak. In general, few juveniles larger than 14 cm were recorded. The population in the main Blackwater channel displayed the most complete structure ranging from 0+ fish through to larger sizes with a maximum of 17.5 cm – the largest size recorded in this survey of the Munster Blackwater catchment.

Population density (no. juveniles / m^2), as minimum density values, showed a very wide spread throughout the Munster Blackwater catchment main channel (Figure 3.14) as well as throughout the individual river tributaries (Figure 3.15). The highest density on the Blackwater main channel was 18 fish / m^2. However, the majority of values were lower, lying in the range 0 – 15 / m^2. In the tributary channels, a wide range of values was recorded.

River Blackwater: Eighteen sites on the main Blackwater channel were examined – five sites in the more upland areas upstream of Mallow and thirteen in the lower reaches between Mallow and Cappoquin. The composite population structure ranged from 0+ fish through to larger sizes with a maximum of 17.5 cm recorded (Figure 3.16). The upper size range tapered off at 14.5 cm with only a small number of individuals in the larger size range of 15 – 17.5 cm. The population was composed of circa 30% juvenile sea lamprey, mostly ranging in size from 6 – 15.5 cm. One specimen of 1.4 cm was recorded, the smallest sea lamprey encountered on the Munster Blackwater. All evidence of recruitment of young-of-the-year and all individuals below 4 cm in length were found in the headwaters. Larger size groups were well represented across the majority of sites with a significant number of fish in the 6.5 – 14.5 cm range. In general, the lamprey captured in the lower reaches, downriver of Mallow, were dominated by larger, older size groups.

River Licky: Three sites were fished on the Licky, one of which yielded no juvenile lamprey. The population was almost equally composed of juvenile river / brook lamprey

and juvenile sea lamprey, which accounted for circa 44% of the numbers captured. The population structure of the pooled data indicated the presence of only one 0+ river / brook juvenile, suggesting of limited spawning of river / brook lamprey in this channel. Two modal peaks were displayed at the 5 cm and 7 cm ranges. All juveniles in excess of 9.5 cm were identified as sea lamprey. The population structure at individual sites suggested that most of the more recent spawning for both river / brook and sea lamprey took place at the more upstream bridges along the channel. Population density fluctuated widely between sites. One yielded zero density while the other two yielded 7.5 and 48 juveniles / m^2 respectively.

Greagagh River: Four sites were fished on the Greagagh, all of which yielded juvenile lamprey. The population consisted entirely of juvenile river / brook lamprey with no juvenile sea lamprey captured. The population structure of the pooled data showed a lack of 0+ juveniles, again suggesting of no recent spawning of river / brook lamprey in this channel. The population structure appeared to be less spread out than the Licky, with no lengths falling in the range of 5 – 9 cm. All individuals were found at the 4 cm and 11 – 11.5 peaks. There was a prominent modal peak at 7 cm. The population structure at individual sites indicated a similar pattern in most of the sites. Population density barely fluctuated between sites with the three lower sites yielding densities between 4 and 5 / m^2 and the uppermost site yielding a value of 11 /m^2.

River Bride: Fourteen sites were fished on the Bride, two of which yielded no juvenile lamprey. The population was comprised almost entirely of juvenile river / brook lamprey with juvenile sea lamprey accounting for circa 8% of the numbers captured. The population structure of the pooled data indicated the presence of only one 0+ river / brook juvenile, indicative of limited spawning of river / brook lamprey in this channel. A number of modal peaks were displayed most notably at the 8 - 9 cm and 10.5 - 11cm ranges. No sea lamprey juveniles smaller than 7 cm were recorded. The population structure at individual sites indicated that most of the spawning for both river / brook and sea lamprey took place just above the lowest bridge sampled. Population density fluctuated widely between sites. Two sites yielded zero density while the other twelve varied between 0.7 and 15 juveniles / m^2. Of the two sites with juvenile sea lamprey present, total density varied from 1 / m2 to 13 / m^2.

Finisk River: Three sites were fished on the Finisk, all which yielded juvenile lamprey. The population was composed entirely of juvenile river / brook lamprey with no juvenile sea lamprey captured. The population structure of the pooled data indicated a deficit of 0+ river / brook juvenile, suggesting no recent spawning of lamprey in this channel. The modal peak displayed at 12 cm recorded only two individuals. All other peaks showed one individual each. The population structure suggested that in general spawning has taken place on a limited scale along the channel. Population density fluctuated little between sites ranging from 2 to 5 juveniles / m^2.

Glenshalane River: Three sites were fished on the Glenshalane, two of which yielded no juvenile lamprey. The population was composed entirely of juvenile river / brook lamprey with no juvenile sea lamprey captured. The population structure of the pooled data

indicated that there were no 0+ river / brook juvenile present, suggesting no recent spawning of river / brook lamprey in this channel. Two peaks were displayed at the 4 and 4.5 cm ranges yielding three and two individuals respectively. Population density ranged from 0 / m^2 at two of the sites to 5 / m^2 at the third lowermost site. All sites fished were of a relatively high gradient.

Araglin River: Two sites were fished on the Araglin, both of which yielded juvenile lamprey. The population was mostly composed of juvenile river / brook lamprey with juvenile sea lamprey accounting for circa 20% of the numbers captured. The population structure of the pooled data indicated the presence of no 0+ juveniles, suggesting no recent spawning of river / brook lamprey in this channel. A number of modal groups were displayed most notably at 4.5 cm, 5.5 - 13.5 cm and 14.5 – 16 cm. No sea lamprey juveniles smaller than 6 cm were recorded. The population structure at individual sites displayed similar clusters at the 4.5 cm and 14.5 - 16 cm groups with more individuals captured in the 5.5 - 13.5 cm group at the lowermost site. Population density differed in each site with the lowermost site showing a density of 18 individuals / m^2 and the upper site a density of 10 / m^2.

Awbeg 1 River: Four sites were fished on the Awbeg 1, three of which yielded juvenile lamprey. The population consisted almost entirely of juvenile river / brook lamprey with juvenile sea lamprey accounting for circa 16% of the numbers captured. The population structure of the pooled data showed a lack of 0+ juveniles, suggesting no recent spawning of river / brook lamprey in this channel. The population structure showed one modal group between 7 and 8 cm with single individuals falling at the 4 cm, 12 cm and 14 cm peaks. Population density varied between sites ranging and ranged from 0 – 3 individuals / m^2. A juvenile sea lamprey of 14 cm was recorded in the uppermost site – the largest sized juvenile recorded in this channel.

River Clyda: Three sites were fished on the Clyda, all of which yielded juvenile lamprey. The population was dominated by juvenile river / brook lamprey with juvenile sea lamprey accounting for circa 9% of the numbers captured. The population structure of the pooled data indicated that no 0+ juveniles were present, suggesting no recent spawning of river / brook lamprey in this channel. The modal peak displayed at 7 cm recorded only four individuals. All other peaks showed between two and three individuals each. No sea lamprey juveniles smaller than 7.5 cm were recorded. In general, sizes fell between 3.5 and 12 cm. Population density varied greatly between sites ranging from 9 – 42 individuals / m^2.

River Lyre: Three sites were fished on the Lyre, only one of which yielded juvenile lamprey. The population consisted entirely of juvenile river / brook lamprey with no juvenile sea lamprey captured. The population structure of the pooled data showed a lack of 0+ juveniles, suggesting no recent spawning of river/brook lamprey in this channel. The population structure appeared to be clumped together, with most of the lengths falling in the range of 4.5 – 8.5 cm. There was a prominent modal peak at 7 cm. However, it is likely that the size distribution spanned a number of age groups. The population structure

at individual sites indicated a similar pattern in most of the sites. Population density ranged from 0 – 15 individuals / m^2.

River Allow: Three sites were fished on the Allow, all which yielded juvenile lamprey. The population was dominated by juvenile river / brook lamprey with juvenile sea lamprey accounting for circa 20% of the numbers captured. The population structure of the pooled data showed a lack of 0+ and 1+ juveniles, suggesting no recent spawning of river / brook lamprey in this channel. The population structure differed for river / brook and sea lamprey with sea lamprey comprising the two smallest individuals, i.e. 9 and 10 cm respectively. The modal group of 12 – 14.5 cm comprised entirely of river / brook juvenile lamprey. Population density ranged from 2 – 10 individuals / m^2.

River Dalua: Two sites were fished on the Dalua, both of which yielded juvenile lamprey. The population was composed entirely of juvenile river / brook lamprey. The population structure of the pooled data indicated a small presence of 0+ juveniles, indicating Spring 2003 spawning of river / brook lamprey in this channel. There was no prominent modal peak and it is likely that the size distribution spanned a number of age groups. Sizes fell between 1.5 cm and 12.5 cm. Population density varied little between sites and ranged from 3 – 5 individuals / m^2.

Owenkeal River: Only one site was fished on the Owenkeal which yielded a population density of 5 individuals / m^2. The population was dominated by juvenile river / brook lamprey with juvenile sea lamprey accounting for circa 5% of the numbers captured. The population structure showed a small presence of 0+ juveniles, indicative of recent spawning of river / brook lamprey in this channel. The population structure was well spread out, with lengths ranging from 2.5 – 15.5 cm. There was a prominent modal peak at 7 cm and two distinct modal groups between 5.5 and 7 cm and between 11 and 13 cm. The one sea lamprey juvenile captured was 6 cm in length.

Finnow River: Only one site was fished on the Finnow which yielded a population density of 8 individuals / m^2. The population differed from all other channels in that it was mostly composed of juvenile sea lamprey with juvenile river / brook lamprey accounting for circa 35% of the numbers captured. The population structure showed a lack of 0+ juveniles, suggesting no recent spawning of lamprey in this channel. Most of the population had lengths ranging between 11 and 13 cm. There was a prominent modal peak at 13 cm composed entirely of sea lamprey. The two river / brook lamprey juveniles captured were 4 and 14.5 cm in length.

Owentaraglin River: Four sites were fished on the Owentaraglin, all of which yielded juvenile lamprey. The population was dominated by juvenile river / brook lamprey with juvenile sea lamprey accounting for circa 23% of the numbers captured. The population structure of the pooled data indicated the presence of no 0+ juvenile lamprey, indicative of no recent spawning of lamprey in this channel. Two modal groups were displayed at the 3 – 4.5 cm range and the 12 - 13 cm range. The population structure at individual sites indicated that the sea lamprey were randomly dispersed throughout the population. The

population structure at individual sites indicated differing spawning pattern at each sites. Population density ranged from 3 – 12 individuals / m^2.

Awanaskirtaun River: Only one site was fished on the Awanaskirtaun which yielded a population density of 3 individuals / m^2. The population was dominated by juvenile river / brook lamprey with juvenile sea lamprey accounting for circa one third of the numbers captured. The population structure showed a lack of 0+ and 1+ juveniles, indicative of no recent spawning of lamprey in this channel. The lengths of the entire population length ranged from 9.5 to 15 cm. However, it is likely that the size distribution spanned a number of age groups.

Crooked River: Two sites were fished on the Crooked River, only one of which yielded a small number of juvenile lamprey. The total number captured was three individuals one of which was identified as a sea lamprey. The population comprised of two 7cm fish and one 8 cm fish suggesting that all juveniles were from the same age class. Population density at the two sites were 0 and 30 individuals / m^2 respectively. Both sites were of a relatively high gradient.

Mocollop Glen, Duvglasha, Awbeg 2 and **Breedog Rivers**: One site was fished on all channels and each site yielded between one and three individuals. All individuals captured were juvenile river / brook lamprey with the exception of one individual from the Awbeg 2 River, which was identified as a sea lamprey juvenile.

Glendine, Glenmore, Glen, Nad, Brogeen, Glashawee and **Owengloor Rivers**: Thirteen sites were fished on these seven rivers yielding no juvenile lamprey.

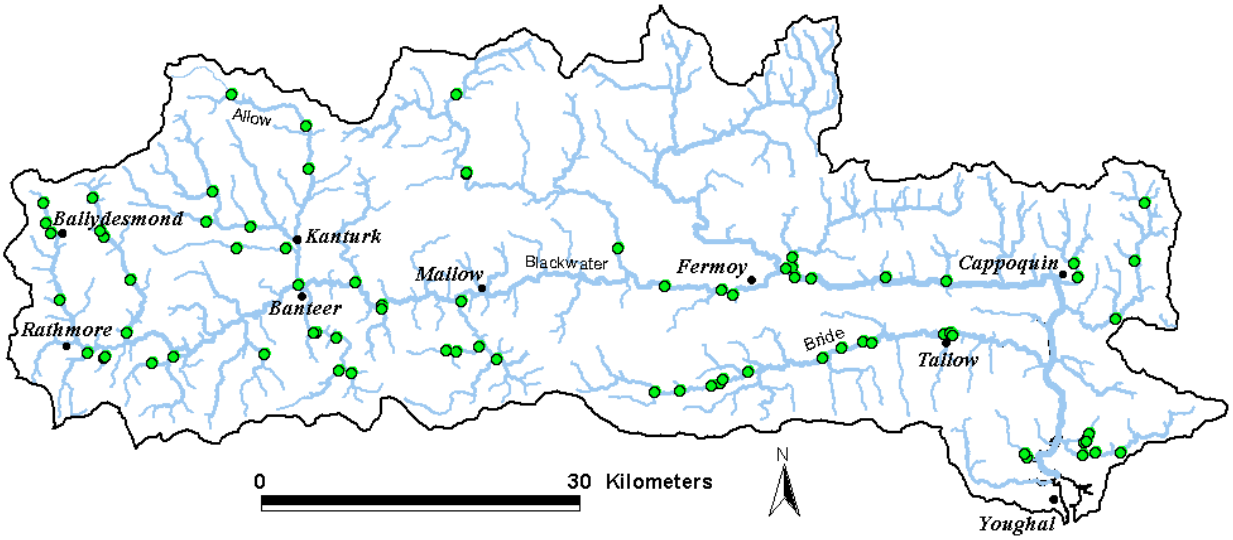
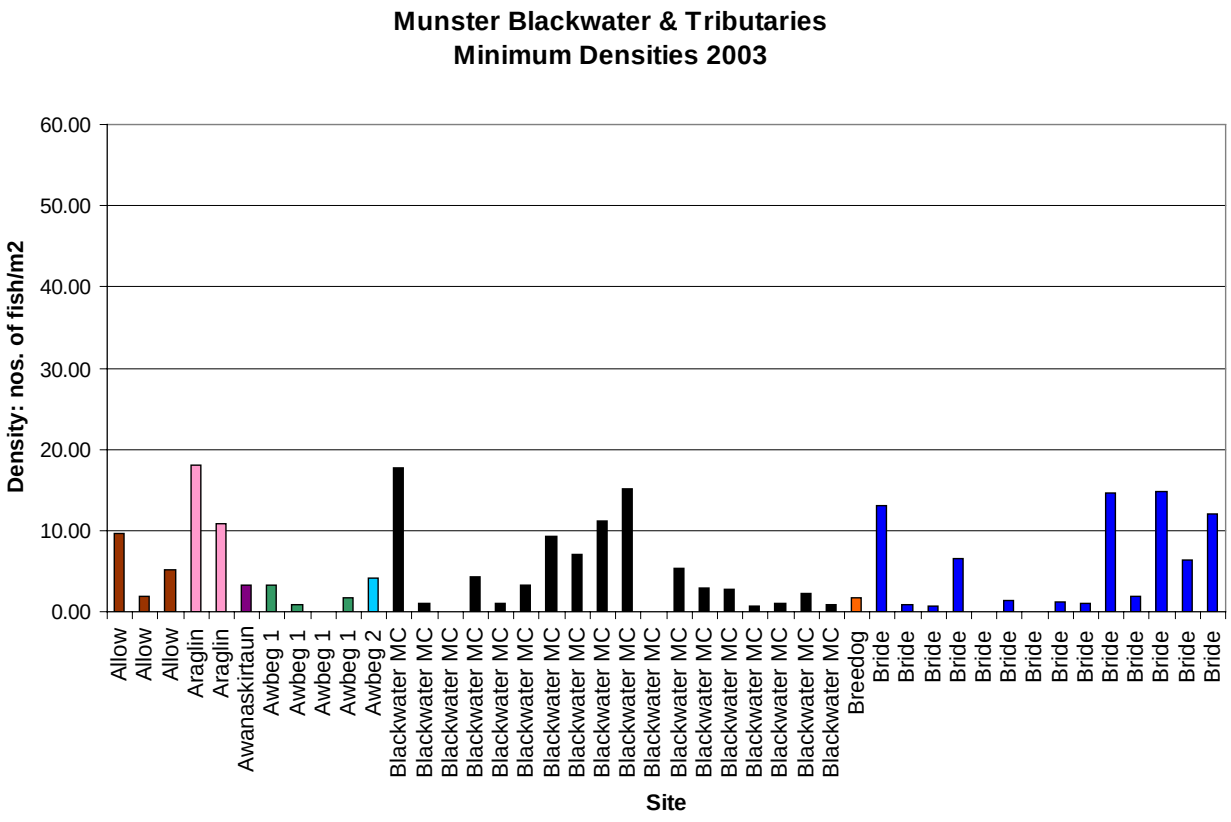
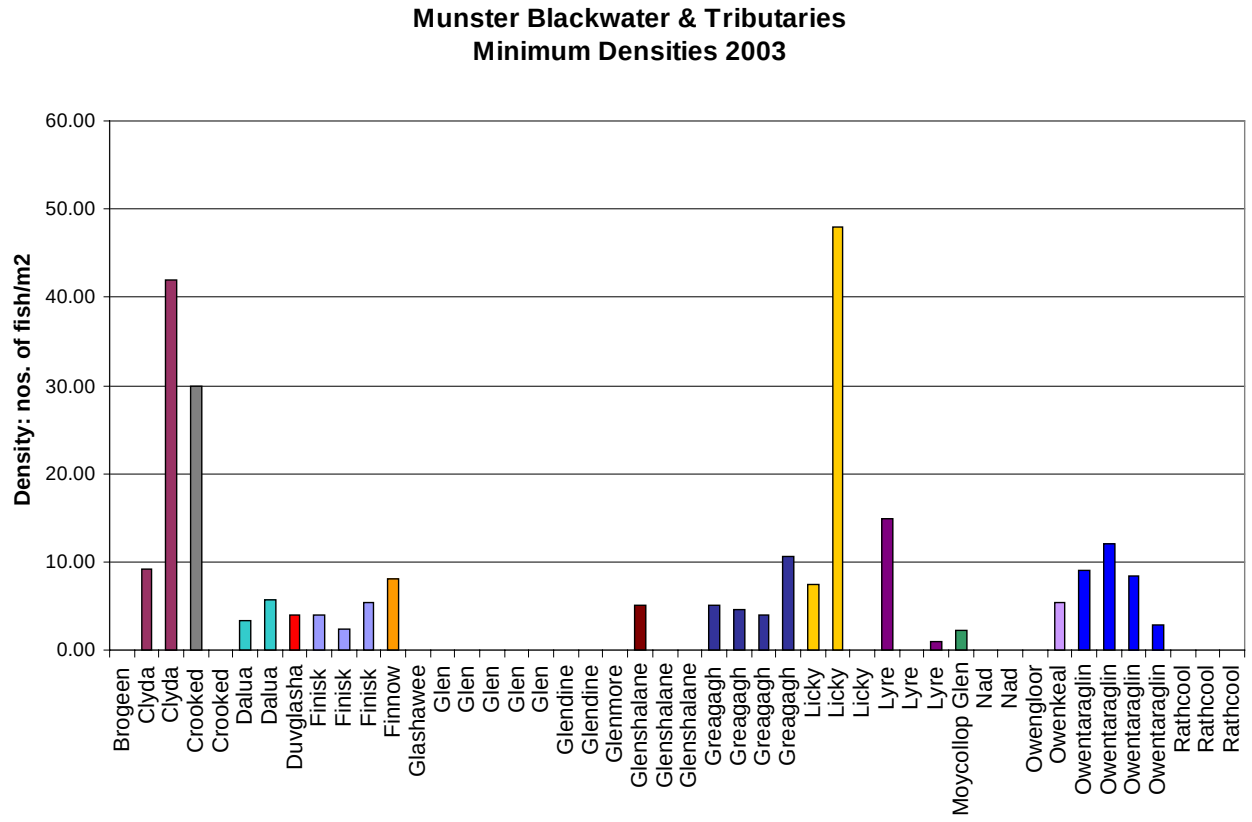


Figure 3.13: Map of Munster Blackwater showing electric spot-fishing sites 2003





Figures 3.14 & 3.15: Minimum densities of lamprey juveniles on the Munster Blackwater main channel and tributaries.

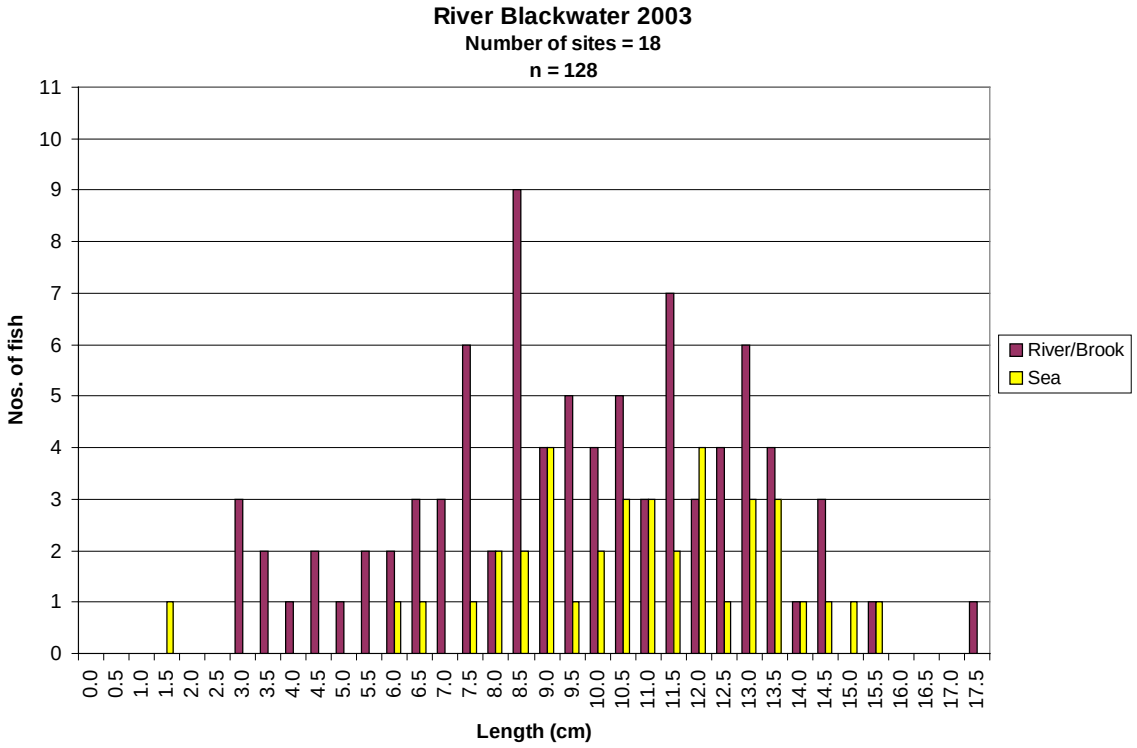


Figure 3.16: Blackwater main channel length-frequency distribution

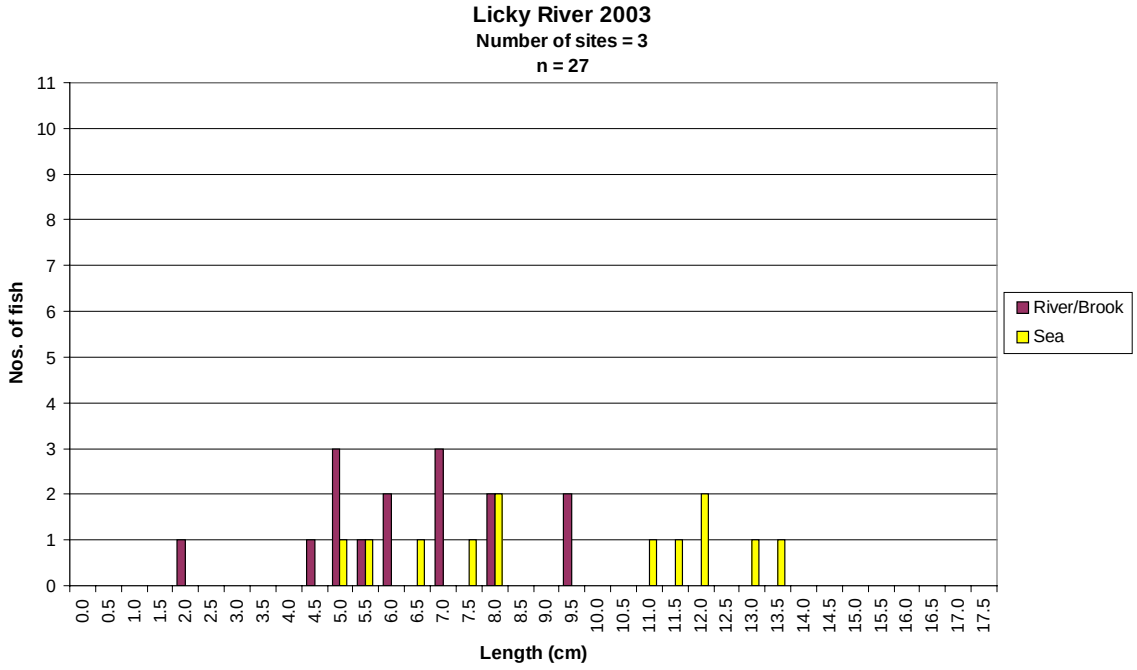


Figure 3.17: River Licky length-frequency distribution

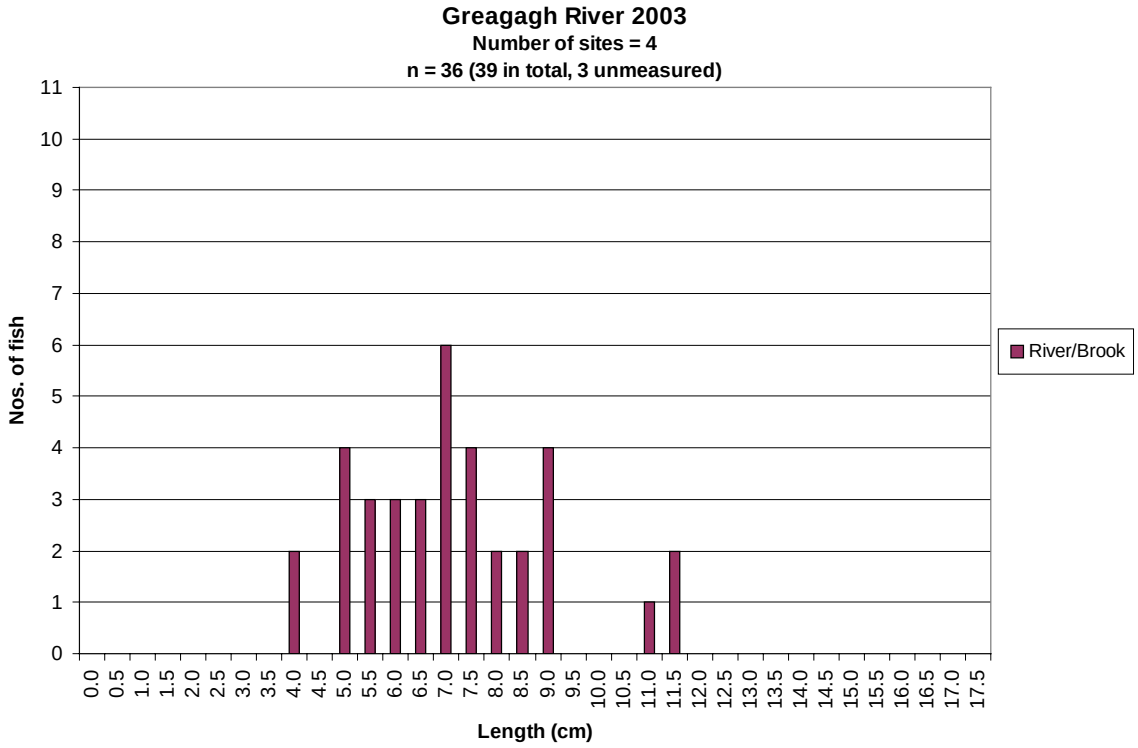


Figure 3.18: Greagagh River length-frequency distribution

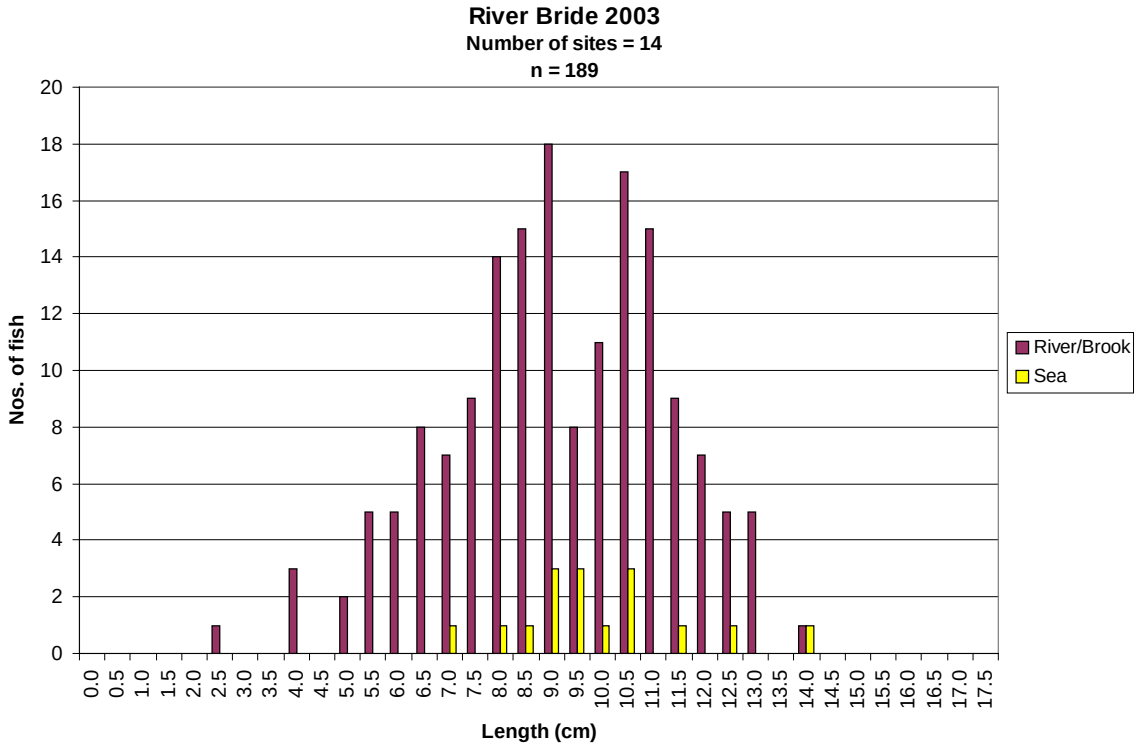


Figure 3.19: River Bride length-frequency distribution

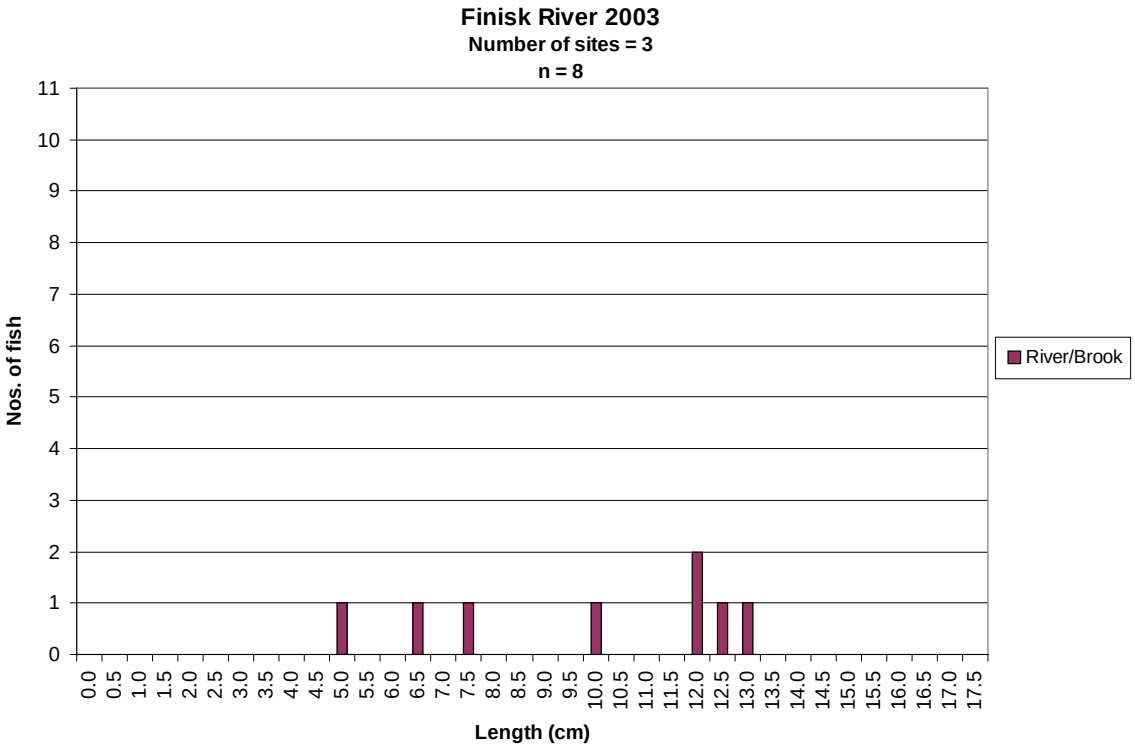


Figure 3.20: Finisk River length-frequency distribution

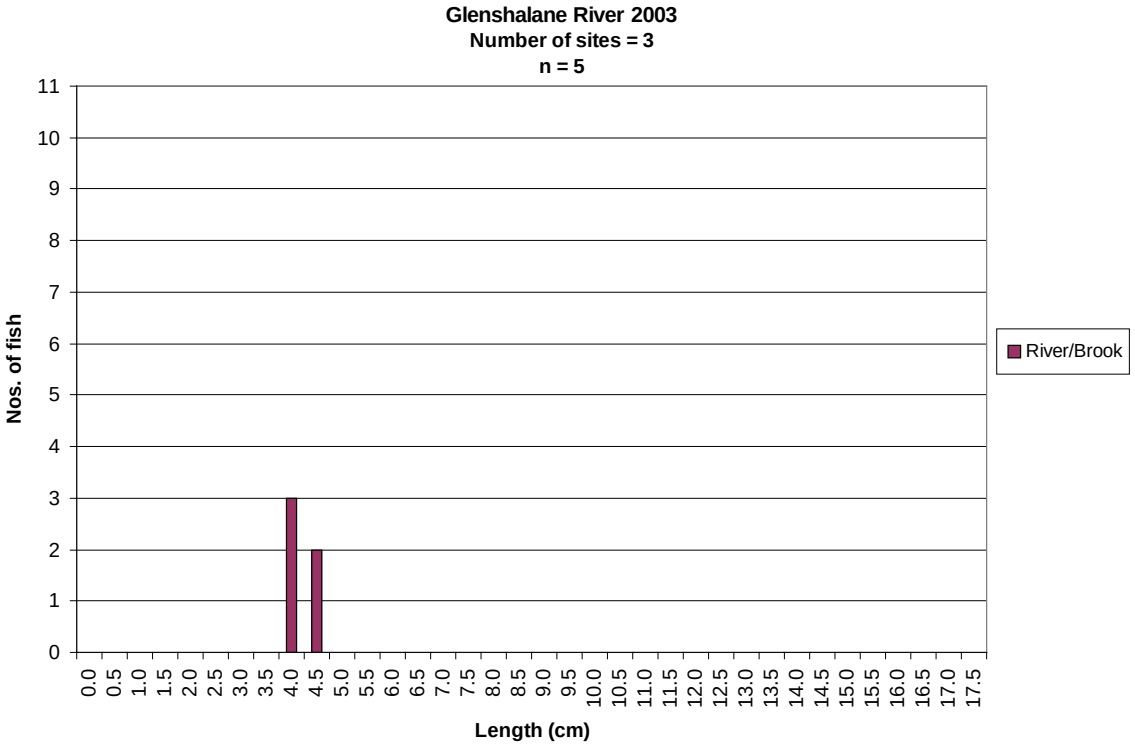


Figure 3.21: Glenshalane River length-frequency distribution

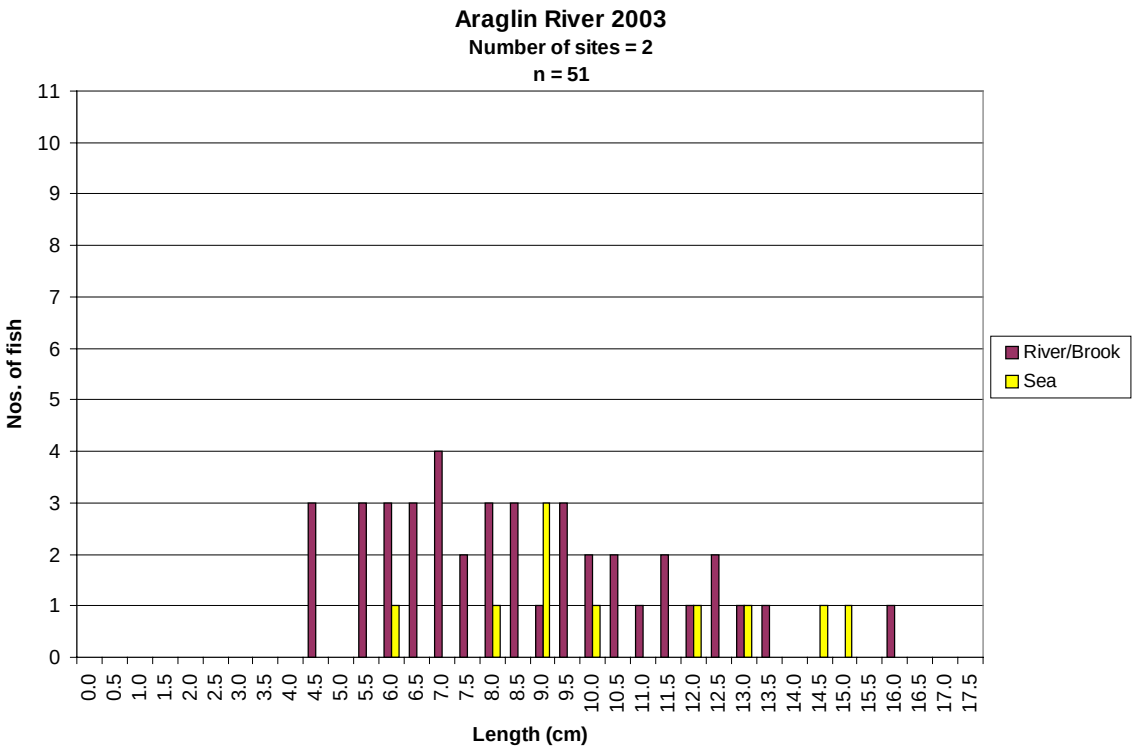


Figure 3.22: Araglin River length-frequency distribution

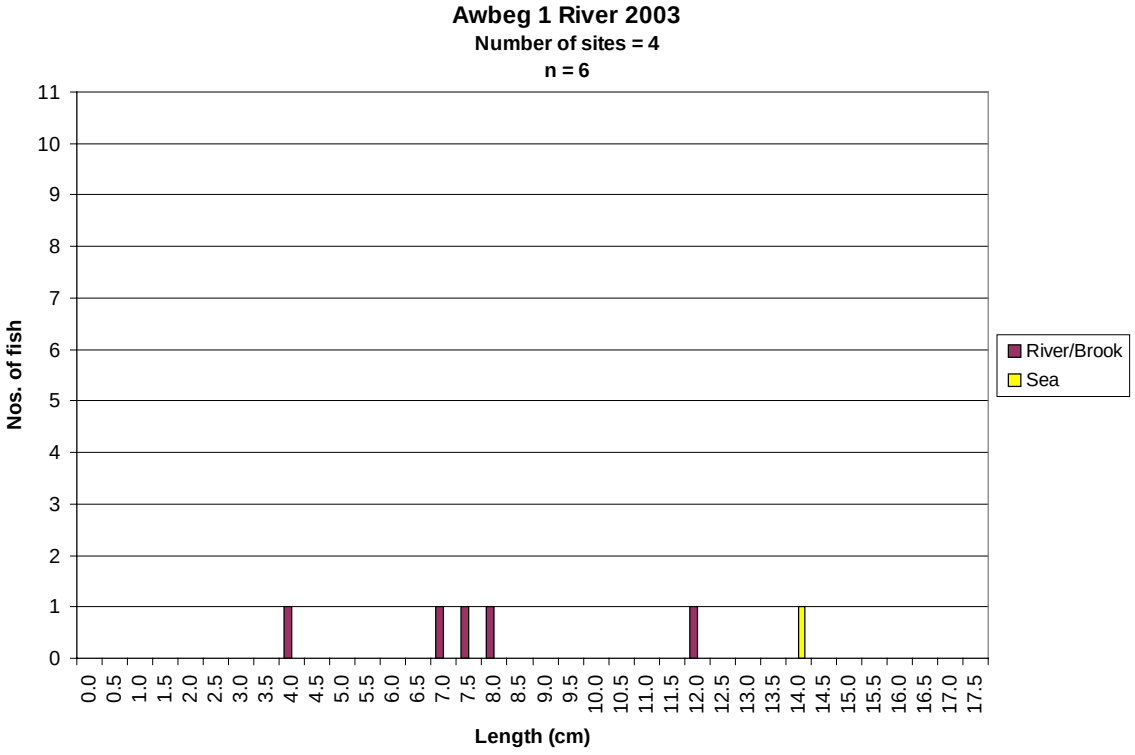


Figure 3.23: Awbeg 1 River length-frequency distribution

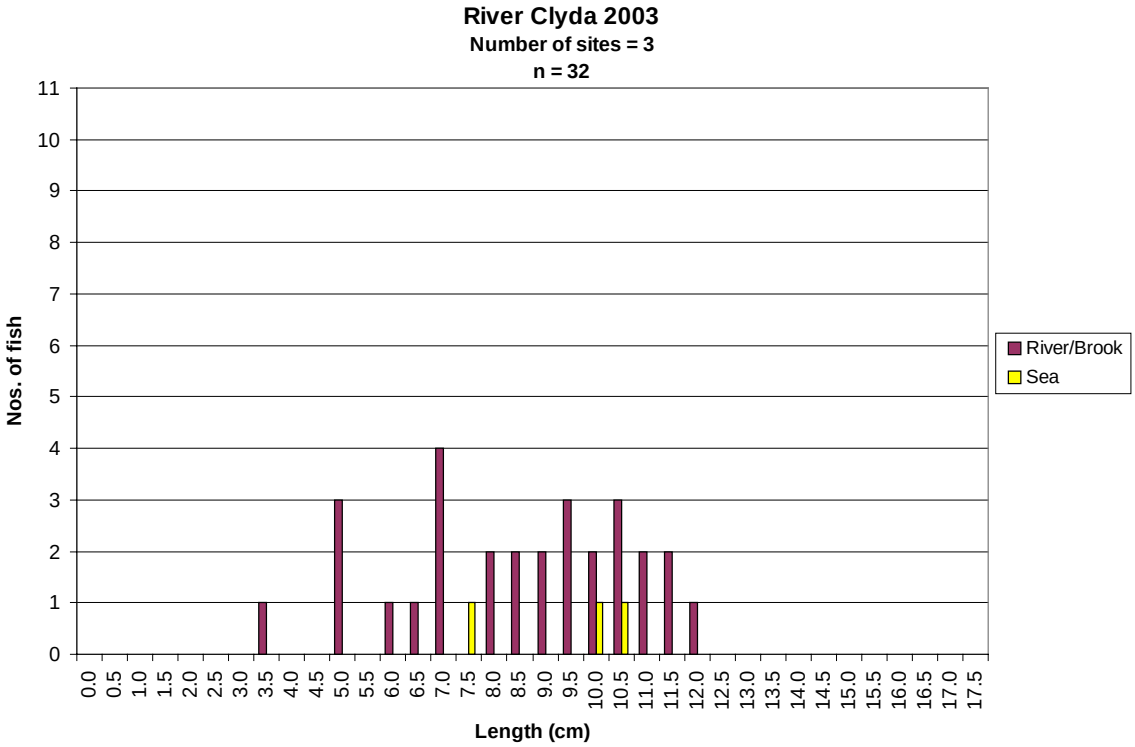


Figure 3.24: River Clyda length-frequency distribution

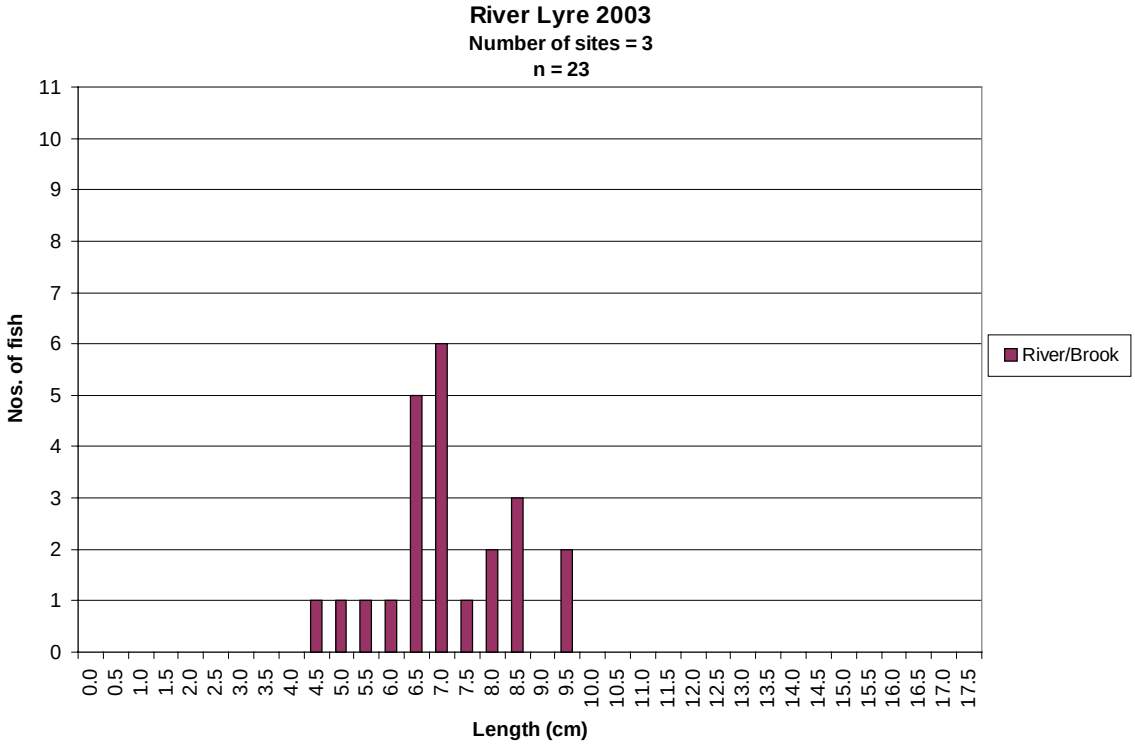


Figure 3.25: River Lyre length-frequency distribution

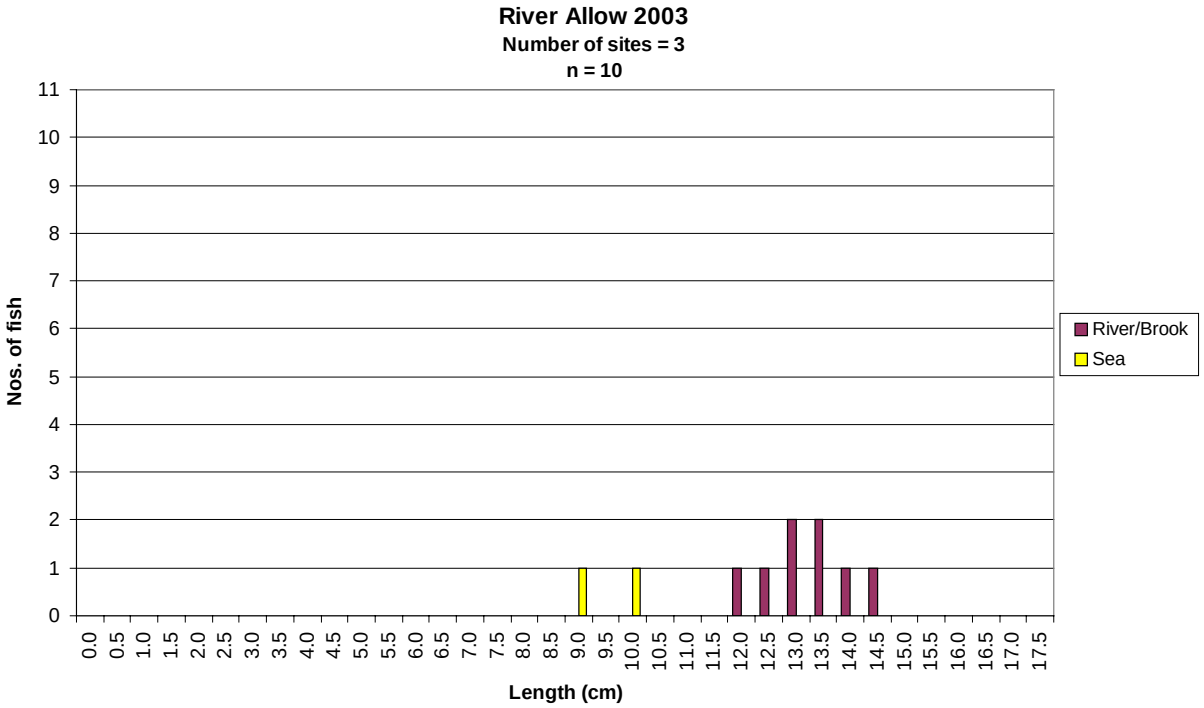


Figure 3.26: River Allow length-frequency distribution

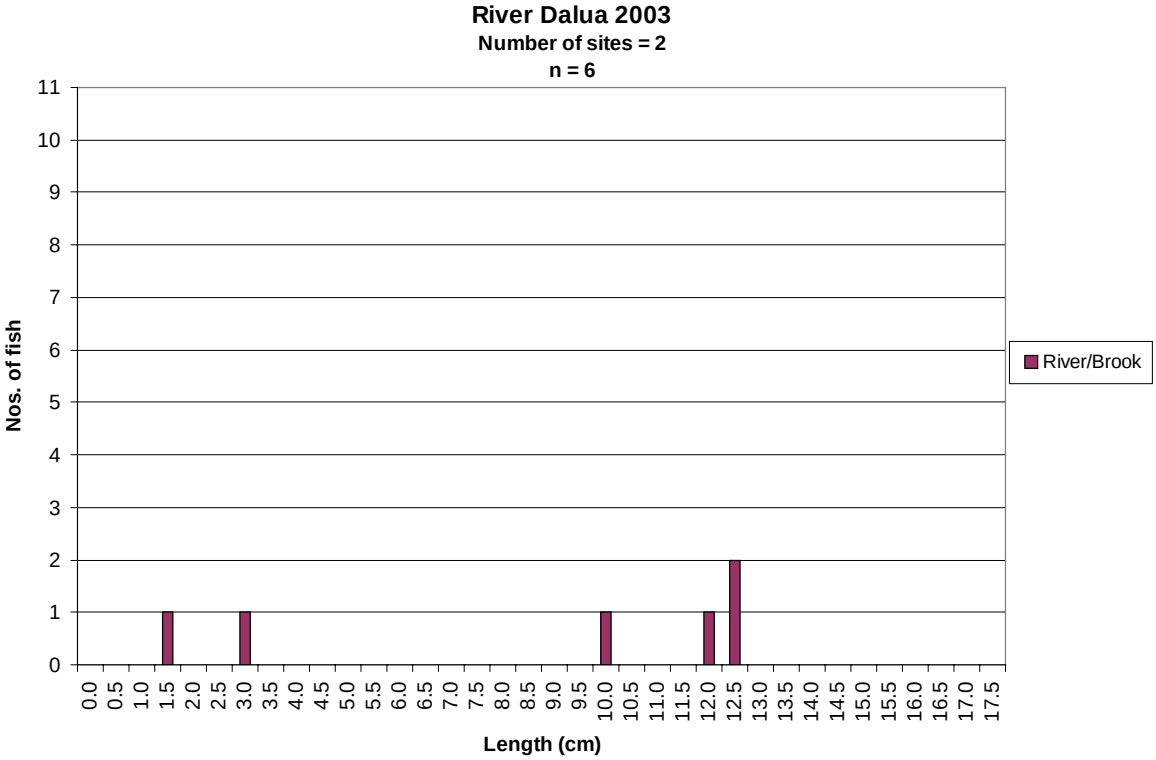


Figure 3.27: River Dalua length-frequency distribution

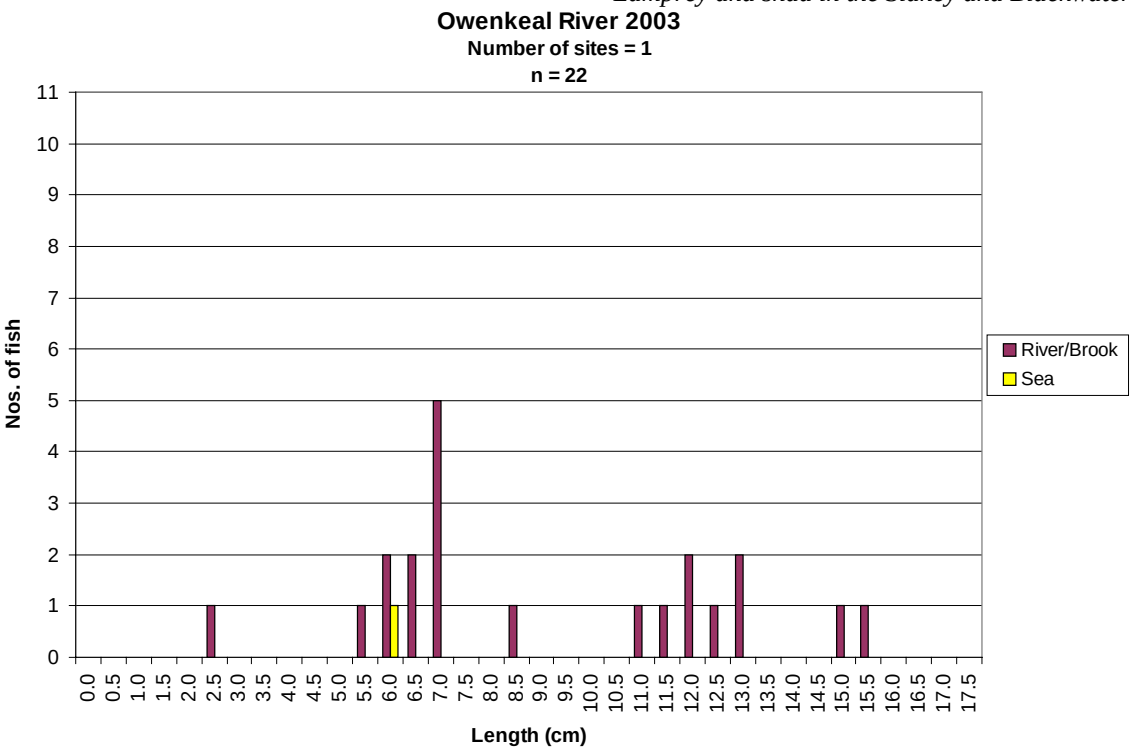


Figure 3.28: Owenkeal River length-frequency distribution

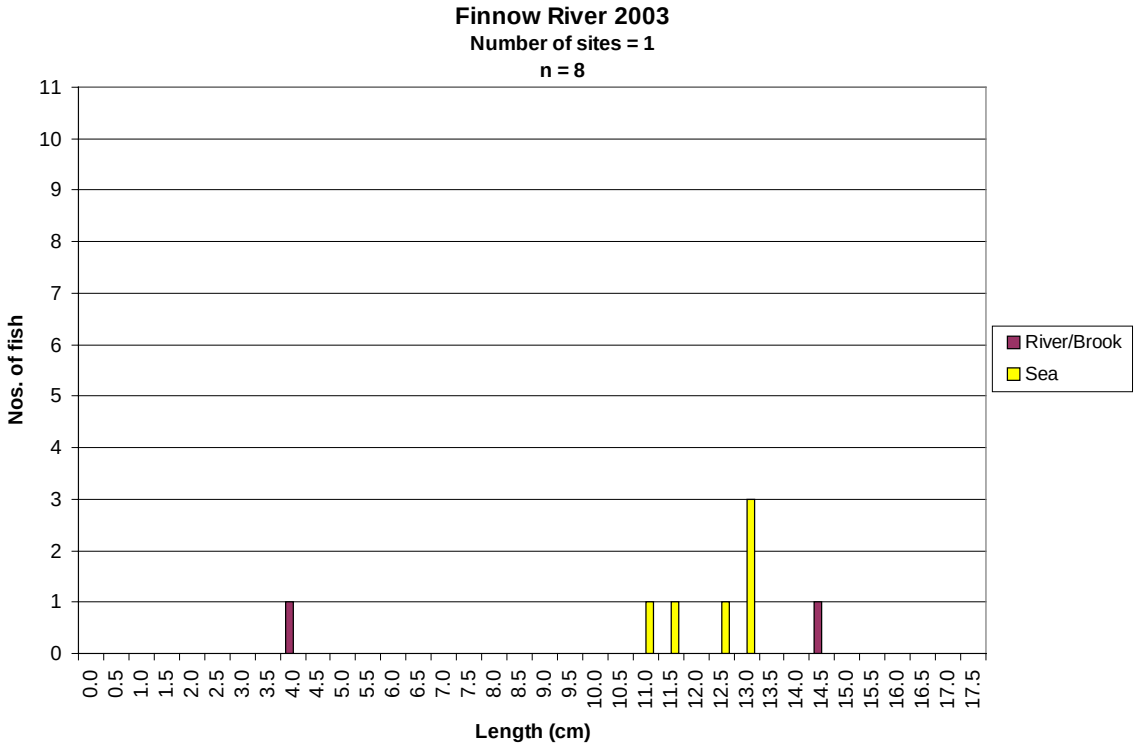


Figure 3.29: Finnow River length-frequency distribution

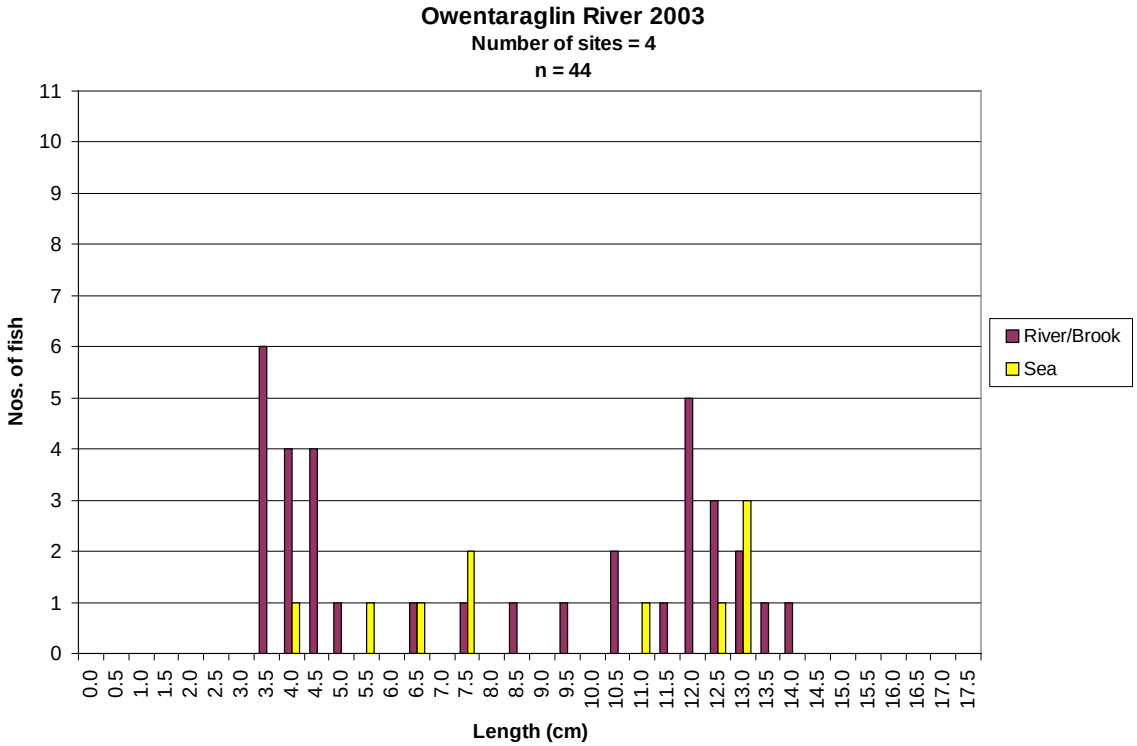


Figure 3.30: Owentaraglin River length-frequency distribution

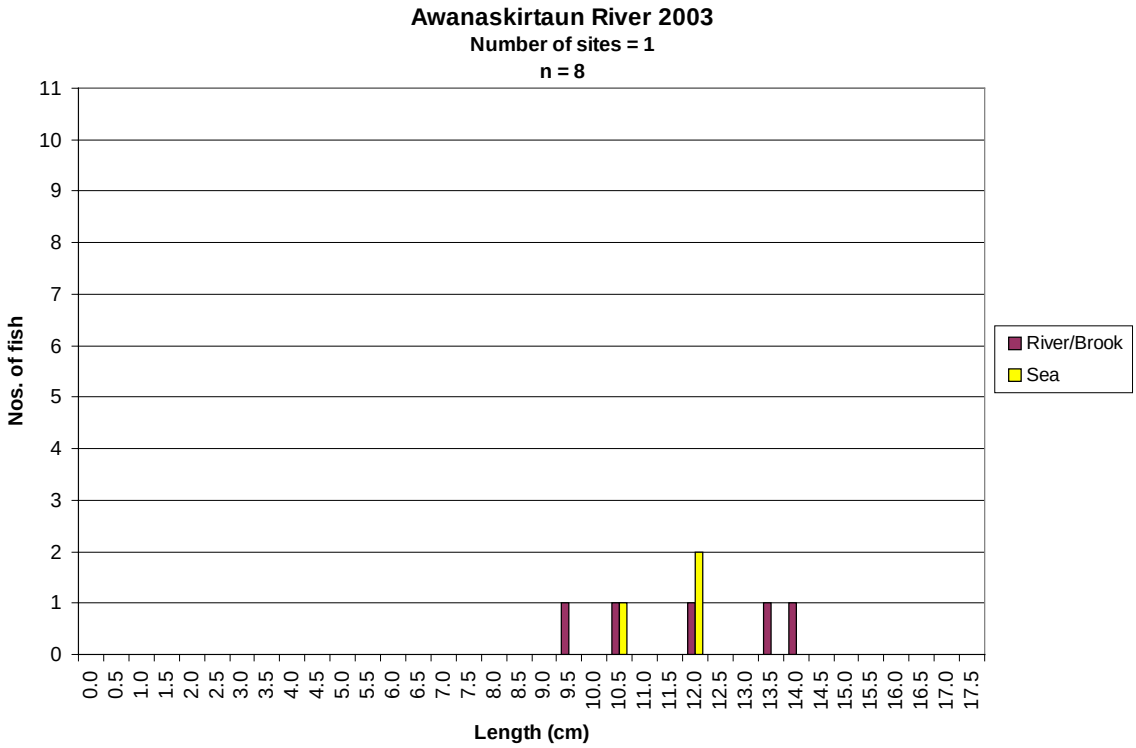


Figure 3.31: Awanaskirtaun River length-frequency distribution

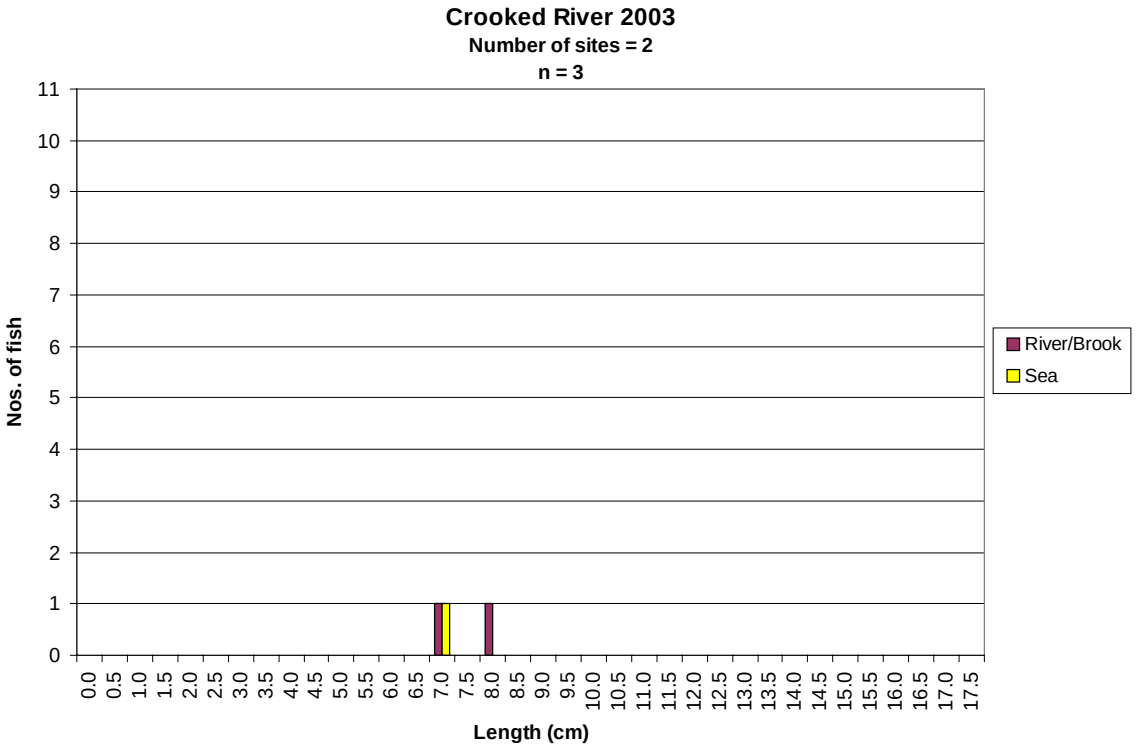


Figure 3.32: Crooked River length-frequency distribution

3.2.2 Investigations of lamprey spawning

Sea lamprey: Direct observation was used to observe and record locations and extent of sea lamprey spawning (Figure 3.33). Long segments of the main channel between Mallow and Cappoquin were examined by boat over the period 3-16th July 2003. A number of areas with suitable bed type for sea lamprey, based on observations in other channels, were observed. A single redd was recorded opposite Mallow castle, 7 downstream of Killavullen and 3 downstream of Ballyhooly. The majority of sea lamprey spawning sites recorded by boat were observed downstream of Fermoy Bridge and weir. A further 18 redds were observed in small clusters of twos and threes between Careysville and Cappoquin. A total of 65 redds were counted by boat along the entire stretch.

In addition the River Bride, the Douglas, the Flesk, the Shanowen, the Knocknapogue, the Glenaboy and the Owenageeragh were walked between bridges over the period 16-18th July yielding no sea lamprey redds. However, 2 large sea lamprey redds were observed upstream of Tallow Bridge during a spot fishing exercise on the 31st July.

River and Brook Lamprey spawning: Direct observation was also used in an attempt to observe and record locations and extent of river and brook lamprey spawning. Segments of most channels were examined by walking from bridge to bridge over the period 30th April - 15th May 2003. The only river lamprey spawning site encountered was at Rathcormack Bridge, River Bride on the 30th April 2003. Four redds were observed directly upriver of the Bridge. No spent bodies were encountered and the redds were considered to be old. No brook lamprey spawning sites were encountered.

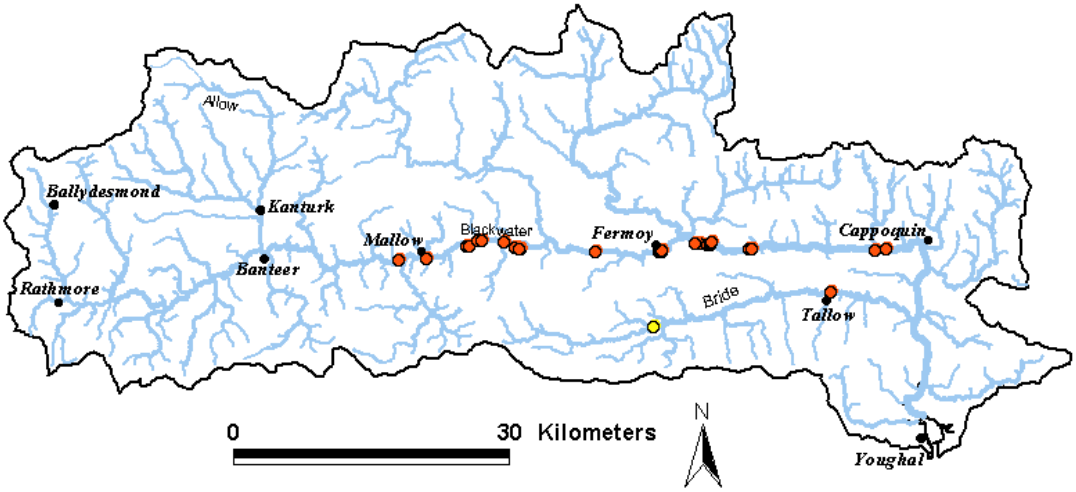


Figure 3.33: Map of Munster Blackwater showing lamprey spawning sites 2003

- Sea lamprey redds
- River/Brook lamprey redds

3.2.3. Investigations of adult lamprey

The estuarine sampling carried out in early September 2003 included the setting of fyke nets overnight at locations between Youghal and Cappoquin. No river lamprey were taken in this sampling programme.

An addition series of 5 fyke netting operations were undertaken for adult river lamprey over the period 28th October – 11th November 2003 at the Hut Pool between Cappoquin and Lismore and on the Broads of Clashmore. All efforts were unsuccessful and yielded no lamprey.

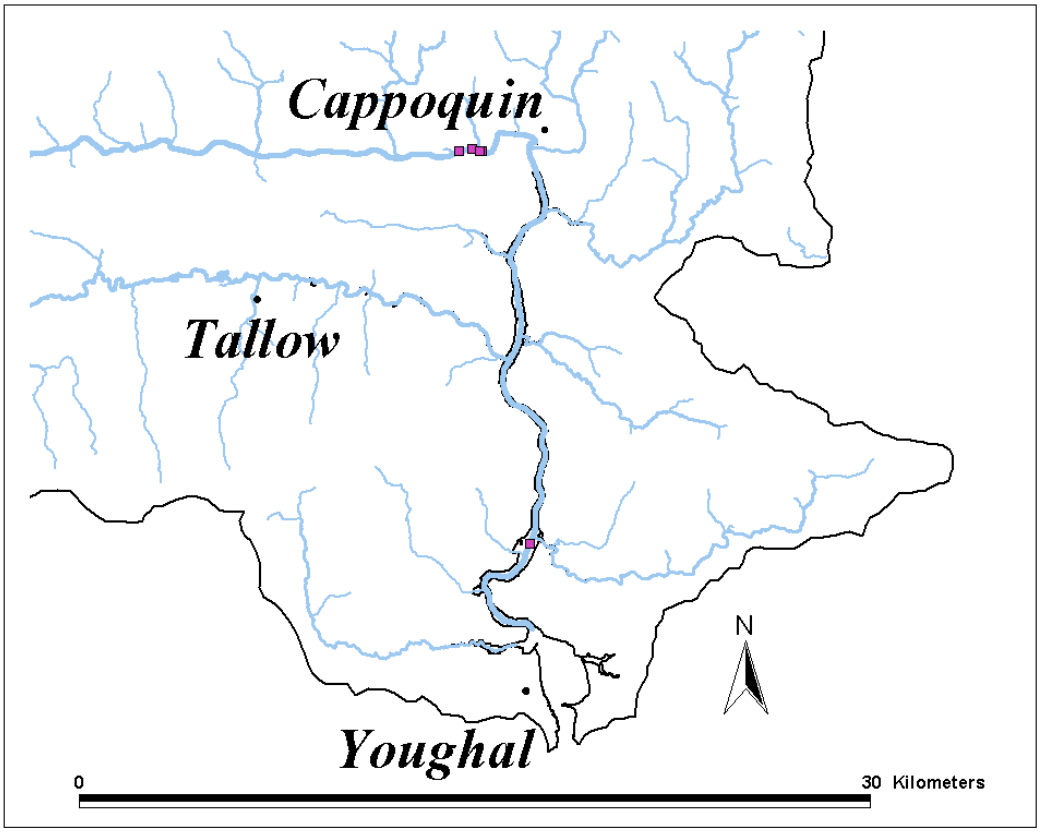


Figure 3.34: Map of Munster Blackwater lower reaches showing fyke netting sites 2003

3.2.4 Archival material

As with the Slaney catchment, the principal sources of archival material were the material compiled by Kurz and Costello (1999), unpublished data of the Central Fisheries Board and unpublished material of the Environmental Protection Agency (EPA).

The report of Kurz and Costello (1999) reflected the synthesis of a larger database on records of lamprey distribution in Ireland. Extracts from this database, pertinent to the catchments under examination in the present study, were made available by National Parks and Wildlife. The sources of information included Fisheries Board personnel, aquatic scientists and commercial netsmen. A total of 10 individual reports related to the Munster Blackwater catchment, with the majority referring to observations of *P. marinus*. Six sightings were reported from various locations on the main channel as well as one from the Owentaraglin. Two records of unspecified juveniles came from the R. Funshion, which lies outside the current SAC.

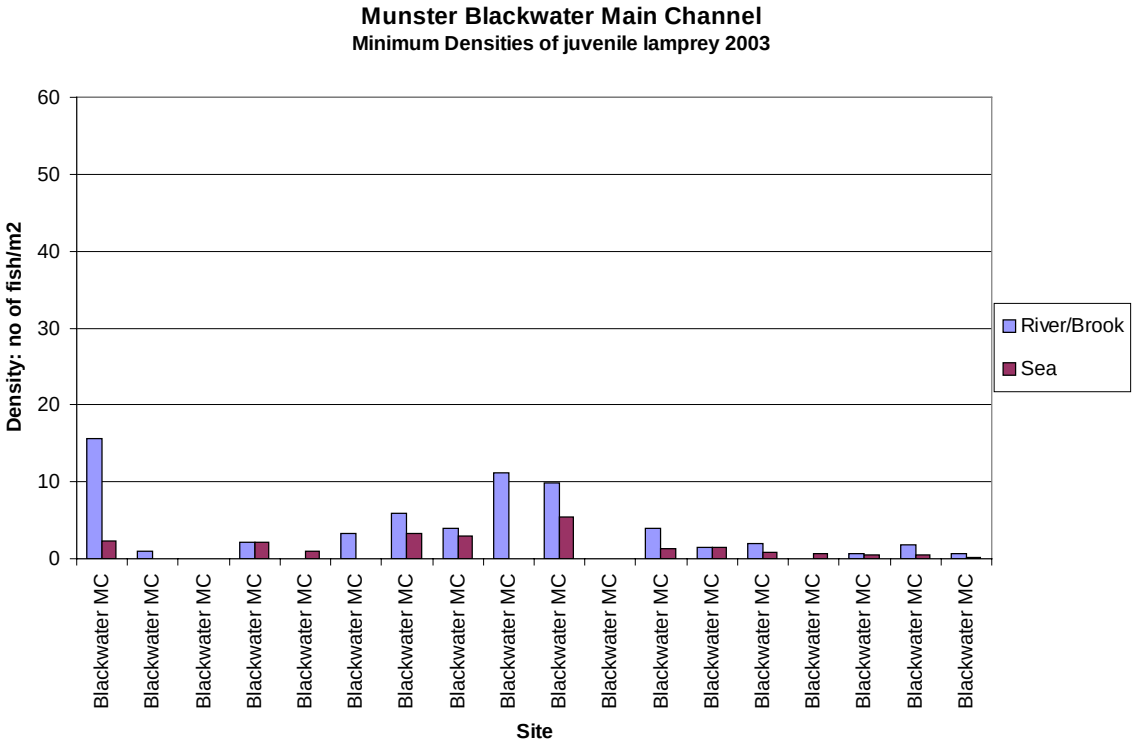
3.3 Comparison of Lamprey data sets

3.3.1 Comparison of Rivers Blackwater and Slaney

The collection of data sets from the Munster Blackwater and Slaney catchments allowed a generalised picture of population structures, densities and spawning patterns of lamprey to emerge.

Both main channels had a high occurrence of juvenile lamprey, 97% and 88% of sites fished on the Slaney and Blackwater respectively yielded juvenile lamprey. In general, larger sized juveniles were collected from the sediments of the River Blackwater than from the River Slaney (Figures 3.16 and 3.4A&B). In addition, the size range on the Blackwater spanned a greater number of age classes. However, the numbers of individuals captured on the Slaney were approximately double those taken from the Blackwater channel. In addition, there were a substantial number of sea lamprey juveniles present in the Blackwater samples while none emerged from the Slaney samples (Figures 3.35 & 3.36). Sea lamprey juveniles had a wide distribution on the River Blackwater ranging from the headwaters to the lower reaches of the system suggesting little by way of obstruction to their passage, despite the presence of weirs at a number of locations (Plates 5-7).

Juvenile lamprey numbers and density data were very low, in absolute terms and relative to Slaney tributary data, in the majority of sites on Blackwater tributaries. In general, substrate type varied from fine sand to cobbles at sampling sites, but overall higher densities occurred in tributaries of both catchments at sites with fine sand present. However, a number of uncharacteristic sites in each catchment yielded juvenile lamprey densities. In the Munster Blackwater catchment, sites comprising a thin layer of sand over bedrock were fished on the Owentaraglin, Awbeg 2 and Bride rivers yielding densities of 2, 4 and 12 individuals / m^2 respectively. A further site on the Bride, of sand over cobbles, gave a density of almost 15 / m^2. In addition a site on the Greagagh consisting solely of large cobbles yielded a density of 4 / m^2. Approximately thirteen sites consisting of fine sand overlain by various materials including leaf litter, weed, cobbles and roots generated densities ranging from 2 to 18 individuals / m^2 in both catchments. The site at O' Connell's Island on the Blackwater main channel was the only site with fine sand overlain by filamentous algae and yielded no juvenile lamprey. The highest density recorded in the study was 197 individuals / m^2 on the River Bann in the Slaney catchment. Substrate at this site comprised almost entirely root structures and little else.



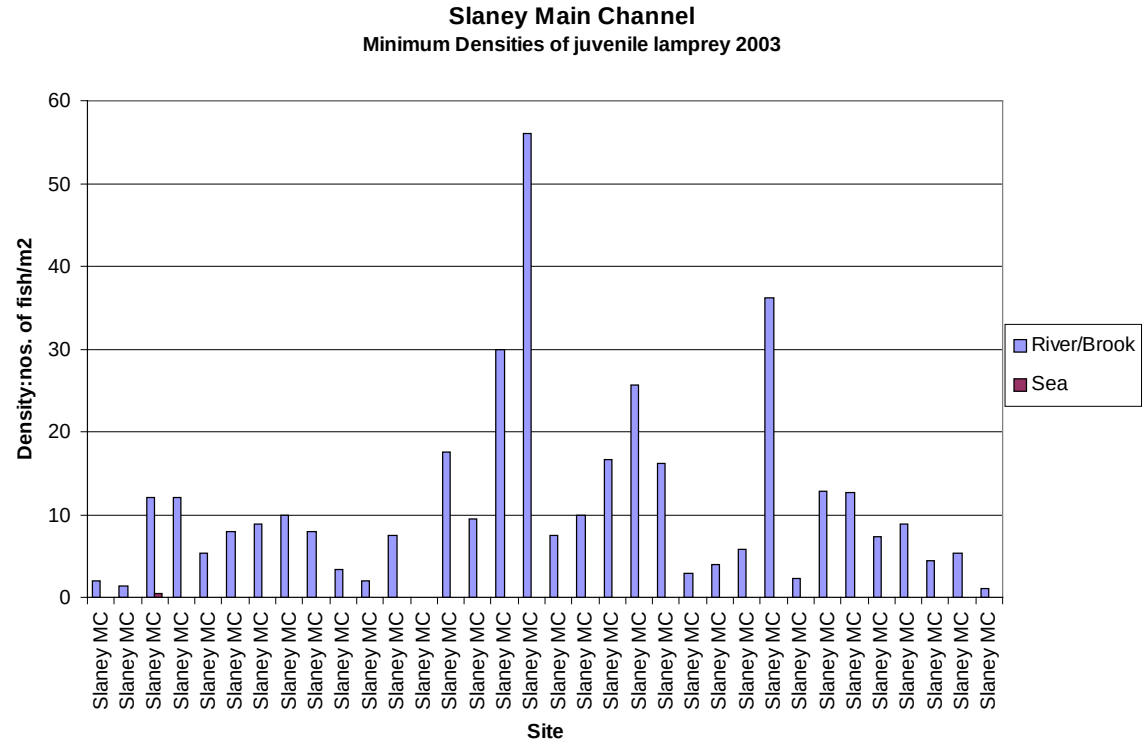


Figure 3.35 & 3.36: Minimum densities of juvenile river/Brook and sea lamprey in the Munster Blackwater and the Slaney main channels

Plate 5: Careysville weir

Plate 6: Kanturk weir

Plate 7: Glenshalane weir

3.3.2 Lamprey distribution in relation to water quality

Use of GIS technology permitted an overlay of the EPA's water quality classification for each catchment, as a mapping, onto the lamprey distribution data compiled in the present study (Figures 3.37 & 3.38). The EPA Q-value system indicated a clean water status for the majority of channels where juvenile lamprey were sampled. Juvenile lamprey and spawning sites were encountered along stretches of water covering a range of Q-values from Q3-4, indicative of slightly polluted waters, to Q4-5, indicative of clean waters. No juvenile lamprey or redds were found at any sites with a categorisation of less than Q3-4, i.e. at any moderately or seriously polluted sites. However, the EPA Q-mapping indicated that such waters were highly localised in both catchments. All sites examined upriver of Mallow, on the main Blackwater channel, and upriver of Tullow on the main Slaney channel showed Q-values between Q4 and Q5.

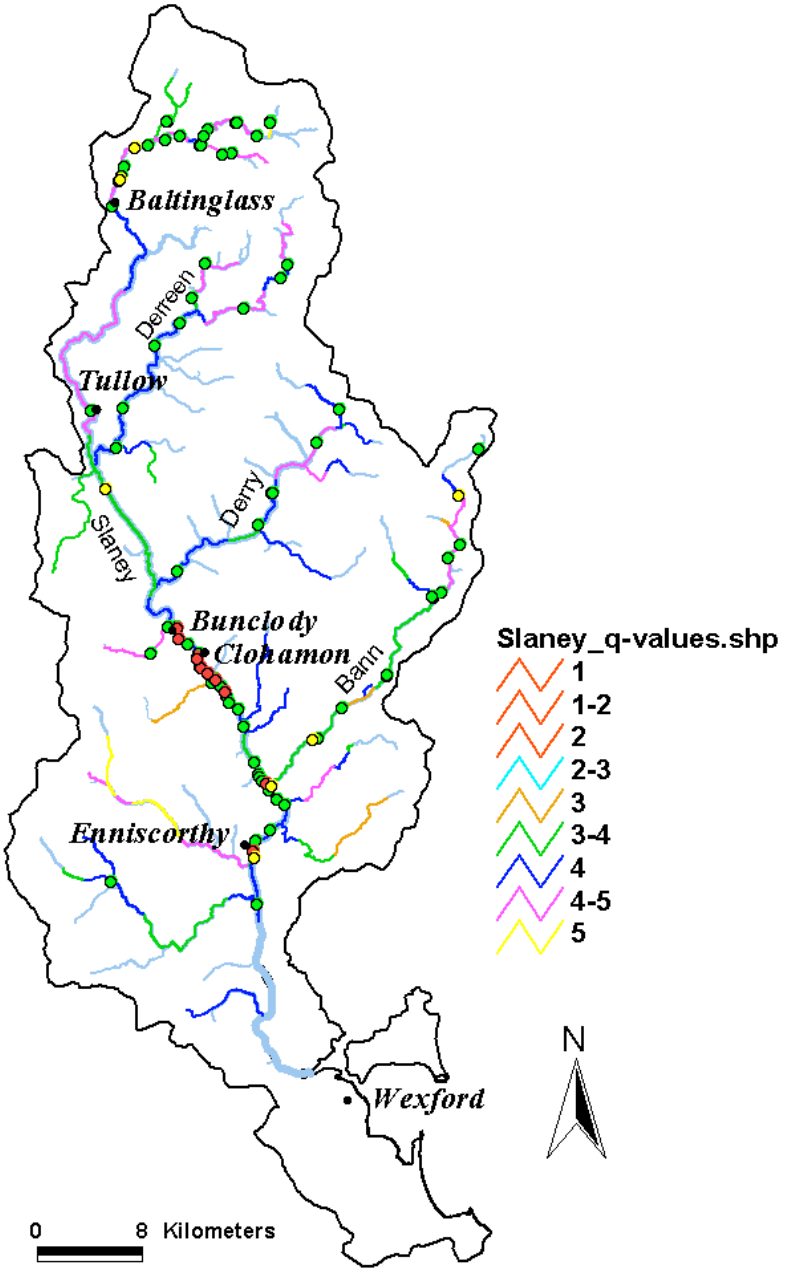


Figure 3.37: Map of the Slaney catchment showing lamprey spot fishing and spawning sites and the EPA Q-values

- Sea lamprey redds
- River/Brook lamprey redds
- Lamprey spot fishing sites

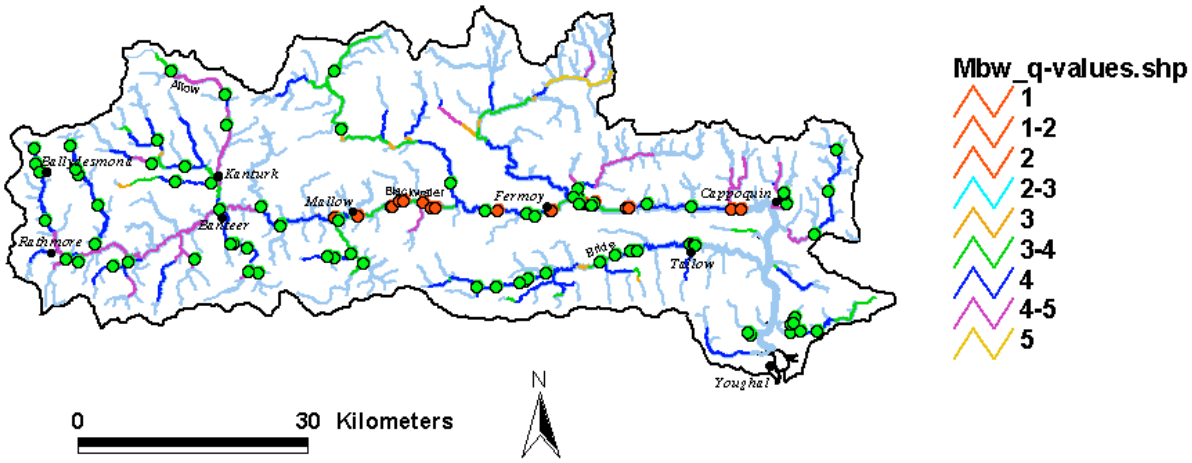


Figure 3.38: Map of the Munster Blackwater catchment showing lamprey spot fishing and spawning sites and the EPA Q-values

- Sea lamprey redds
- River/Brook lamprey redds
- Lamprey spot fishing sites

3.4 Shad Investigations on the Slaney and Blackwater

3.4.1 Fish taken in the present study

In spite of a significant sampling effort, little success was achieved in the scientific netting surveys conducted for shad on the two estuaries. No shad were captured in netting operations on the Slaney during the scientific survey, which took place over the period 26th May – 7th July 2003. Twenty-five separate operations took place over this time period (Figure 3.39). Various types of netting procedures were adopted included fixed and floating drift nets, draft nets and fyke nets. On the Blackwater, 16 young shad were captured in netting operations during the scientific survey, which took place over the period 29th May – 4th July 2003 across 8 days. As with the Slaney survey, various types of netting procedures were adopted included fixed and floating drift nets, draft nets and fyke nets. A total of 15 separate operations took place over this time period (Figure 3.40). All of the twaite shad taken in the Blackwater were caught by two floating drift nets on the 29th May 2003 at Brian's Cúl on the Broads of Clashmore. This sample is considered to be of significance due to the relatively small size of the fish taken. No allis shad were taken in the scientific survey.

A total of 5 adult shad was made available to the study by commercial netsmen operating draft or drift nets. This sample consisted of 2 twaite shad, from the Slaney, and 3 allis shad – two from the Munster Blackwater and one from the Slaney. All three Slaney fish were taken in salmon draft nets in the estuary. The two twaite shad were taken near Ferrycarrig in the lower reaches and the allis at Macmine in the middle reaches. Of the two Blackwater fish, one was a more truly coastal specimen, being taken circa 3 km off the mouth of the Blackwater estuary. The second Blackwater fish was of considerable significance as it was captured on rod-and-line in the Careysville fishery near Fermoy. This fish had penetrated into freshwater a distance of 25 km upstream of the head of the tide at Cappoquin.

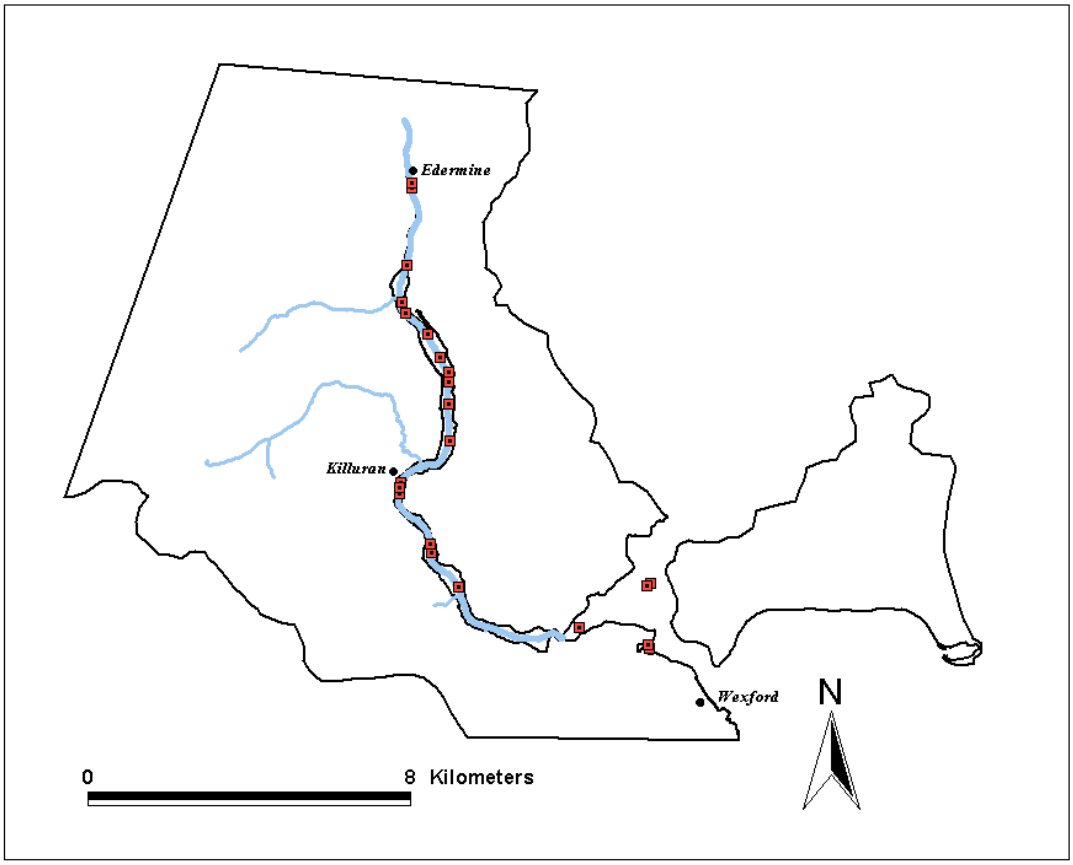


Figure 3.39: Map of the Slaney estuary showing netting operations for shad 2003

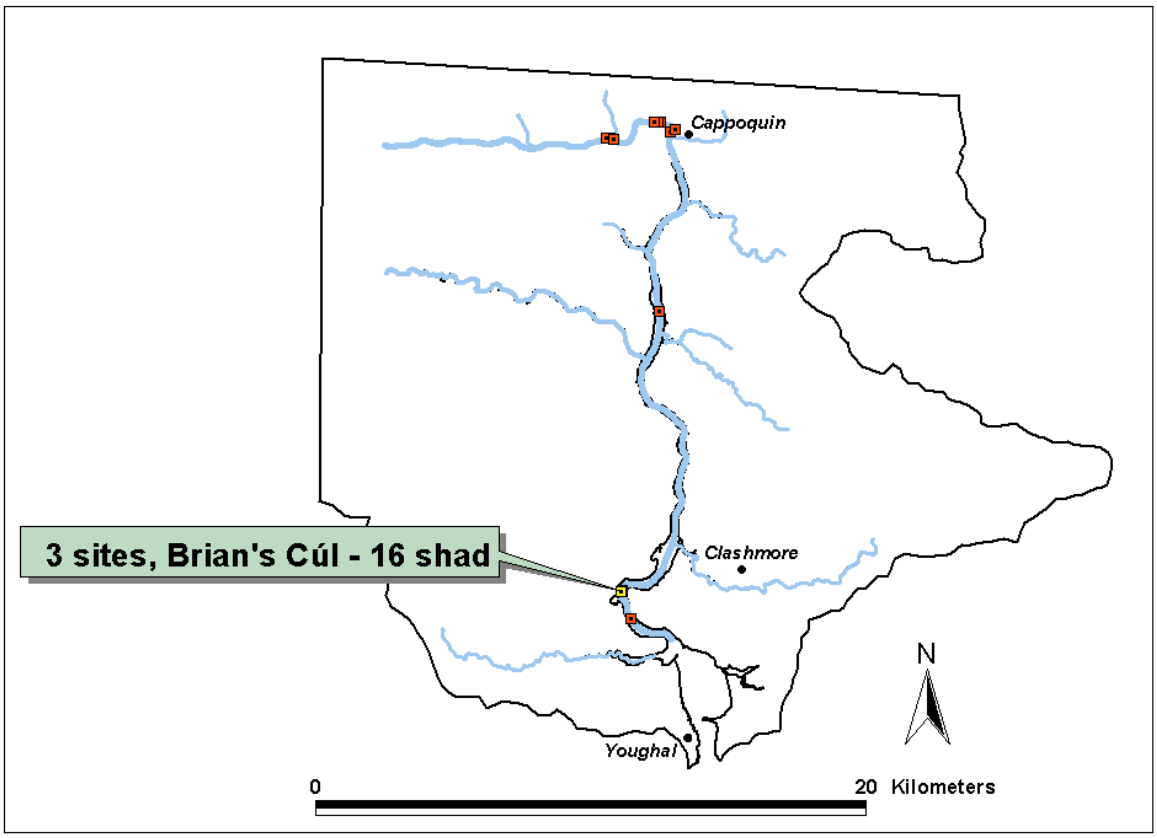


Figure 3.40: Map of the Munster Blackwater estuary showing netting operations for shad 2003

3.4.2 Archival material

Since 2000, the Central Fisheries Board has been compiling a database on shad material from Irish waters, based on samples of material collected by or submitted to it for examination and on material in published or grey literature form. This provides a listing of species, date and location of capture and such biological information as length, weight, sex, gonad condition, gill raker count, feeding activity. The material from the present survey was combined with archival material to examine some of the biological features of the two species of shad taken from the Slaney and Munster Blackwater. Typically, the two species can be distinguished in the field by examination of the gill rakers on the first gill arch under the opercular flap. The allis shad have a greater number of rakers than twaite shad and the allis rakers tend to be longer. Data from both species for the two catchments indicated a clear difference in numbers between the two species (Figure 3.41). The data also indicated a difference between raker counts of young twaite shad (<23 cm) and older twaite shad (>23 cm), suggesting that raker counts increase, to a certain level, as shad grow.

The length frequency distribution (Figure 3.42) indicated a degree of overlap between allis and twaite shad. The allis sample ranged from 40 cm to 52 cm, with fish in excess of 50 cm being taken in both estuaries. Two clusters of twaite shad were identified, the group of small fish (20 – 24 cm) taken in the present study in the Munster Blackwater and the larger group of fish (34 – 46 cm) taken in commercial drift – and draft nets. These different records reflect the different mesh sizes used. The length – weight data indicated a cubic relationship with a very high R^2 value (Figures 3.43A & 3.43B). Similar cubic expressions and R^2 values were obtained when the twaite data, only, and the combined twaite and allis data were used, suggesting that the allis growth form is similar to that of the twaite but can extend to greater body length, with associated weight increase.

Of the 7 allis shad examined, four had been feeding on shrimp and two had empty stomachs. Of the latter, both were females with gonad in an advanced state of development i.e. ovaries filling a large part of the body cavity with eggs clearly developed. The twaite shad with stomach contents had been feeding on shrimp or small crustaceans and/or fish. In the majority of cases, the fish material could not be identified. However, sand eel and sprat/herring were recorded in some cases.

Since completion of the present study, a further two shad were presented for examination by commercial netsmen on the Slaney. One of these was a partly spent female twaite shad taken in mid June. The second, on initial examination of gill rakers appeared to be an allis shad. This was a relatively small male fish, almost ripe, and was taken in mid May. This fish had a gill raker count of 78, suggesting it was a hybrid. The occurrence of such hybrids is a source of concern in regard to the conservation status of both species of shad in the Slaney.

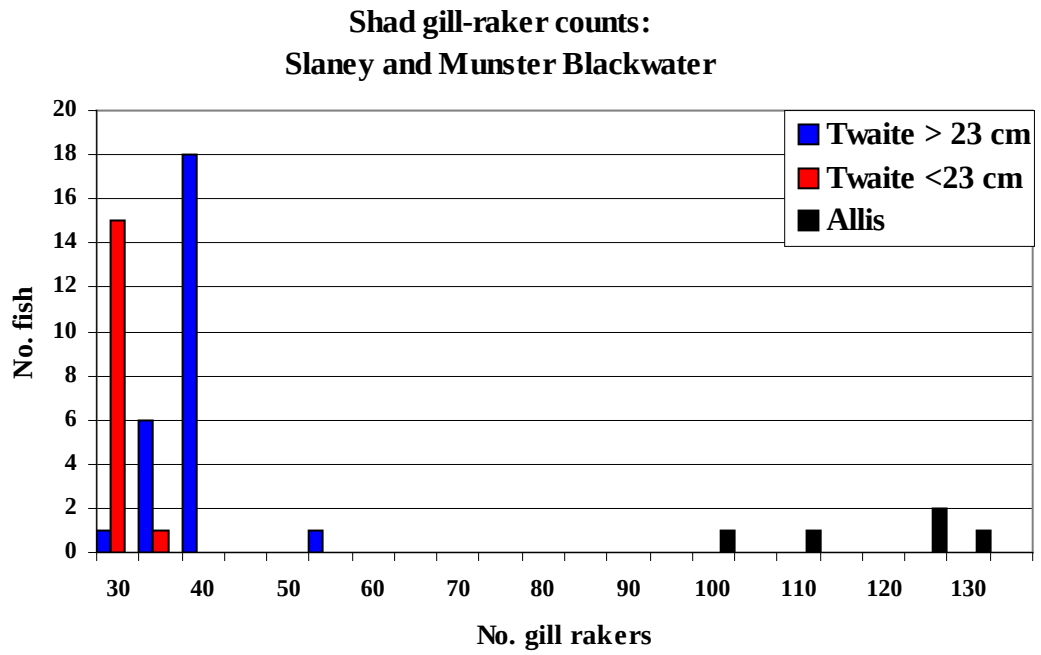


Figure 3.41: Shad gill-raker numbers for allis and twaite shad in the Slaney and Munster Blackwater catchments 2000-2003

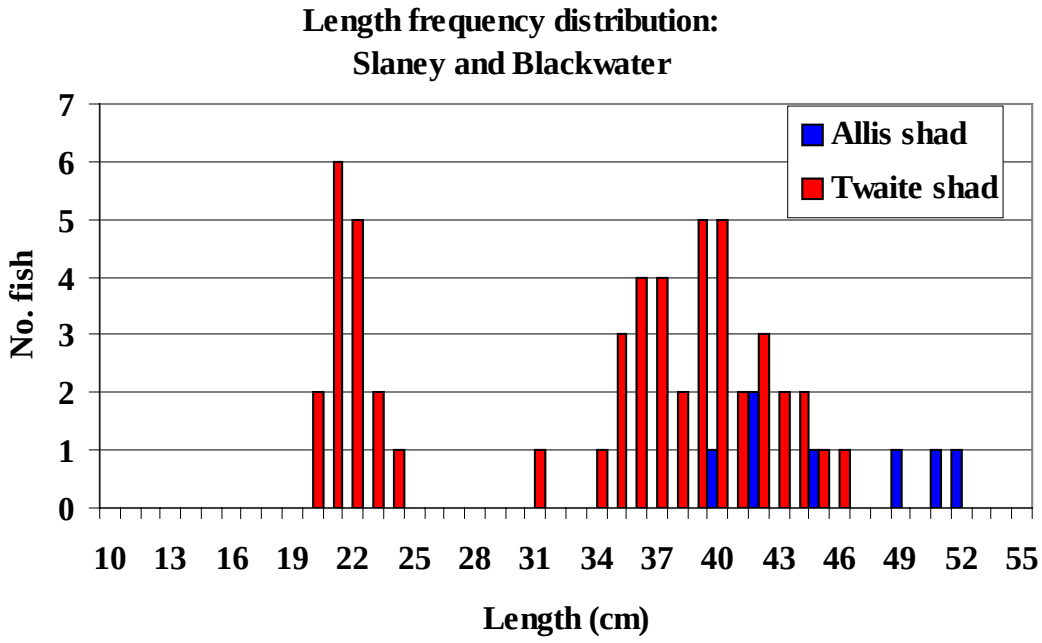
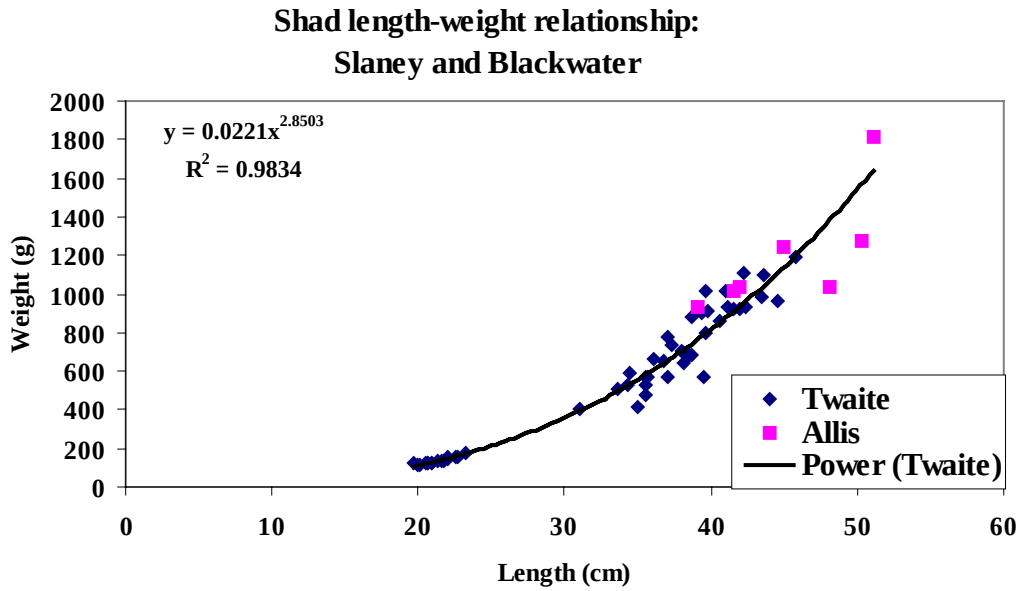
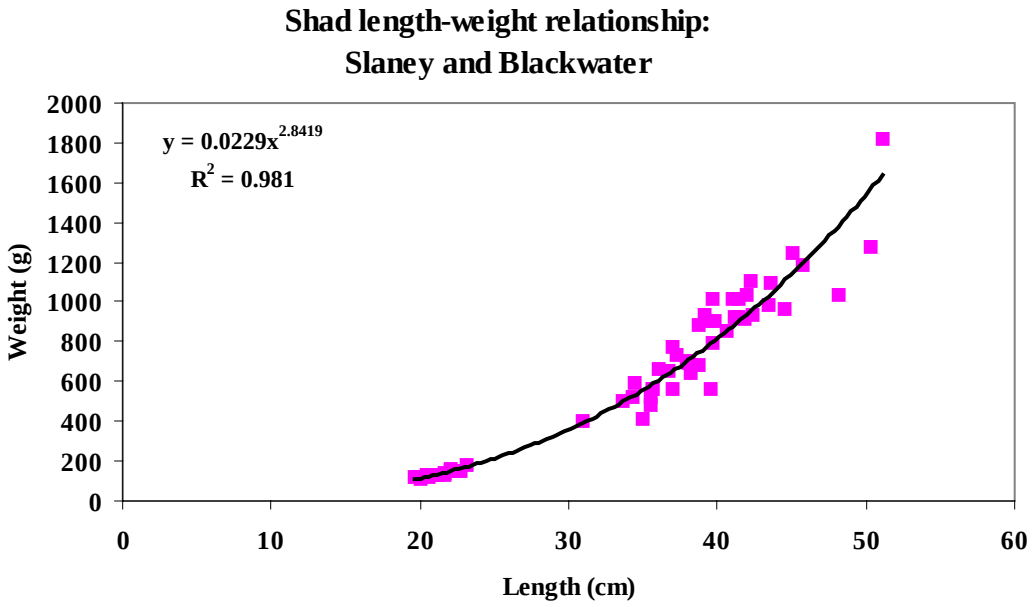


Figure 3.42: Length-frequency distribution for allis and twaite shad in the Slaney and Munster Blackwater catchments 2000-2003





Figures 3.43A & 3.43B: Length-weight distribution for allis and twaite shad in the Slaney and Munster Blackwater catchments 2000-2003

Plate 8:

Plate 9:

Plate 10:

4. Discussion

4.1 Lamprey

4.1.1 River Lamprey anadromy

River lampreys are reported to migrate into freshwater prior to spawning in two movements – an autumn migration and a second in spring, immediately prior to spawning (Abou-Seedo and Potter, 1979, Witkowski and Koszewski 1995, Maitland 2003). Investigations by CFB recorded river lamprey in autumn fyke netting in the period 2000-2003 in the estuaries of four east-coast rivers - Boyne, Liffey, Avoca and Slaney. In the period October –December 2001 river lamprey were taken at a range of sites in the estuary of the Slaney between Killurin and Edermine. In addition, netting in the river upstream of the tide yielded river lamprey at Scarawalsh and upstream of the weir at Clohamon. No river lamprey were recorded at this time at a site near Tullow. Thus it would appear that the river lamprey move up the estuary and on into freshwater during the autumn – winter period prior to spawning in the Slaney as has been reported in one UK study (Jang *et al* 2003). Specimens of river lamprey have been taken in freshwater as early as July in the Derry, 37 km upstream of the head of the tidal Slaney (W. Roche unpublished data), and in the adjoining Avoca catchment in both July (W. Roche unpublished data) and in quantity in August (D. Byrne unpublished data). In contrast to the findings from east-coast rivers, autumn-run river lampreys were not taken in fyke nets in the estuaries of the Suir or Barrow-Nore, despite an intensive sampling effort in the estuary and main stem of the Nore system (J. King and D. Lyons, unpublished data) and were not taken in the present study in the Munster Blackwater. Individual river lamprey have been taken in autumn in the Barrow (J. King unpublished data) and in the Suir (Kelly and King 2001). In the autumn of 2003, fyke netting was undertaken in the upper reaches of the estuaries in the Maine, Laune, Munster Blackwater, Suir, Nore and Slaney with positive results accruing in the Slaney only. Commercial netting for eel in the autumn period has also recorded large numbers of river lamprey as by-catch on the Slaney but this has not been the case on the Suir. Thus, relative to the experience in other Irish estuaries, the Slaney would appear to have a substantial autumn run of river lamprey. The small dataset from spring 2003 for the Slaney indicates that a spring run also occurs on this system. These fish are smaller than the autumn-run fish and have a higher gonadosomatic index, as reported by Witkowski and Koszewski (1995). Ongoing investigations of CFB, in spring 2004, have indicated a spring run of river lamprey in other large south-east Irish rivers, including the Suir, Barrow and Nore.

4.1.2 Distribution of sea lamprey

Weirs are identified as significant obstructions to passage for anadromous species such as the sea lamprey (Assis 1990). The present study has shown very substantial differences in distribution of sea lamprey between the two catchments, indicative of differences in degree of penetration of spawning adult fish. Both systems have large weirs in the lower reaches of their catchments and both have shown heavy degree of sea lamprey spawning

in the areas downstream of these weirs – Clohamon on the Slaney and Fermoy on the Blackwater. However, for fish to reach Fermoy weir they would have to negotiate the large weir at Careysvillle (Plate 5). Lampreys are capable of short bursts of intense swimming, punctuated by short rest periods when they can attach by the oral sucker. In this way they are capable of climbing weirs and waterfalls (Applegate 1950). Thus while some weirs can obstruct passage, some can be passed and use of fish passes by upstream migrants can facilitate this passage (Anon 2003). It is apparent that sea lamprey can, at least in some years, ascend the weirs and other physical obstructions on the Blackwater in sufficient numbers to permit upstream dispersal prior to spawning. The possibility that such escapement is not annual, or that annual escapement is insufficient to adequately populate the potential habitats for this species, is indicated in absences and gaps in age classes evident in the length frequency distribution for this species in the Blackwater. The pattern of sea lamprey redd concentration in the area immediately downstream of weirs, as witnessed at Clohamon and Fermoy in the present study, has been observed in the main channel of several other large Irish catchments. The findings from the present study and from earlier CFB studies point to small breeding populations of sea lamprey, in the year examined, but extended studies would be required to identify trends or fluctuations. The redd counts only provide a 'minimum estimate' of spawning effort as they do not indicate the number of sea lamprey involved. In addition, redds can become levelled in summer floods and may be obscured to observation. These shortcomings have also been identified in a recent UK review (Anon 2003). Nonetheless, sea lamprey redd counts can have a role if used in a conservative and consistent manner Anecdotal reports to the authors in the present study indicated that spawning activity had been observed and much of the spawning effort had been completed some weeks prior to the cruise survey on the Blackwater. Kelly and King (2001) reported sea lamprey spawning in the Suir main stem between late May and late July in 2000 and differences in numbers and locations of redds between June and July cruises in the Suir in 2001 have also been recorded (B. Lehane, unpublished data). Observations by Kelly and King (2001) indicated 2-4 adult fish per nest at a major spawning location on the R. Mulkear. Extrapolation of these numbers to the spawning sites recorded in the present study would indicate a spawning population of 74 - 148 fish in the Slaney main channel and 132 – 264 fish in the Munster Blackwater main channel in 2003. These estimates correspond with unpublished findings from the Suir and Nore main channels (B. Lehane and F. Kelly, unpublished data). Comparable data for Atlantic salmon in the Slaney indicate, on average, an annual count of 1,200 redds or 2,400 adult fish (M. Kelly pers. comm.), with 366 fish taken on rod-and-line by anglers in 2002 (CFB 2003). These data point to a ten-fold difference between observed spawning effort, as redd counts, of these two anadromous Annex II species, both of whom are designated in the Slaney SAC, and may serve to underline the vulnerable status of the sea lamprey in this system.

Juvenile sea lamprey were very infrequent in the major Slaney tributaries. While the weir at Clohamon and its potential to impact on access to upstream waters, including the Derry and Derreen channels, may be a factor influencing sea lamprey distribution upstream of the weir, this factor does not explain the low results in the case of the R. Bann, to which ascending adult sea lamprey have unimpeded access. The widespread distribution of juvenile sea lamprey in the Munster Blackwater in the present study supports the

accumulated anecdotal records in Kurz and Costello (1999) who reported spawning activity of sea lamprey up to the headwaters of the system at Ballydesmond.

4.1.3 Juvenile morphometrics and water chemistry

The substantial difference in maximum length of juvenile lamprey between the two systems in the present study merits some examination. The Munster Blackwater lies on Old Red Sandstone throughout while the Slaney rises and runs over granite and other hard rock strata for much of its course. These differences are reflected in the surface water chemistry, as recorded in the period 1987-1990 (ERU 1992). On the Slaney, median conductivity values in the range 100 – 120 were recorded in upland waters upriver of Baltinglass. Median values ranged between 205 and 290 u S /cm between Baltinglass and Enniscorthy. Over a total of 84 sampling dates in their study period ERU (1992) recorded an alkalinity range of 18 - 112 mg/l CaCO3 on the Slaney. Corresponding data for the Munster Blackwater main channel showed broadly similar range values. Median conductivity values of 132 – 182 uS / cm were recorded between the headwaters and Ballymaquirke Bridge at Banteer, 30 km upstream of Mallow. From Mallow downriver, values rose to between 256 – 354 uS / cm. Alkalinity data ranged between 18 and 162 mg / l CaCO3 (ERU 1992). The data are indicative of relatively low dissolved mineral content, including Calcium, relative to a system such as the Brosna lying on Carboniferous limestone with conductivity range of 470 – 600 uS / cm over the same period (ERU 1992). This background does not suggest that water chemistry is a major factor in the difference in maximum size of juveniles between the two systems. Maitland (2003) reported differences between river and brook lampreys in regards to size of juveniles at metamorphosis or transformation. These observations were based on findings from a range of UK sites, with river lamprey transformers being in the range 9 - 12 cm and brook lamprey in the range 12 - 15 cm. Concurring findings were also reported from the Tay system in Scotland (APEM 2004). On this basis it is tempting to conclude that the juvenile lamprey populations recorded in the Slaney in this study were primarily river lamprey. However, it may reasonably be argued that juveniles taken in upland waters upriver of Baltinglass were likely to be of slower growth due to the low conductivity and alkalinity records from these areas. It is also known that brook lamprey do occur and do spawn in the Slaney, as confirmed by redds and spawning activity recorded by the authors and by staff of the Eastern Regional Fisheries Board. The presence of river lamprey adults in numbers in the Slaney in the autumn may be indicative of a substantial contribution of anadromous fish to the pool of juvenile river/brook lamprey. If so, it would be imperative to ensure the continued ease of passage of upstream migrating adults.

4.1.4 Sampling requirements for juvenile lamprey

The sampling method used for juvenile lamprey was successful in indicating presence/absence as well as identifying, where numbers permitted, the population structure at the sites examined. Both factors are of importance in examining lamprey status in any channel. The third factor of importance is an assessment of abundance. This

is generally recorded in terms of density or numbers of juveniles per unit area. The density data presented in this study is a measure of minimum density i.e. figures represent the lowest density value for the site, based on the data collected (after Crisp, Mann and Mc Cormick 1974). Methodologies to derive a more statistically-based assessment of density employ a multi-pass electric fishing method, operated inside an area of channel isolated by fine-mesh netting (Potter *et al.* 1986; APEM 2002; Jellyman & Glova 2002; Harvey & Cowx 2003). This depletion approach was adopted in the quantitative fishing carried out at three locations in the present study. The principle of repeat fishing is that depletion occurs in the numbers of the target organism captured. This depletion permits an assessment of population density with an associated standard deviation or confidence intervals (Carle and Strub 1978, Zippin 1956). The failure to record depletions in the present study identifies the existence of some shortcoming in the procedure applied. Comparison with comparable approaches in the UK (Harvey and Cowx 2003) identified differences in size of area sampled and duration of each sampling period. Large-scale sampling was undertaken by King and Lyons (unpublished data) in the R. Nore in 2002 using sampling enclosures of differing dimensions. This differed from the standardised $1m^2$ sampling unit used in the LIFE in UK Rivers study (APEM 2002; Harvey & Cowx 2003). The non-standard area was adopted due to the distribution of fine sediments, which were generally deposited in narrow strips close to the water's edge. Use of a pre-formed $1m^2$ area would have incorporated areas of bed material that differed from the fine-grained strata to be surveyed. Use of the standardised pre-formed unit area permits a consistency of effort with least scope for variation or deviation. The small area used, $1m^2$, also permits a consistent focussing of the pulses of electricity into the sediment in the enclosure. The larger size of the enclosures used in the present study and by King and Lyons (unpublished) was not compensated for by relative increases in sampling time. In addition the efficiency of the electric pulses was considered to be more dispersed. While depletions were reported in enclosures by Harvey and Cowx (2003) there was considerable variation in the size of the 95% confidence intervals obtained, ranging from zero to 50% of density estimate, suggesting that accurate replication and high level of depletion can be difficult to achieve. The approach of Harvey and Cowx (2003) is currently being trailed by CFB in selected quantitative studies with some success.

4.1.5 Water Quality

Water quality in the estuaries of both the Slaney and Blackwater has been classified as eutrophic (EPA 2001). However, this has not prevented the penetration of a range of anadromous species both into and through the estuaries to freshwater. The main stem and major tributaries of both systems have been subject to water quality monitoring, via invertebrate assemblages, since 1971. The main channel of the Slaney remained in a satisfactory condition over the 30-year period to 2001 in the upper reaches above Tullow. However, evidence of ecological deterioration was present from Tullow to Enniscorthy (Clabby, Lucey and Mc Garrigle 2002). This deterioration was manifest as algal growths and siltation – pointing to nutrient enrichment and land management practises. These factors were also identified in several of the larger tributaries. A similar review of the Blackwater system for the period 1971 – 1997 compiled by the EPA (Clabby et al 1998) found the Blackwater main stem to be in satisfactory condition when surveyed in 1997, apart from distinctly eutrophic sections at Rathmore, Ballyduff and between Mallow and

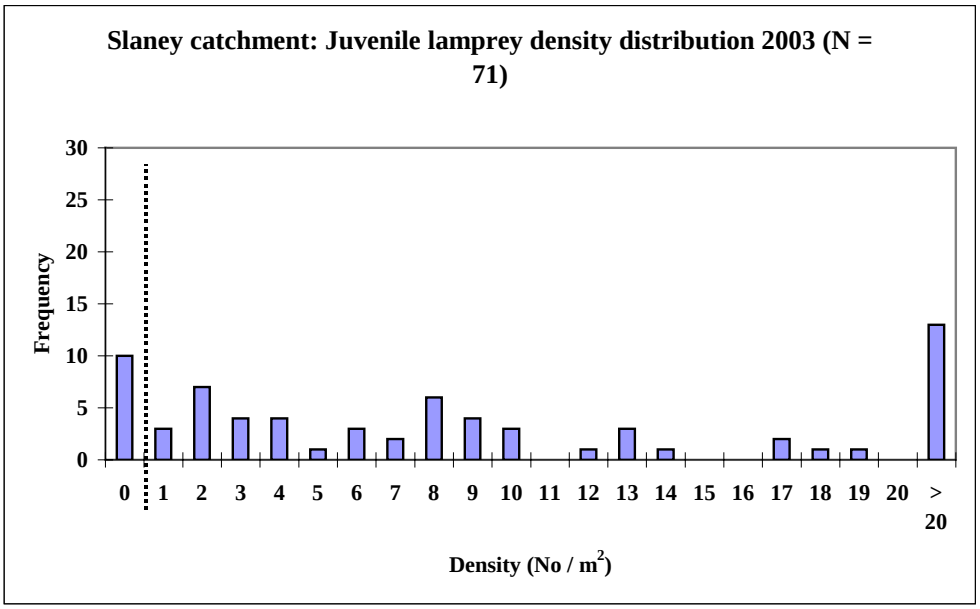
Fermoy. The data over the 1971 – 97 period indicated a decline in water quality at many stations up to 1990 but results showed a trend to increasing quality level at many stations since that period. The present survey recorded juvenile lamprey in a range of EPA 'Q' rating locations from 'Q' 4 - 5 to Q 3 – 4 and indicate the capacity of ammocoetes to dwell in waters ranging from slightly polluted to clean. The absence of 'Q' rating sites with low values (Q 1, 2 or 2 – 3) did not permit an assessment of juvenile lamprey ability to dwell in such conditions. Some of the observations of the 2002 report of Clabby *et al* are of interest in the repeat reference to siltation from land drainage and other land management practises. It is possible that in a very alluvial system such as the Slaney that increased siltation, while impacting adversely on some elements of the biota and their habitat, could be of potential value to juvenile lamprey colonisation.

4.1.6 Management Implications

In terms of assessment of status over time it is considered that any monitoring programme for juvenile lampreys must be able to assess presence/absence, population structure and population size or density. One limitation on sole use of juvenile lamprey lies in the practical problem of discriminating between the three taxa on the riverbank. The recent key developed by Gardiner (2003) reviews the status of previous work in this area and provides photographic support to text. He confirms that juvenile river and brook cannot be discriminated. The two taxa can, however, be distinguished from juvenile sea lamprey. When juveniles have transformed or metamorphosed, the young river and brook can be discriminated on the basis of dentition. The young sea lamprey also has a dental pattern sufficiently different to allow their identification. Spot fishing alone permits assessment of presence/absence. However, this fishing needs to be of sufficient duration to collect an adequate sample size to compile a size frequency distribution. To permit an assessment of abundance or density, discrete enclosures must be sampled. A fisheries or wildlife management plan for a species within an SAC must achieve a balance between extensive- and intensive sampling. The balance will depend on time and funding logistics but the options chosen must provide information of a nature that will permit sound management judgements. The present study has shown the role of spot electric fishing in generating presence/absence data as well as information on population structure. The density data compiled provides for relative comparison within channels and between channels and catchments. However, monitoring populations over time will require a more quantitative approach with a statistical basis capable of generating confidence intervals around the estimated density values.

Harvey and Cowx (2003) identified three strategies for assessment of the conservation status of juvenile lampreys in SACs - abundance classification (density estimation), population demographic structure (population structure) and distribution (presence / absence). The text in parentheses relates to the terminology of the present authors and shows a very close concurrence to the approach of Harvey and Cowx (2003) whose approach was developed for the LIFE in UK Rivers project. These authors have tentative target density values for river / brook juveniles (>2 / m^2) and juvenile sea lamprey (0.1 / m^2) for compliance with favourable conservation status. The majority of sites in the Slaney system would emerge as satisfactory, for juvenile river / brook, on this basis (Fig

4.1). However, the Slaney would present as extremely deficient in terms of its sea lamprey populations. In contrast, on the Munster Blackwater the sea lamprey density values generally exceeded the threshold of 0.1 fish / m^2 proposed by Harvey and Cowx (2003) in those sites where sea lamprey were recorded. While the river / brook juvenile density data also frequently exceeded the 2 fish / m^2 threshold, the large number of locations registering zero density was a cause of concern in the Blackwater system. Harvey and Cowx (2003) concur with the present authors in regard to the importance of population structure data or size frequency distribution data, particularly where several age classes may be present. Harvey and Cowx (2003) identified that at least two, and up to six, age groups were present at many of their survey sites and they proposed that, to achieve favourable conservation status, at least two age-classes should be present.



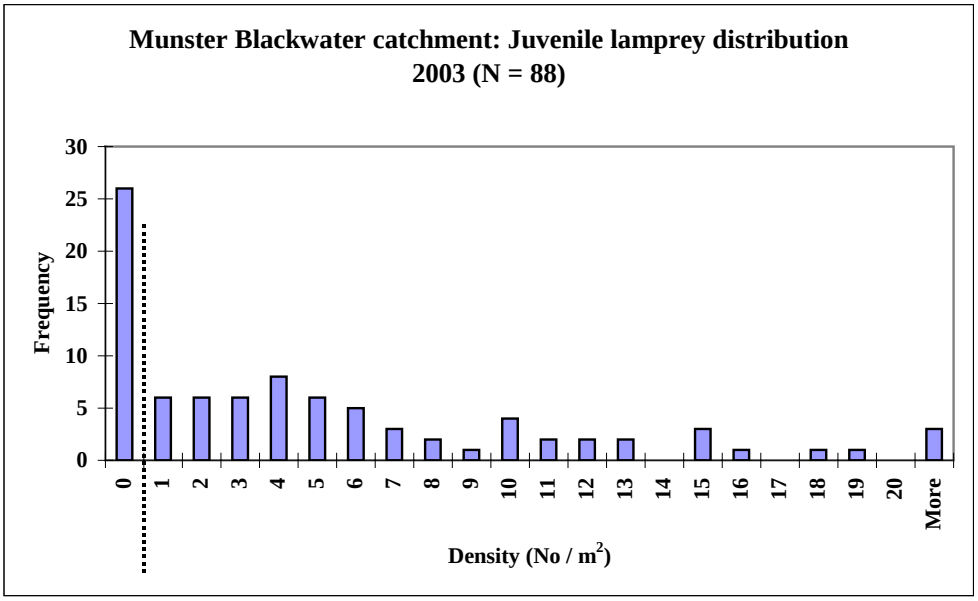


Fig. 4.1 Density distribution of juvenile lamprey in Slaney and Blackwater SACs in context of proposed values for favourable conservation status of Harvey and Cowx (2003) as shown by dotted line.

4.2 Shad

4.2.1 Potential threats – Commercial Fisheries

A number of factors have been identified as constituting potential or actual threats to the status or survival of shad populations. These include interception at sea or during spawning movements, obstruction to passage in rivers or estuaries and severe decline in water quality. Fisheries for shad have operated in the North and Baltic Seas (Manyukas 1989) as well as in Portuguese (Assis 1990), Spanish (Utrilla *et al* In Press), French (Rameye *et al* 1978) and German (Thiel *et al* 1996) estuarine waters and rivers. Aprahamian (1981) referred to commercial UK shad fisheries in the Severn and Fahy (1982) reported a small Irish commercial outlet for shad in the R. Slaney estuary in the period from 1965-75. There is no commercial fishing effort for shad in Ireland at present. Commercial drift, draft- and snap-net fisheries operate for Atlantic salmon in a number of Irish estuarine waters in which shad feeding or spawning movements have been previously recorded (Bracken and Kennedy 1967). Twaite shad ascend the R. Barrow annually during April and are angled in the spawning area downstream of St. Mullins during May (ISFC 2003). These fish have also been taken in the Munster Blackwater at the top of the tide in early May (Went 1953 and J. King unpublished data). Thus the upstream migration and the early spawning period occur prior to commencement of the licensed draft- (R. Slaney) and snap netting season (May 12th annually) and of the drift (R. Blackwater) netting season (1st June annually). Post-spawning fish, descending back to the lower reaches of individual estuaries, may be migrating during part, at least, of the salmon netting season. Thus it is possible that shad could be captured, unintentionally, as by-catch. Fahy (1982), in his examination of shad capture in the Wexford Harbour commercial fishery in the period 1965-76, found that the largest numbers of shad were taken in nets in the July-August period, well outside the shad spawning period. Netsmen in the R. Suir and R. Slaney point to the fact that shad were encountered in nets over a long number of years, as supported by Fahy (1982), and that numbers encountered have only declined in recent years – at a time when fewer netsmen are operating in these estuarine waters. Based on findings of a questionnaire sent to Scottish salmon netsmen, Lyle and Maitland (1995) reported that shad had occurred extensively around the Scottish coast in the past but were now increasingly uncommon. Aprahamian (1981) has pointed to the fact that the decline in shad populations has coincided with the decline of Atlantic salmon and other commercially valued species. With the advances in technology applied to marine capture of fish, the large size of craft and the 'factory-ship' nature of certain commercial operations on the high seas it is possible that shoaling species such as shad may be susceptible to capture in large amounts at sea, with consequent effects on populations available to enter estuaries to spawn. A small example of this was a sample of 57 allis shad, landed as by-catch by one trawler on the Irish south-east on one day in mid-June 2001, ranging in size from 28 cm to 39 cm (J. King unpublished data).

4.2.2 Potential threats – Obstruction of upstream migration

Both twaite and allis shad have the capacity to travel long distances up estuaries and deep into freshwater to spawning grounds (Aprahamian 1981, Manyukas 1986, Mueller 1992). Aprahamian (1982) reported that shad had travelled 174km upstream to spawning areas in the Severn system while Mueller (1992) reported the presence of allis shad in the R. Rhine, up to the year 1900, as far upriver as Basel in Switzerland. This migratory capacity appears to be quite constrained in the Irish rivers where twaite shad have been recorded, with upstream movement being impeded by weirs or localised high gradient areas at the head of the tide in the R. Barrow and R. Suir. In the R. Munster Blackwater, the allis shad taken near Careysville in the present study had travelled 25 km upstream of the top of the tide and is likely to have been impeded by the weir at this location. Construction of dams or weirs can completely disrupt such movements and telescope spawning effort into considerably reduced area. In addition to physical impact on spawning effort, restriction of upstream movement in channels used by both species can lead to hybridisation between the two species (Mennesson-Boisneau *et al* 1993, Carstairs 2000). The progeny are viable and fertile and, in time, can return to breed. If this restriction continues over an extended period of time, introgression can occur with the overall population taking on the attributes of the more well-represented species. This has clear conservation implications for the less-represented species. While the majority of gill raker counts of shad taken in the Blackwater and Slaney clearly divided into two groups, representing the two species of shad, gill raker counts of intermediate value have been recorded in Irish shad studies (J. King unpublished data) from a small number of fish – suggesting that some degree of hybridisation may occur in Irish populations. A hybrid shad was taken by commercial netsmen in the Slaney in May 2004 and submitted to CFB. This indicates a pressure on shad populations in the Slaney. If homing to natal waters does occur in shad then this also indicates that some degree of spawning does occur in the Slaney. It is possible that the pressure may relate to a very low broodstock, of both species combined, and that this is leading to some hybridisation. Hybridisation has also been recorded in Scottish shad, on the basis of gill raker counts and confirmed by biochemical genetic work (Maitland and Lyle 2001).

4.2.3 Potential threats – Water Quality

Pollution and decline in water quality have been cited in a number of studies as contributing to decline in shad populations (Rayeme *et al* 1976, Manyukas 1989, Maksimov and Toliusis 1999). This impact may be mediated by some toxic effect on adult fish or the impaired standard in estuarine or riverine areas may prevent upstream migration thereby hindering or preventing spawning. Juvenile fish mortality may occur in polluted waters. Conversely, improved water quality has been cited as a reason for the upstream displacement of the major shad spawning areas in the R. Elbe (Thiel *et al* 1996). Similarly, capture of both allis and twaite shad in the Thames estuary in recent years, including young fish of 16 – 21 cm, is also considered to be a consequence of improvement in water quality (Environment Agency 2001, Colclough 2001). Both the

Slaney and Munster Blackwater estuaries have been classified as eutrophic (EPA 2001). However, both estuaries provide passage for a range of diadromous species including Atlantic salmon, European eel and the lamprey and shad species recorded in this study. The young shad captured in the Blackwater in the present study are considered indicative of spawning within the estuary, as with the young shad taken recently in the Thames (Colclough 2001). Smelt (*Osmerus eperlanus*), another eutrophication-sensitive estuarine species, has been recorded in recent years by CFB in the Munster Blackwater and was again taken in the 2003 autumn estuarine survey in this study. Smelt were also taken in the Slaney estuary in the course of the present study – the first known occasion on which this species was confirmed for the Slaney. The fact that both species of shad continue to be taken in both estuaries may be indicative of the water quality aspect as not being an overriding factor in determining their current status in these estuaries.

4.2.4 Management Implications

To date, a limited designation list of candidate Special Areas of Conservation (SACs) has been compiled for twaite shad in Ireland. No designations have been made in regard to the allis shad as there are no known spawning sites for this species in the state. However, the gravid condition of the individual female allis shad taken in the Slaney in both 2002 and in the present study is indicative of the presence of spawning fish in Irish waters. The limited knowledge base available, and the small additions from the present study, are indicative of the difficulties in attempting to establish the status of these species. This absence of knowledge on which to make management judgements is also manifest in other jurisdictions (Maitland & Lyle 1991). In the context of developing a network of SACs in the UK, there has also been an awareness of shortcomings in the knowledge base and a requirement to address these (Brown et al 1997). In Ireland, the CFB initiated the compilation of a baseline data on the biology and status of the shad species in 2000, working in conjunction with the Regional Fisheries Boards and with the NPWS. The strategies have included data collection from commercial sources at sea and in estuaries, from angling sources and from scientifically based surveys. The Irish approach parallels one currently being developed by the Environment Agency in one of its regions of the UK (Robert Hillman pers. Comm.; Anon 2000). The difficulties of a scientifically-based sampling approach for shad have been highlighted in the present report and reflect the findings of Maitland and Lyle (2001) who carried out extensive sampling for juvenile and adult shad in the Solway system and the Cree estuary in Scotland. Despite extensive sampling for planktonic and juvenile life stages of shad, none were collected in that study. As with the present study, all captures of adult shad came as by-catch from stake nets set by commercial salmon netsmen. The difficulties in developing a standardised, repeatable, sampling technique that will provide information on the status of the target species, experienced both in the present study and in the UK, create a problem for long-term monitoring of shad and for assessment of the conservation status of the two species.

Anecdotal information clearly points to a decline in the status of shad in the estuaries of the Slaney and Suir over the past thirty years. The success of the shad spawning effort is impacted on by flood and drought conditions, with the species likely to be reliant on occasional strong year classes (Aprahamian *et al* 1998). Given such a tenuous chain of

supply into the population, it is evident that the impact of commercial fishing or by-catch, decline in water quality and obstruction to passage may exacerbate an already difficult situation. Shad have been taken from a range of locations around the Irish coast by commercial fishermen as by-catch, pointing to a widespread distribution of the species. However, the extent of capture is unknown, particularly among large 'factory ships'. Likewise, the genetics of fish captured both inshore/in estuaries and off the coasts is unknown. It is conceivable that shad populations from the Severn and Welsh rivers in the UK may share common open-sea grounds with Irish shad from the south-east. Genetic typing of material from these rivers in Ireland and the UK, along with material from the Irish Sea, would be important, in conservation terms, in identifying if stocks from individual rivers/estuaries are unique. If so, there would be an even greater need to safeguard and conserve the populations at the individual river level.

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