

A PRELIMINARY ASSESSMENT OF THE DISTRIBUTION OF THE SEA LAMPREY (*PETROMYZON MARINUS* L.), RIVER LAMPREY (*LAMPETRA FLUVIATILIS* (L.)) AND BROOK LAMPREY (*LAMPETRA PLANERI* (BLOCH)) IN NORTHERN IRELAND

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ABSTRACT

Lampreys are endangered in Europe, and European states are legally required to take measures to ensure their protection. However, there is currently little information on the distribution of the three species present in Northern Ireland. Anecdotal records of adult lampreys were collated from anglers and other sources, and a systematic electrofishing survey was undertaken to establish the distribution of lamprey ammocoetes. Lampreys were found in seven of the nine Northern Irish river catchments. Brook lampreys (*Lampetra planeri* (Bloch)) were widely distributed, but the two anadromous species, sea lamprey (*Petromyzon marinus* L.) and river lamprey (*Lampetra fluviatilis* (L.)), were more limited in their distribution, possibly due to barriers restricting migration.

INTRODUCTION

Three species of lamprey are found in Northern Ireland: sea lamprey (*Petromyzon marinus* Linnaeus 1758), river lamprey (*Lampetra fluviatilis* (Linnaeus 1758)) and brook lamprey (*Lampetra planeri* (Bloch 1784)). Although believed to be widespread in the UK, these species are endangered, even extinct, in other areas of Europe, and all three are on the International Union for Conservation of Nature's red list of threatened species. The species are also included in Annex II of the EU Habitats Directive (Directive 92/43/EEC), making it a legal obligation for EU member states to create Special Areas of Conservation. Although lamprey distribution and ecology in Ireland has been studied (Kurz and Costello 1999; Byrne *et al.* 2001; Kelly and King 2001; Igoe *et al.* 2004), this work was mainly restricted to the Republic of Ireland. More information on lampreys in Northern Ireland is required to ensure that the requisite management strategies can be put into place.

All three species of lamprey have a larval, or ammocoete, phase, typically lasting between three and five years, during which they live in burrows in river sediments, feeding on micro-organisms and detritus (Hardisty and Potter 1971a; Hardisty 1986).

Following metamorphosis, the river and sea lampreys migrate downstream to feeding areas, normally in the sea or estuaries, although some forms feed in large lakes (Hardisty and Potter 1971b; Goodwin *et al.* 2006). They then migrate upstream to spawn after a feeding period of between one and two-and-a-half years (Hardisty and Potter 1971b; Beamish 1980; Hardisty 1986; Halliday 1991). The brook lampreys do not feed as adults, and after metamorphosis they remain in the river until beginning spawning (Hardisty and Potter 1971a; Hardisty 1986). In Northern Ireland lampreys are commonly known as sucker fish and lamper or ramper eels.

The destruction of ammocoete habitat is thought to be a major factor in the decline of lamprey populations (Kirchhofer 1996; Maitland 2003). Alteration of flow regimes within rivers may result in the destruction of sediment beds (Kirchhofer 1996), a problem compounded by land-drainage systems, which may increase the incidence of flash flooding (Kurz and Costello 1999). In Switzerland the draining of minor tributaries, sealing of the stream bed with concrete, and installation of sand and gravel traps have resulted in loss of ammocoete habitat (Kirchhofer 1996). Water pollution may also make rivers unsuitable for ammocoetes (Kirchhofer 1996; Maitland 2003).

There is little existing information on lamprey distribution in Northern Ireland because of the nature of the lamprey's life cycle. As the ammocoete phase occurs under sediment, ammocoetes are seldom seen, and adult lampreys are usually cryptic, especially during the upstream migration (Kelso and Glova 1993; Jellyman *et al.* 2002), only becoming active in the open during their relatively brief spawning period (Hagelin and Steffner 1958; Hardisty and Potter 1971b; Sjöberg 1977). Sightings appear to have usually occurred at spawning time, as the behaviour reported has been consistent with that of spawning lampreys (e.g. large groups of lampreys observed moving stones). Fishermen may know the location of ammocoete beds because they dig up the ammocoetes for bait, for which they are highly valued by anglers (Baxter 1954; Maitland 2003).

The angling community is a potential source of information on lamprey distribution, but no effort had been made to collect data from anglers prior to this survey. We collected records of sightings of adult lampreys from anglers and other river users using a questionnaire, and these were collated with records from other sources. This information was supplemented by surveying selected stretches of river for lamprey ammocoetes using electrofishing. Using these data, we aimed to gain a preliminary impression of the distribution of lampreys in Northern Ireland. Habitat data were also collected during the electrofishing survey to examine associations with lamprey ammocoetes; this is published separately (Goodwin *et al.* 2008).

MATERIALS AND METHODS

COLLATION OF EXISTING LAMPREY RECORDS

Lamprey records were obtained from the Centre for Ecological Data and Recording at the Ulster Museum. A questionnaire and poster were sent to all the Northern Irish angling associations, and additional copies of the poster were placed in angling shops throughout the province in an attempt to gain more records. Some records were obtained from survey teams from the Environment and Heritage Service, as in a few cases brook lampreys were found in kick samples taken during water quality-monitoring programmes.

Frequently, the common names of lampreys caused confusion in identification, so, where possible, descriptions of the lampreys sighted were obtained. Many anglers assumed that sea lampreys were only present in or near the sea and that, thus, any large specimens found in rivers must be river lampreys. Where possible, a description of the lamprey was obtained so that the identification

could be confirmed. If there was any doubt, the specimen was recorded as 'species unknown'.

AMMOCOETE SURVEY

Forty-five sites were selected for surveying during June to September 2002 and 2003. The River Habitat Survey database was used to select sites with a water depth of less than 1m, as backpack electrofishing is not safe above this depth (Bohlin *et al.* 1990). All suitable sites were then grouped by catchment, the percentage of all rivers occurring in each catchment was calculated, and a proportional number of sites in each catchment were selected for sampling. ArcView[®] GIS software was used to ensure that, where possible, the selected sites were spaced evenly over the catchment. The Skeogh River catchment was not sampled because of its small size. Ammocoete distribution across stream and river channels has been shown to be highly heterogeneous, with most ammocoetes being present at the margins of the stream (Torgersen and Close 2004). Thus, it was decided that bankside sampling would be appropriate. All sites were fished by a two-person team using a backpack electrofisher (Electracatch[™] model WFC911). In each site ten stations were sampled, with each 2m × 0.5m length of bank giving a 1-m² total sampling area per station. Distance between stations was evenly spaced out over a length approximately equivalent to seven times the width of the river, theoretically encompassing a riffle-pool-glide sequence, with a minimum distance of at least 1m between stations (Leopold *et al.* 1964). For detailed methods see Goodwin (2004) and Goodwin *et al.* (2008). Upon completion of electrofishing for the whole site, all ammocoetes were anaesthetised with clove oil. They were then measured to the nearest mm and, with the aid of a hand lens, identified as being either river/brook or sea lamprey ammocoetes according to the criteria outlined by Maitland (1972) and Gardiner (2003).

RESULTS

There were sightings of lampreys in all Northern Irish river catchments apart from Melvin and Skeogh River (Table 1; Fig. 1). Unfortunately, for over half these sightings the species remains unknown. Brook lampreys appear to be widespread in Northern Ireland, occurring in seven of the nine catchments (Table 1). River lampreys are present at several sites in the Neagh and Erne catchments, in the Finn River in the Foyle catchment and in the Lagan River in the Lagan catchment (Table 1). Sea lampreys appear to be restricted to areas of large rivers close to the coast or loughs, as sightings were made in the Foyle, Lagan, Neagh, Mourne and South Armagh, and Roe catchments (Table 1).

DISTRIBUTION OF LAMPREYS IN NORTHERN IRELAND

During the electrofishing survey, ammocoetes were captured in six of eight sampled catchments, but none was found in the Erne and Melvin catchments (Table 1). In ten cases ammocoetes were not found at sites despite adults being reported as present in the river. All ammocoetes found, apart

from one individual, were river/brook lampreys. One sea lamprey ammocoete was found on the Kilkeel River, Co. Down, which is in the Mourne and South Armagh catchment. At sites where they were present, the ammocoetes were found at between one and eight stations per site, with the

Table 1—Distribution of sea, river and brook lampreys in Northern Irish river-catchment areas. Records were collated from sightings of adults and from an electrofishing survey of ammocoetes.

<i>Catchment</i>	<i>Sea lamprey</i>	<i>River lamprey</i>	<i>Brook lamprey</i>	<i>River/brook ammocoetes</i> ¹	<i>Lamprey, species unknown</i> ²
1. Erne		Cladagh Colebrooke Lurgan Tempo	Boho Colebrooke Mill Lough Owengarr Screenagh Sillees Swalinbar		Colebrooke Erne Kesh Sillees Swalinbar Tempo
2. Foyle	Finn Foyle Mourne Beg	Finn	Fairy water Finn Owenkillew Quiggery water	Broughderg Finn Glenelly Mourne Beg Owenkillew	Camowen Finn Strule
3. Lagan	Lagan ³	Lagan	Lagan Riavernet	Blackstaff	Ballynahinch Enler Quoile
4. Melvin					
5. Neagh	Agivey Lower Bann	Ballinderry Lough Neagh Main	Ashfield burn Braid Killagan Moyola Rock Torrent Upper Bann	Ballinderry Ballymully Crumlin Gleneavy Grillagh Mettican Moyola	Ballymully Blackwater Lissan Lower Bann Main Moyola Upper Bann
6. Mourne and South Armagh	Kilkeel		Slieve gullion stream	Kilkeel	
7. Antrim coasts and glens			Burngushet Bush	Bush Dervock Glenshesk Tow	Bush Glenshesk
8. Roe	Faughan Roe		Burntollet	Faughan Muff Owenbeg	Faughan
9. Skeogh River ⁴					

¹ From electrofishing surveys, it is not possible to distinguish between brook and river lampreys in the ammocoete phase.

² Anecdotal records where species was not specified.

³ Sighted below Stranmillis Weir—it is not known if sea lampreys are able to traverse the fish pass at Stranmillis Weir.

⁴ Not electrofished.

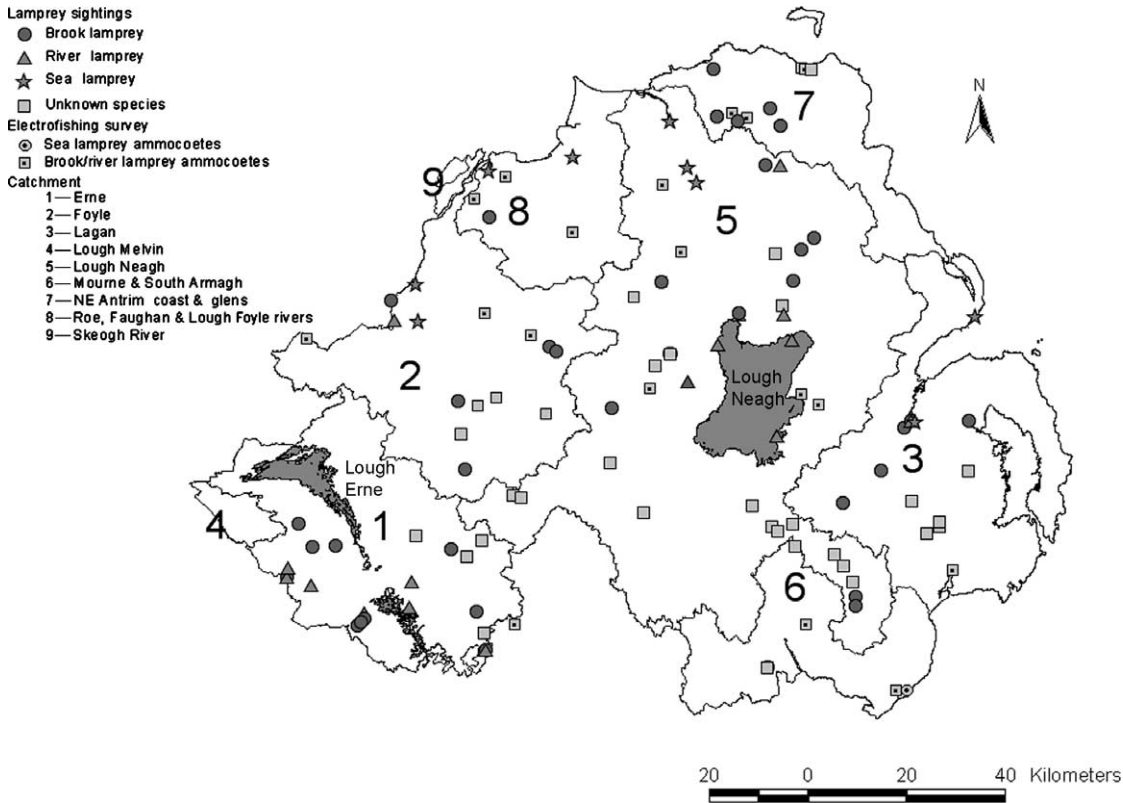


Fig. 1—Distribution of brook, river and sea lampreys in Northern Ireland. Records were collated from sightings of adults and from an electrofishing survey of ammocoetes.

mode being two stations, and the mean being 3.6 stations (SE 0.48). The maximum density of ammocoetes found at any one station was 10 per m², and the mean density of ammocoetes per station at which ammocoetes were present was 2.16 per m² (SE 0.24).

DISCUSSION

Ammocoetes were found in all catchments apart from the Erne and the Melvin catchments. Melvin is a very small catchment, containing predominantly fast-flowing, rocky rivers, and, consequently, it may not provide appropriate habitat for ammocoetes. It was expected, however, that ammocoetes would be found in the Erne catchment, as several records of adults had been obtained from this area; however, as soft sediment was only available at two of the four sites sampled, these areas may not have had enough suitable ammocoete habitat to allow for colonisation. As some of the records of adults from the Erne catchment are fairly recent, and from a reliable source, it is unlikely that ammocoetes are not present here. This reflects the need for an increased number of electrofishing samples.

It is important that electrofishing surveys are targeted specifically at ammocoetes, as the methods

necessary for capture differ from those used for other fishery surveys (Harvey and Cowx 2003; APEM 2004a). Additionally, due to their size, any ammocoetes captured during the course of other fishery surveys may be missed, or misidentified as eels. Whilst the type of survey used here can identify rivers with ammocoete populations, it is not possible to distinguish between brook and river lamprey ammocoetes, thus, re-sampling rivers for adults may be necessary.

Whilst records from other sources may provide useful supplementary data on lamprey distribution, there are several problems with this type of anecdotal information: records are likely to relate to the level of human use of an area, rather than to actual lamprey distribution; species identifications are sometimes unreliable; and most sightings are likely to be of spawning lampreys and, thus, will not indicate the distribution of ammocoetes. Nevertheless, records of this type provide useful supplementary data on adult lampreys that may subsequently be used to target more detailed surveys.

The densities of ammocoetes recorded are similar to those recorded in surveys conducted elsewhere in Europe (Waterstraat and Krappe 1998; Cragg-Hines and Johns 1999). Sea lamprey ammocoetes occurred in much smaller numbers than

river or brook lamprey ammocoetes, with only one sea lamprey ammocoete being found during the survey (in Kilkeel River). This reflects the situation in England and Scotland, where sea lamprey ammocoetes typically make up less than 4–5% of the ammocoete population (APEM 2004b).

The distribution of anadromous lampreys may be restricted by accessibility of spawning sites (Youngs 1979; Granado-Lorencio 1991; Boyer *et al.* 2000; Moser *et al.* 2002; Rosell 2002). Although adults are capable of long migrations (Applegate 1950), sea lampreys in the UK usually spawn nearer to the sea. In the Republic of Ireland (Kurz and Costello 1999; Igoe *et al.* 2004) and Scotland (APEM 2004b) spawning sites are usually in the lower reaches of rivers. In Northern Ireland sea lampreys are frequently observed spawning below large weirs, such as Carnroe on the Lower Bann, and they may be unable to migrate past these. Prior to the construction of Carnroe Weir in 1847, sea lampreys penetrated through Lough Neagh as far as the Ballinderry River, where there are historical records of them spawning in large numbers (Thompson 1856). River lamprey distribution may also be restricted by barriers to migration. Goodwin *et al.* (2008) found that, in the Ballinderry River, ammocoete abundance was negatively related to the number of potential migratory barriers.

There is currently little information on the suitability of fish passes for lampreys, so in many cases these passes are inappropriately designed (Haro and Kynard 1997). In some cases lampreys may be able to circumvent obstacles—river lampreys have been observed migrating upstream round Randalstown Weir on the River Main through long grass on its banks (Alan Keys, pers. obs.). Lampreys are able to survive for at least 30h in humid air (Potter *et al.* 1996). However, where the banksides are steep or concreted, overland passage may not be possible, thus, suitable fish passes are essential to move upstream. It is recommended that the suitability of passes on important rivers for lampreys should be investigated. Appropriately constructed passes may result in the recolonisation of anadromous lampreys into rivers. River lampreys are believed to have recolonised the River Lagan following construction of Denil passes in weirs (Rosell 2002).

In summary, the sea lamprey has a limited range in Northern Ireland, so surveys of its habitat are important if the species is to be conserved. Further surveys of the Lower Bann (downstream of Carnroe Weir) and the Foyle system are recommended. The river lamprey is probably reasonably abundant throughout the province. However, there is a suspected landlocked population in Lough Neagh (Goodwin 2004; Goodwin *et al.* 2006) that is of particular conservation interest. Therefore, surveys of the tributaries of Lough Neagh are

required to assess available ammocoete habitat and spawning grounds in order to safeguard this population. The brook lamprey is probably the most abundant of the three species present in Northern Ireland, as it has not been affected by barriers to migration, which seem to have been detrimental to the other two species. The River Muff merits further investigation, as the largest number of ammocoetes was found there, suggesting it might represent a particularly large population.

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