FIRST RECORD AND INITIAL HYDROACOUSTIC STOCK ASSESSMENT OF POLLAN *COREGONUS AUTUMNALIS* PALLAS IN LOUGH ALLEN, IRELAND

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ABSTRACT

The Irish Pollan *Coregonus autumnalis* Pallas is unique in western Europe, with its current known distribution being limited to four lakes in Ireland; Lough Neagh and Lower Lough Erne in Northern Ireland and Lough Ree and Lough Derg in the Republic of Ireland. In this paper we report the first authenticated record of pollan in a fifth Irish lake—Lough Allen, County Leitrim. Using hydroacoustic technology, combined with a ground-truth gill netting survey, abundance estimates show that the population is relatively small, numbering in the region of several thousand individuals. Captured fish ranged in age from 1+ to 4+, indicating reproductive success in each year over the previous four years. Threats to sensitive species such as pollan include eutrophication, competition with introduced species, land drainage and the resulting siltation of downstream lakes. Further detailed investigations on the status of this newly discovered population, including location of spawning sites, recruitment success and genetic relationship with other Irish populations, are crucial in informing management decisions with a view to protecting this unique and threatened fish species.

INTRODUCTION

The Irish Pollan *Coregonus autumnalis* Pallas is unique in western Europe. Extant populations are known to exist in only four lakes in Ireland: Lough Neagh and Lower Lough Erne in Northern Ireland and Lough Ree and Lough Derg in the Republic of Ireland (Rosell *et al.* 2004). These populations are landlocked relicts of postglacial colonisation by anadramous populations that still occur in North America and northern Eurasia as 'Arctic Cisco' (Maitland and Campbell 1992; Rosell *et al.* 2004). Of these four lake populations, three have become severely reduced since 1970, with only Lough Neagh currently supporting a large stock (Rosell *et al.* 2004).

Irish pollan exist in atypical conditions when compared to those of Arctic populations of *C. autumnalis*, which typically inhabit cold, low productivity waters. In Ireland, pollan inhabit meso-hypertrophic systems with summer surface water temperatures that can reach 18°C–20°C, well above the optimum growth range for pollan (Harrod *et al.* 2001; Rosell *et al.* 2004).

Lough Allen is a 3600ha mesotrophic lake, situated in County Leitrim with a small portion in County Roscommon. It is the uppermost of the three main lakes in the Shannon catchment (Lough Allen, Lough Ree and Lough Derg). It is approximately 12.9km long and 4.8km wide, with a maximum depth of 42.7m and an average depth of 10.9m. The fish species present in the lake include pike *Esox lucius* L., perch *Perca fluviatilis* L., roach *Rutilus rutilus* L., bream *Abramis brama* L., roach × bream hybrids, brown trout *Salmo trutta* L. and eels *Anguilla anguilla* L. Pollan have not previously been recorded in Lough Allen; however, in summer 2004, commercial eel fishermen operating in the Upper Shannon area claimed that pollan were present in the lough, occurring occasionally in fyke nets used to catch yellow eels. Confirmation of the presence of pollan in the Upper Shannon area was obtained in November 2005 when a fisherman recovered a specimen 7km below the outlet of Lough Allen and about 1km upstream of the confluence with the Shannon–Erne navigation route (McCarthy and Blaszkowski 2006). It was suggested that this specimen would most likely have migrated downstream from Lough Allen; however, until now no documented evidence exists of pollan within the lake itself.

This paper documents the first record of pollan in Lough Allen, and evidence from initial hydroacoustic data suggests that the population is relatively small, numbering in the region of a few thousand individuals.

MATERIALS AND METHODS

SURVEY DESIGN AND GROUND-TRUTH NETTING

A hydroacoustic survey was conducted during the daytime over a three day period from 6–8 June 2006. Fifteen latitudinal and three longitudinal transects spaced 500m apart were identified (Fig. 1), and acoustic data were recorded at a constant speed of 5km h^{-1}. Data from a concurrent netting survey were used to 'ground-truth' species identification. A total of 33 benthic and 6 floating monofilament multi-mesh gill nets (randomised fourteen-panel, mesh size 5–75mm) were randomly set throughout the lake over three nights in accordance with a modified version of the European Standard for Sampling of Fish with Multi-mesh Gillnets (CEN 2005), adapted to reduce the netting effort by approximately half for Irish lakes.

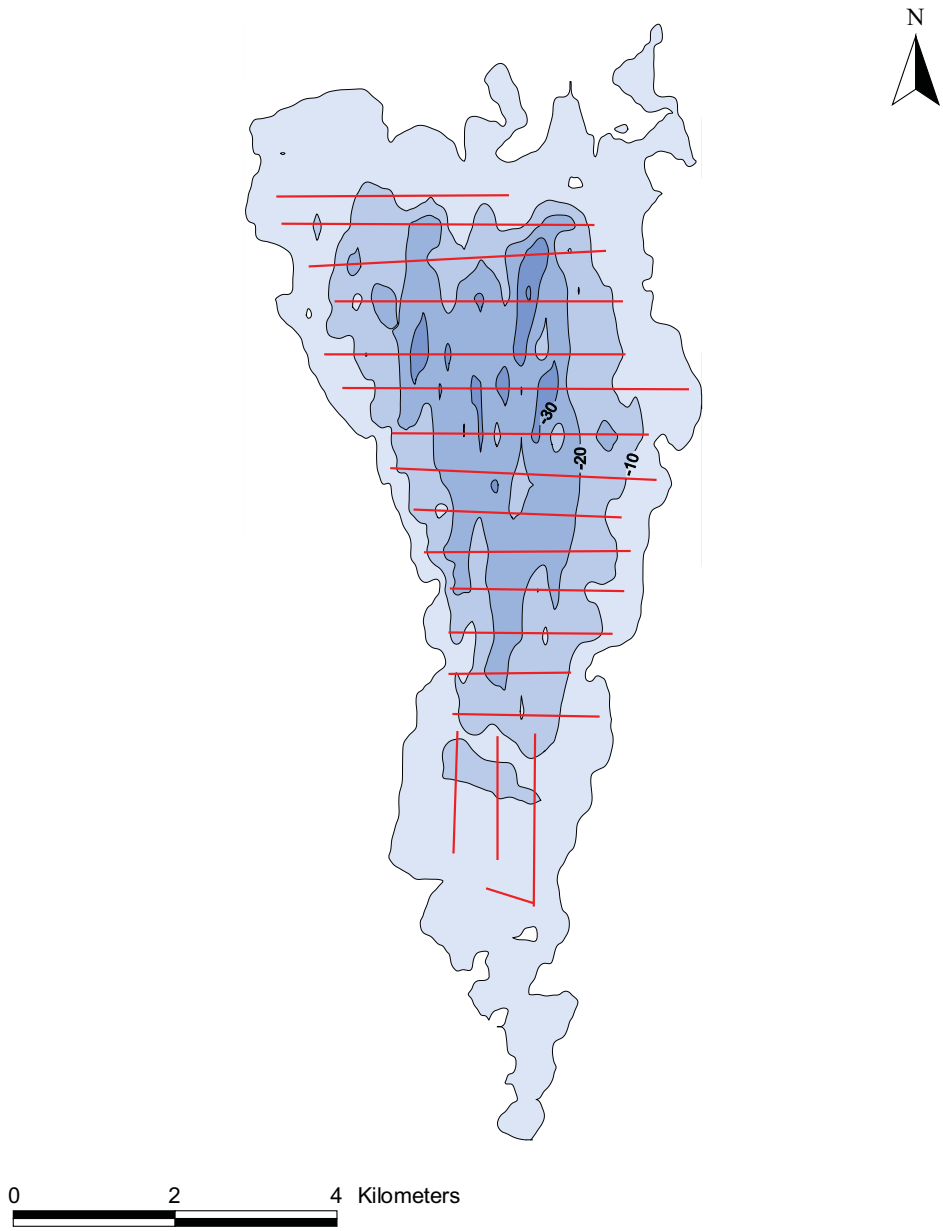

Fig. 1—Position of sailed transects during which data were recorded (depths in metres).

ECHOSOUNDER SETUP AND DATA PROCESSING

The sonar system consisted of a Simrad EY60 scientific echosounder with a vertical split-beam transducer (SIMRAD ES200-7C: 200KHz operating frequency, circular 3dB beam angle 6.5°) mounted using an adjustable bracket on the boat's port side at a depth of 0.5m. Sonar parameters were set as follows: transceiver power output, 90W; ping rate, 5 pings s^{-1}; pulse duration, 256μs; range, 70m; amplitude echogram threshold, −100dB.

Data were processed using Sonar5-Pro (Balk and Lindem 2004) post-processing software. Base threshold for data conversion was −100dB. Amplitude echograms were converted to TVG 40logR. Single Echo Detection (SED) criteria, set in accordance with the draft CEN standard Data Sampling of Fish Populations with Acoustics (CEN 2007) for situations with medium signal-to-noise ratios, were defined as follows: minimum echo length, 0.7; maximum echo length, 1.6; maximum phase deviation, 0.5; maximum gain compensation, 6dB (one-way); multi peak suppression, off. Minimum TS for SED acceptance was set at −45dB, which is equivalent to a fish approximately 10cm long (Love 1971).

Fish tracks were identified using the Sonar5-Pro automatic tracking feature: minimum track length was set to 3 pings, maximum ping gap was set to 0 pings and the gating range was 0.1m. The minimum range for both tracking and biomass analysis was set at 2m. Each file was manually checked and tracks edited as necessary.

DATA ANALYSIS

Each transect was split into 500m segments (for the end of some transects the segment length was between 500m and 1000m) and the number fish ha^{-1} was calculated for each segment (n = 91). Mean number fish ha^{-1} was then calculated.

In order to assess the status of the pollan population in the lake, netting data were used to identify the areas where pollan were found. Out of a total of 39 nets, pollan (n = 6) were found in only five nets in the north-west corner of the lake. A polygon was drawn around the five nets using ArcView GIS 3.3 software, and the distance was calculated between this polygon and the closest net that didn't contain pollan. The polygon was then buffered to this distance of 300m to provide an estimate of the area of the lake that contained pollan (Fig. 2). The number of fish ha^{-1} for each transect segment within this area (n = 5) was obtained and the mean calculated. This figure was then multiplied by the area to provide an estimate of the total number of fish in this area. Finally, this figure was multiplied by the mean proportion of pollan captured in the five nets to give an estimate of the number of pollan within this area.

RESULTS

A total of eight species (including one hybrid) were recorded in the netting survey. The number of each species captured, along with minimum and maximum lengths are given in Table 1.

From the hydroacoustic data, mean (± SE) fish ha^{-1} among transects for the whole lake was 5.2 (± 0.9), ranging from 0 to 34.3 fish ha^{-1} (Fig. 3). Most fish were recorded in water depths greater than 10m, with few, if any fish being recorded in shallower areas. This highlights the relative ineffectiveness of vertical hydroacoustics in shallow water environments due mainly to the narrow cross section of the acoustic beam. This is reinforced by the netting data in which higher fish densities were recorded around the lake margins than in pelagic areas. Pollan, however, are a pelagic species generally found in deeper, colder water (Harrod *et al.* 2001) and are therefore well suited for targeting with vertical hydroacoustic surveys.

Out of a total of 39 gill nets, pollan (n = 6) were only captured in five nets in the north-west corner of the lake, encompassing an area of approximately 168ha. Mean (± SE) fish ha^{-1} within this area from hydroacoustic data was 5.1 (± 3.8), ranging from 0 to 19.7 fish ha^{-1}, giving a value for the number of fish in this area to be 857 (± 638). The mean proportion of pollan captured in the nets was 0.54 (± 0.16), indicating that the number of pollan in this area numbered between 83 and 1047 individuals.

DISCUSSION

Based on the results of this study, the pollan population in Lough Allen appears to be very small. However, we must consider the limitations of this approximate 'first estimate' of population size and regard this figure as such, rather than as an absolute abundance value. The abundance values quoted have large standard errors due to the large variation in fish densities recorded among the relatively few transects in which pollan were found. The authors therefore emphasise the importance of the discovery of a new population of this fish species rather than using the limited current data to establish an absolute population size.

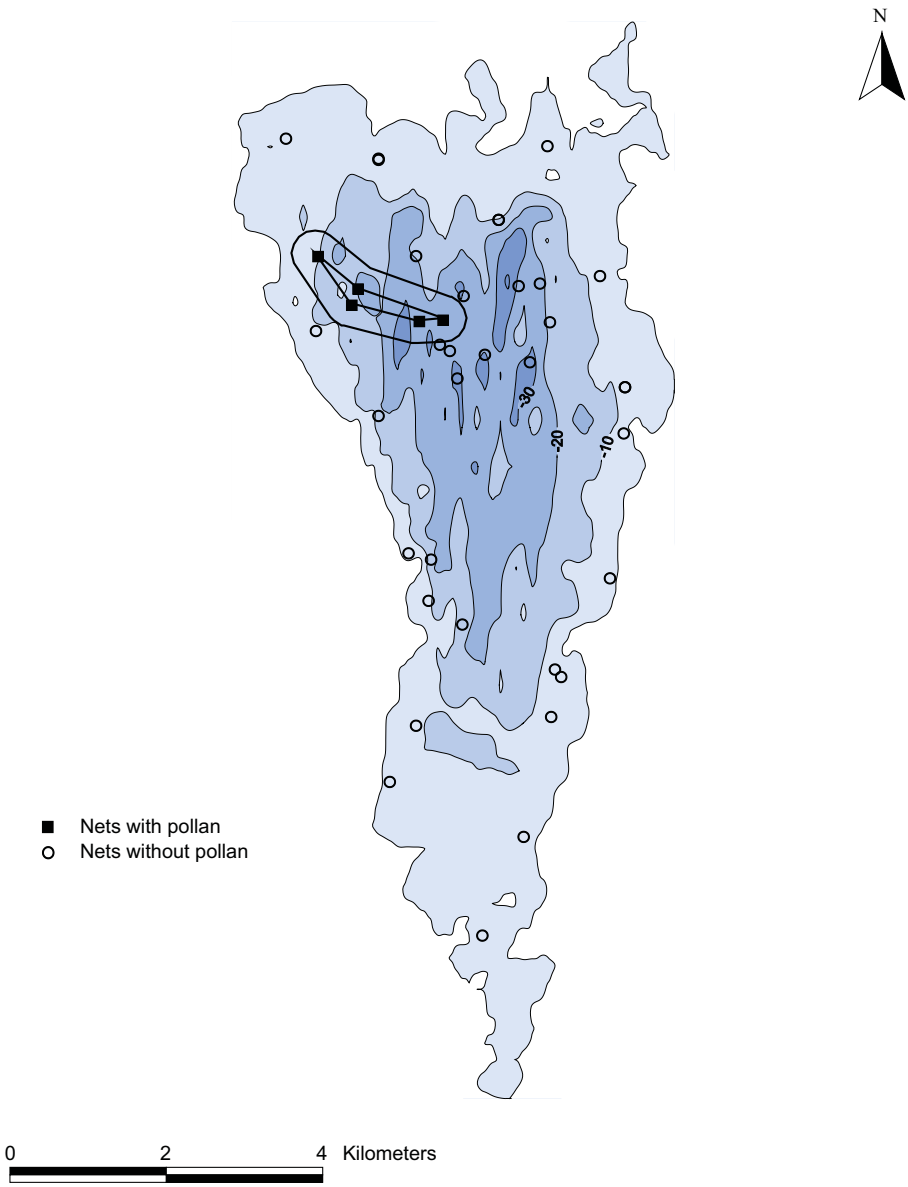

Fig. 2—Position of nets containing pollan (squares) and nets where no pollan were found (circles). A polygon is drawn around the nets containing pollan and a buffer zone of 300m added (depths in metres).

Table 1—Number of fish and minimum and maximum lengths of all species captured in the netting survey.

Species	*Number*	*Min length (cm)*	*Max length (cm)*
Pike	6	40.9	60.0
Perch	465	5.0	36.5
Roach	130	6.4	24.2
Bream	15	17.3	40.0
Roach × Bream hybrid	18	22.0	30.7
Brown trout	8	19.2	47.0
Pollan	6	14.3	25.2
Eel	4	41.0	75.0

Furthermore, the abundance estimate is based on a relatively small area of the lake in which pollan were captured in nets. However, due to the randomised nature of the netting survey, a large area of water >20m deep in the central region of the lake was not netted. Indeed the highest hydroacoustic fish densities were recorded in an un-netted area just south of the location where pollan were captured (Fig. 3). The area of the lake containing pollan, and hence the size of the pollan population, could therefore be larger than that quoted in this study. It is suggested that for the purposes of 'ground-truthing' hydroacoustic data, a structured and targeted netting survey would be more suitable than a randomised sampling design such as was available in this investigation.

A minimum length of 10cm was used in the above abundance estimate, however a large proportion of targets in the 168ha area containing pollan were in the 4–10cm size class. If these fish (many of which would likely include young-of-the-year pollan) are included in the abundance analysis, the estimated size of the pollan population would be in the order of several thousand individuals.

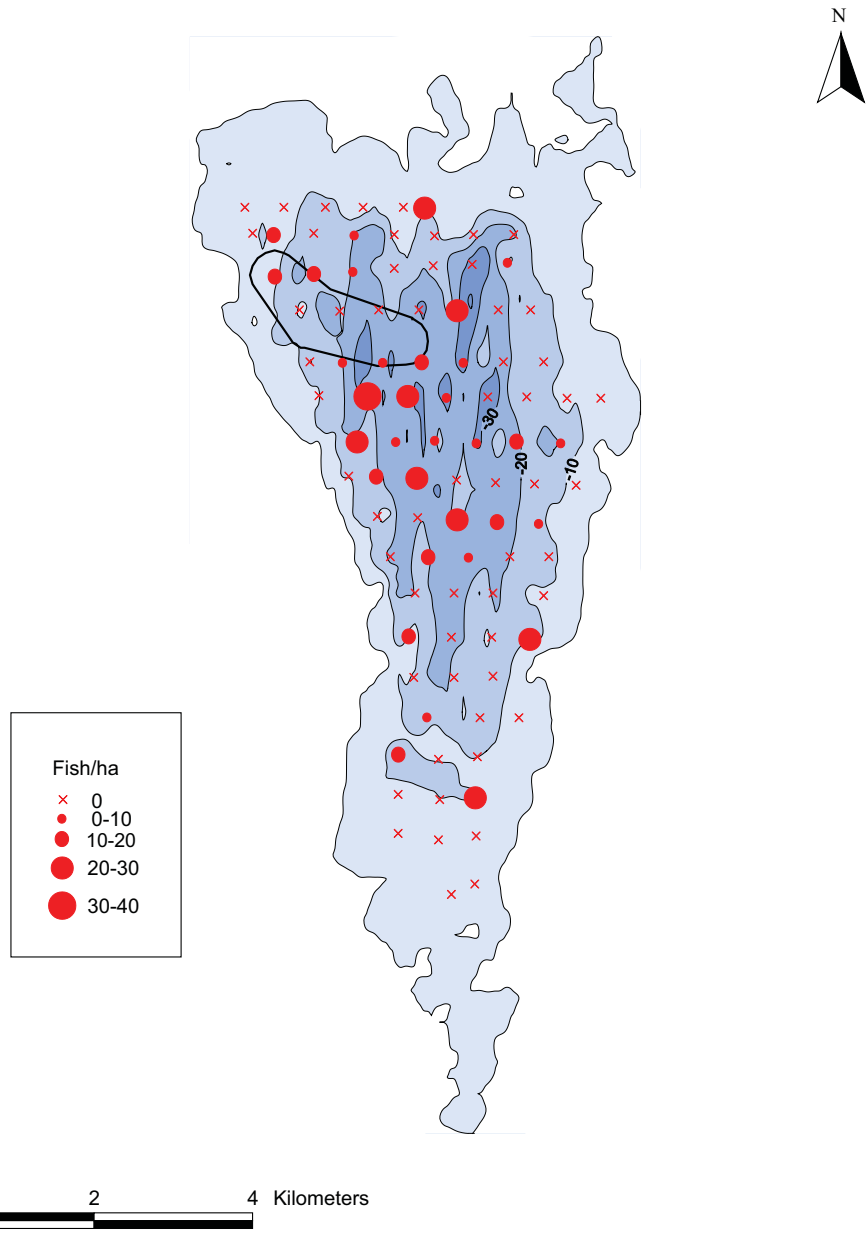

Fig. 3—Spatial distribution of fish >10cm length in Lough Allen, from hydro-acoustic data. Area where pollan were captured is marked with a black polygon (depths in metres).

Pollan in Ireland are a relatively short-lived species, with most authors encountering fish up to five years old, and ages over this being unusual (Rosell *et al.* 2004). Specimens captured during this survey ranged in age from 1+ to 4+, and growth analysis indicates that the pollan in Lough Allen are slower growing than those in Lough Neagh, Lough Erne and Lough Derg, with the length of the oldest 4+ fish being only 25.2cm compared with a length of around 35cm for the same age in other populations (Rosell 1997; Rosell *et al.* 2004).

Early hydroacoustic estimates of population size show the number of pollan in Lough Allen to be relatively small, numbering in the region of several thousand individuals, and therefore this population would be particularly vulnerable to a number of environmental pressures. The main perceived threats to pollan include eutrophication, competition with introduced species, increased water temperature above thermal tolerances, land drainage and resultant siltation of lakes downstream of drained rivers (Griffiths 1997; Harrod *et al.* 2001). It is essential that more information is attained on this newly discovered pollan population in Lough Allen, including their genetic relationship with other Irish populations, trophic position within the food web, recruitment success and, perhaps most urgently, the location of spawning sites. Such information, along with further targeted hydroacoustic surveys of population size, is crucial in informing management decisions with a view to protecting this unique and threatened fish species.

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