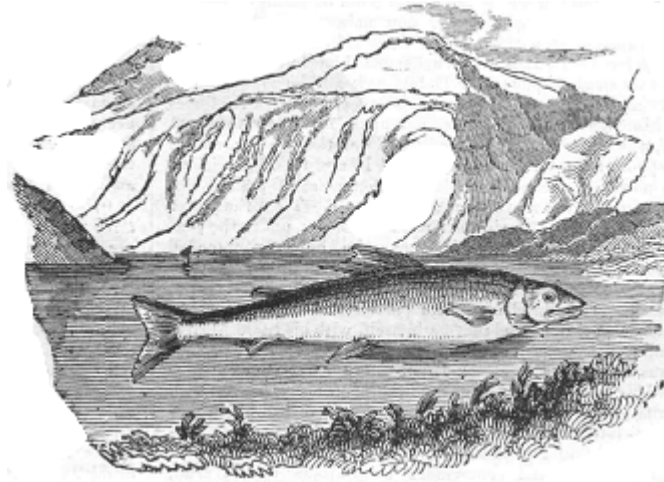


Gill net surveys of fish life in Loughs Dan, Tay and Glendalough upper lough, Co. Wicklow.

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[“Char, with View of Lough Dan.” Extract from the *Dublin Penny Journal*, Vol. 1, No. 17, October 20, 1832]



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Surveys of fish life in Loughs Dan, Tay and Glendalough upper lough, Co. Wicklow.

Executive summary

- The following glacial loughs in Co. Wicklow were surveyed by standard multimesh monofilament benthic and pelagic gill nets in June 2005; Glendalough upper, Lough Dan and Lough Tay.
- This report provides information on catch per unit effort and depth distribution of the fish community in the three loughs during the period of sampling.
- The surveys form a baseline data set for all three loughs against which any future changes can be referenced.
- The fish communities in all of the three loughs can be described as simple (i.e., consisting of only a few species). Native brown trout were present in all loughs sampled. Non-native minnow were recorded in both Loughs Dan and Glendalough upper. The brown trout were predominantly caught in the littoral or shallower strata of the loughs surveyed.
- No Arctic char were recorded in any of three loughs. Despite historical records for the three loughs and a relatively recent record for Lough Dan, the combination of data indicates that Arctic char are now extinct in Lough Dan, Tay and Glendalough.
- The loughs appeared to be unaffected by organic pollution and although minnow were discovered it is not thought that their presence would be inimical to Arctic char survival. Water temperatures were also favourable for this cold water species during the period of sampling.
- It is concluded with reasonable certainty that Arctic char are now extinct in Lough Dan, Tay and Glendalough and that lake acidification was the most likely cause.
- The last know record for Arctic char in these loughs is 1988 for Lough Dan.

Introduction

This report outlines the gillnetting results for the June 2005 survey on the fish communities sampled from three freshwater loughs, in Co. Wicklow (Loughs Dan, Tay and Glendalough).

The primary aim of the current investigations was to determine with confidence the status of Arctic char in the three Wicklow loughs. In addition, information was to be gathered on the presence of other fish species, to determine the status and profile of the brown trout population, the potential presence of ferox trout and the presence of non-indigenous fish species. All surveys were carried out using experimental monofilament multimesh gill nets following the standard method (Appelberg 2000). These data are therefore directly comparable with other studies carried out in almost 40 Irish loughs and in other countries. Brown trout samples were retained for genetic analysis in Queens University and biological data will be worked up at a later stage by students in University College Dublin.

Typical fish communities of glacial loughs in County Wicklow

In Ireland the fish community of glacial loughs (loughs left behind by the retreating glaciers of the last Ice Ages) have usually escaped the more negative consequences of human interferences, e.g., nutrient pollution, non-native fish introductions. Therefore they still retain native fish communities and are important from a native fish biodiversity perspective. These communities are of both national heritage importance and are important internationally from scientific and conservation perspectives (Igoe and Hammar 2004). Many are also important angling destinations and are managed by local angling club or fisheries boards.

For millennia these native fish communities, the longest surviving of Ireland's native animal communities, were the sole fish species in the country's freshwaters. Typically they are dominated by salmonids such as brown trout and Arctic char. Three spined stickleback and to a lesser extent nine spined stickleback may also occur. Where access to sea is still permitted, migratory salmonids (Atlantic salmon and sea trout) and European eel usually occur. These fish species represent a major part of Ireland's surviving early postglacial fauna, and are reflective of freshwater fish communities that must have been prevalent throughout much of northwestern Europe immediately after the last Ice Age. In essence they reflect the Irish fish fauna first encountered in loughs and rivers by our early ancestors during the Megalithic period. As such, these native freshwater fish species are highly significant, not just for Ireland, but also for much of western Europe, where many such communities have been lost or replaced (Igoe 2004).

The biodiversity value of these species, in particular brown trout, is now being recognized and their taxonomic status under review (Ferguson 2004) as genetic studies are

illustrating that they are far more diverse than previously thought. Recent studies on the genetics of brown trout from glacial loughs in other regions of Ireland suggest that their genetic diversity is high and in some cases certain populations should be considered as being unique (Paulo Prödohl, Queens University Belfast). Although less work has been carried out on Arctic char in Ireland, similar analogues probably pertain to this species also. In Ireland each Arctic char population has been confined to their respective lough for up to 17,000 years ago and no mixing of DNA between populations from different (even adjacent) loughs has occurred in most catchments since the last Ice Age. The broad phenotypic diversity of the species here in Ireland has already been reported (Igoe and Hammar 2004) and the species is recognized for its general plasticity globally (Johnson 1980). Recent studies on mitochondrial DNA of Irish populations (supplied by the Irish Char Conservation Group from loughs in Donegal and Kerry), confirm large genetic divergence between populations even from loughs close to one another (Paulo Prödohl, Queens University pers. comm.).

In summary brown trout and Arctic char are some of the most important elements of Ireland's fauna from biodiversity, conservation, heritage and economic perspectives.

Knowledge to date

However the fish fauna of most Irish loughs have yet to be studied thoroughly and there is still a paucity of information on the genetic relationships between their brown trout populations. In addition, the genetics of Arctic char populations are largely undescribed. These genetic information gaps must be filled if Ireland is to make informed choices about water use and prioritize conservation efforts. Even basic information is lacking for most glacial loughs in Ireland such as a description of their species composition, i.e., what species are present? Information is available on the above for only a few Irish loughs (e.g., Igoe et al 2004, Ferguson 1996) and these data are clearly inadequate for generic decision making with regard to water use and protection of fish life in these lough types. Information needs to be collected on a lough-by-lough basis, particularly where proposals to utilize a glacial lough for human uses may alter the lough level or hydraulic cycle. Baseline data will also provide information on the biodiversity importance of the fish species present and their heritage and conservation value both locally and nationally.

Acidification impacts on fish communities

Impacts on fish communities in a number of countries due to acidification have been recognised. Arctic char are particularly sensitive to acidification and extinctions attributable to acidification have been recorded from a number of European countries e.g., (Lindstrom and Andersson 1981). Maitland (1995) lists acidification as one of the major threats to Arctic char worldwide. In Ireland investigations into acidification in poorly buffered areas have shown

strong correlations with low or zero fish density and acidification impacts. Igoe and Kelly-Quinn (2002) highlight the potential role that acidification may have in explaining the lack of recent records of Arctic char from Lough Dan in Co. Wicklow.

This report investigates further the status of Arctic char in Lough Dan, Tay and upper Glendalough using more sophisticated netting gear and protocols (Appelberg 2000).

Current project

Concerns have been expressed for the continued survival of Arctic char in County Wicklow, by Anon (1994), Igoe and Kelly-Quinn (2002) and Igoe et al (2003). The Eastern Regional Fisheries Board approached the Irish Char Conservation Group for advice on the preferred options to re-establish Arctic char in this region. As concerns for the survival of Arctic char in the three Wicklow loughs were based on,

- A) the results of previous survey work carried out which employed a range of non-Arctic char specific gear types and
- B) the absence of anecdotal material for some time, it was deemed important to survey using an accepted standard method with proven efficiency for the capture of Arctic char.

Recent studies by the Irish Char Conservation Group have shown that some gear types traditionally used to survey fish populations in Irish loughs were capable of missing an entire population of Arctic char (ICCG in prep). The current methods employed by the Irish Char Conservation Group are designed to sample salmonid populations and are efficient at capturing a cross section of an Irish Arctic char population (e.g., Igoe and Greer 2004). This survey represents the first stage of the recommended plan put forward by the Irish Char Conservation Group.

A four point plan for the reintroduction of Arctic char to Co. Wicklow¹

1. Determine if Arctic char are definitely extinct using the appropriate sampling gear.
2. Once step one is complete/or carry out in tandem, measure the ph of all three loughs (Tay, Dan and Glendalough), particularly during winter.
3. If the survey work concludes that the Arctic char are extinct for any or all three loughs, but that lacustrine environmental conditions are appropriate for re-establishment then consideration of a restocking programme can be considered. In order to translocate Arctic char to the Wicklow loughs it will important that the appropriate brood stock is identified, from a biodiversity perspective. The Arctic char in Loughs Tay and Dan were identified as *Salvelinus obtusus* and the closest morphotypes to them were identified in the Killarney loughs and Lough Accose in Co. Kerry (Went 1945, Igoe and Kelly-Quinn 2002). Although the ICCG awaits results from genetic studies on our samples from these loughs, we suggest that these ones could be considered in the absence of more detailed genetic investigations. It has been suggested that Lough Eske should provide the donor population, however this Arctic char population has been studied/sampled relatively intensively over the last few years and we feel that the population should be give some respite. The Lough Eske char are of the *Salvelinus colii* (Went 1945) and so are unsuitable for stocking from a biodiversity perspective. The preferred option here would be to compare DNA from museum specimens of Arctic char from Lough Tay and Dan with other extant populations including those from the Killarney Loughs and Lough Accose to determine the best match. If no match is found then a second approach could be taken, where the stocking exercise would serve to set up a second or “refuge” population for another Irish Arctic char population that is either of high conservation merit, (e.g., Coomasaharn,) and/or under threat in its current habitat. Therefore thee project would not only serve as an exercise to restore Arctic char to Co. Wicklow, but also serve as a conservation measure for the protection of another Irish genetic stock.
4. Any attempt to reintroduce char will require careful consideration of the restocking options currently available. Restocking could be by stocking in using adult fish

¹ Four point plan presented by the Irish Char Conservation Group to Eastern Regional Fisheries Board outlining protocol for re-establishment of Arctic char in Co. Wicklow.

taken directly from the donor lough, or the introduction of ova stripped from the donor population, or by the use of hatchery reared fed or unfed fry, fingerlings etc. The Irish Char Conservation Group favour the use of ova and avoidance of the hatchery environment. This avoids disease and husbandry problems and allows for more natural development (imprinting etc) in the new habitat. Prior to planting of fertilised ova suitable recipient “spawning sites” must be identified based on characterisation studies of spawning sites from other Irish loughs. The identification of suitable substrates etc could be done with the help of the The Irish Char Conservation Group, who are currently working on the characterisation of Arctic char spawning beds in Ireland (e.g., Igoe and Ruane in press).

It is important that the above steps are followed as most reintroductions of Arctic char to former habitats following extinction meet with failure due to a lack of preparation and failure to address the underlying cause of the extinction in the first place(J. Hammar pers comm.).

Methods

Experimental gill netting surveys were carried out using the standard benthic Nordic multimesh monofilament nylon gillnets, which are composed of different mesh sizes following a geometric series with a ratio between mesh-sizes of 1.25. The gill nets are 30m long and 1.5 m deep and are composed of 12 different mesh panels ranging from 5 to 55 mm knot to knot, each panel about 2.5 m wide. The netting is carried out according to protocols described by Appelberg (2000) and is a proposed standardized European method for a stratified random sampling procedure. Nets were set along lough contours as recommended by Hammar and Filipsson (1985), sampling the range of depth strata for each respective lough, with effort diminishing with depth. Appelberg (2000) outlines two quantitatively different approaches. The first is an intensive sampling effort, which allows the detection of 50% changes in the fish community between sampling occasions on a water body. The second is less intensive and is designed as an inventory sampling method, i.e., identify the species present and gives basic information such as length frequency distributions. The latter method is strongly recommended in natural, unexploited and unknown fish communities particularly where Red Data Book species such as Arctic char are present. The inventory method is generally effective in catching a wide range of species across the spectrum of the spatial subdivisions within a lough, ranging from shallow littoral-benthic and profundal-benthic areas to the pelagic zone. In most loughs, netting effort was in excess of that recommended for

inventory sampling and therefore meet the criteria necessary to ensure an adequate sampling intensity sufficient for species identification.

Table 1. Mesh-size distribution and monofilament diameter of multiple mesh size gillnets of the Nordic type.

Mesh no	Mesh size, knot to knot (mm)	Thread diameter, mm
1	43	0.20
2	19.5	0.15
3	6.25	0.10
4	10	0.13
5	55	0.23
6	8	0.10
7	12.5	0.13
8	24	0.16
9	15.5	0.15
10	5	0.10
11	35	0.20
12	29	0.16

Laboratory analysis

Fish were measured for length and weight. Muscle tissue samples were extracted from both brown trout and Arctic char for genetic work. The analysis is being carried out by Queens University Belfast. Each fish was labelled and frozen. More detailed biological investigations will be carried out on the samples by the Zoology Department in University College Dublin

Results of the gill netting programme

This report outlines the data collected during the gillnetting surveys conducted in June 2005. Information is provided on species identified, relative abundance (catch per unit effort CPUE), CPUE along depth zones and length frequency distribution for the three loughs.

Glendalough: Fish population survey

Glendalough, Co. Wicklow

Lat:Long	52.912, 6.91	Maximum Depth:
	20/06/2005	
Survey Dates:	to	Volume: n/a
	21/06/2005	



Glendalough

Glendalough is a medium sized lough (40 ha) located at an altitude of 132 masl in County Wicklow.

Historical records of Arctic char

The only record for Arctic char in Glendalough is that mentioned by a contributor only identified as “P” in the Dublin Penny Journal in the year 1833 (Went 1945). It is assumed on account of its typology that this lough is Glendalough upper. The lough was gillnetted in 1985 by the Central Fisheries Board and resurveyed in 1989. No Arctic char were recorded on

either occasion (Bowman 1991). Igoe and Kelly-Quinn concluded that the population was probably extinct on account of acidification.

Results of ICCG fish surveys

A total of six benthic gill nets and one pelagic gill net were set on the evening of June 20th and lifted the following morning. The nets were set in a range of depths to get a depth profile of fish distribution in the lough; nets set at depths from 1.7m to 27.1m. The floating pelagic net was set over relatively deep water (32m deep). The total catch and catch per unit effort are presented in Table 2.

Table 2. Results of gill netting in June 2005. CPUE =catch per unit effort, i.e., average number of fish per net.

Survey results: Benthic nets (n=6)				
	Arctic char	Brown trout	Minnow	Eel
Number	0.0	61.0	14	0
CPUE	0.0	10.2	2.3	0

Survey results: Pelagic net (n=1)				
	Arctic char	Brown trout	Minnow	Eel
Number	0.0	33.0	0.0	0.0
CPUE	0.0	33.0	0.0	0.0

Brown trout were recorded in both the benthic and pelagic gill nets. No Arctic char were captured. The large numbers of brown trout taken in the pelagic net suggests that brown trout are taking advantage of this niche (pelagic zone) in the absence of Arctic char. Two trout were phenotypically similar to ferox trout. Genetic analysis of tissue samples from these fish should help determine if this is the case. Minnow were recorded in the shallower benthic nets. Minnow are a non-indigenous fish to Ireland and were at one time a popular angling bait with anglers. Although no eel were taken in the gill nets (gill nets are not designed to capture eel) evidence of eel activity was noted in the form of eel predation damage to entangled trout specimens in some of the benthic nets.

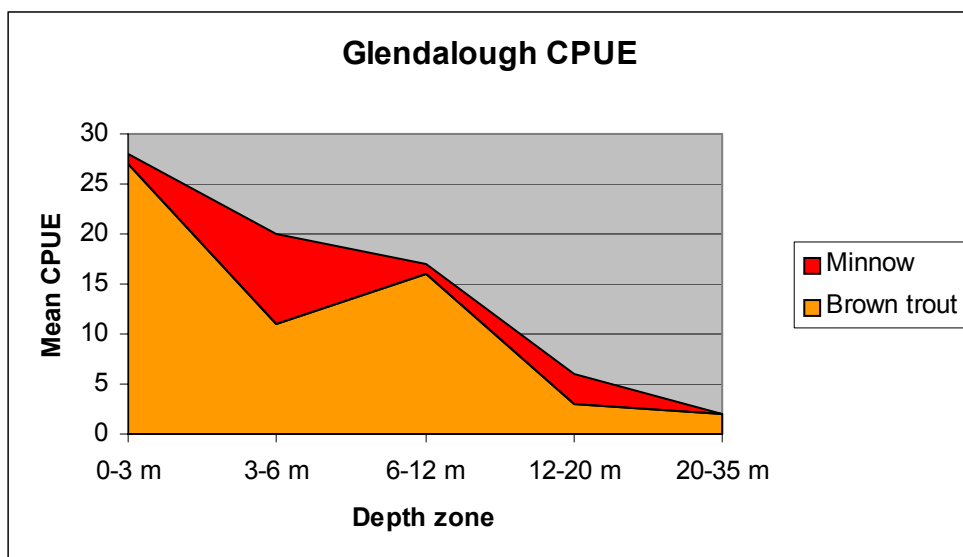


Fig. 1 The relative abundance of brown trout and minnow over the range of depth zones.

When the relative CPUE data is examined by depth zone it is apparent that the greatest concentrations of both trout and minnow occurred in the shallower depths. For brown trout 45% of the benthic population were in the 0-3m zone and 64% in water less than 6m deep. Minnow are generally considered to be a littoral species and 71% of minnow were taken in water less than 6m. Few fish were taken in the deeper water (>20m).

Table 3. Basic length statistics for fish recorded.

Lough	Species	n	Mean	Length (mm)	
				Min	Max
Glendalough	Brown trout	93	21.3	13.0	30.0
Glendalough	Minnow	11	6.4	4.0	7.1

Individual size of Arctic char was small. Trout lengths could be described as moderate and it is evident from the presence of larger individuals that there is a tendency towards piscivory (fish eating). Genetic analysis of tissue should determine whether these fish are closely related to the true ferox trout of Lough Melvin.

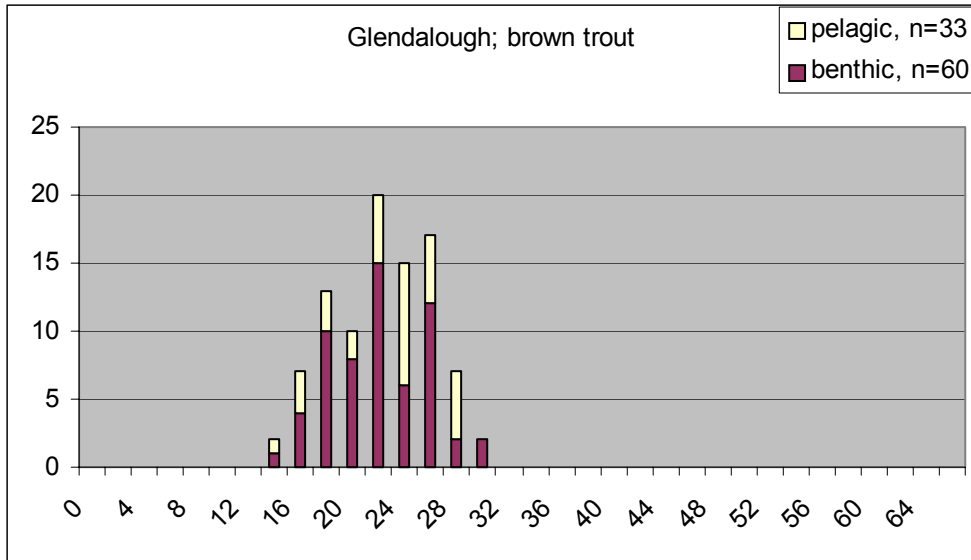


Fig. 2 Length frequency of brown trout caught Glendalough in the floating net (pelagic) and benthic nets.

Conclusion

It can be concluded with reasonable certainty that Arctic char are now extinct in Glendalough upper. The lough holds a large population of brown trout. Minnow and eel are also present. Brown trout were also noted in the pelagic zone in large numbers, which further supports the conclusion that Arctic char are now absent. The secci disk reading for this lough was considerably higher than recordings for Lough Dan and Lough Tay.

Lough Dan: Fish population survey

Lough Dan, Co. Wicklow

Lat:Long 52.971, 6.407 Maximum Depth: -.40 m
19/06/2004
Survey Dates: to Volume: N/A
20/06/2004



Lough Dan is a medium sized lough (140 ha) located at an altitude of 203 masl in County Wicklow. Flanagan and Toner (1975) describe the water chemistry in this lough as extremely soft with a high transparency, concluding that the lough was oligotrophic.

Historical records of Arctic char

Tate Regan (1909) classified specimens Arctic char he examined from Lough Dan to *Salvelinus obtusus* or the “blunt nosed char”, on account of morphometric and meristic features that set them apart from most other Irish populations. Records of char in Lough Dan date back to 1822, Went (1945). Samuel Lewis (1837) referred to the abundance of “bog trout, grey trout and char” in the lake. Went (1945) gave details of a 2+ year old female captured on 14/7/48. However, by the late 1980's it was apparent that the stocks were less

common than previously thought. Kieran O'Byrne, a student at Trinity College Dublin, spent one week setting nets of a combination of 2 and 2.5 cm (stretched mesh) nets in Spring, 1987. The nets were set in the deeper part of the lake where char were expected to reside at that time of year. But no char were captured. The last authenticated specimen was lodged in the Natural History Museum of Ireland in 1988 (Holmes pers. comm), although an angler Tom Sutcliffe is reported to have caught one in 1991 (Anon 1994).

In 1994 the Eastern Regional Fisheries Board set floating and sunken gill nets in May and October 1994. A small number of fyke nets were also set in shallow water in the month of October. A total of >1,900 metres of various mesh sizes were set (ranging from 25m to 110m). No char were taken although 361 brown trout were caught.

Nets were set again in 1996 in association with the Zoology Department, University College Dublin. Again no char were recorded (Igoe and Kelly-Quinn 2002). The head of a “char like” specimen was subsequently sent by an angler to UCD in 1997 for authentication. Examination of the vomerine teeth and dental plate showed that it was a trout, either a brown or possible a rainbow trout (Igoe and Kelly-Quinn 2002).

Results of ICCG fish surveys

A total of 9 benthic gill nets and one pelagic gill net were set in the evenings of June 18th and lifted the following mornings.

Table 4. Results of gill netting in June 2005. CPUE =catch per unit effort, i.e., average number of fish per net.

<u>Survey results: Benthic nets (n=9)</u>				
	Arctic char	Brown trout	Minnow	Eel
Number	0.0	95	4	0
CPUE	0.0	10.6	0.4	0

<u>Survey results: Pelagic net (n=1)</u>				
	Arctic char	Brown trout	Minnow	Eel
Number	0.0	75.0	0.0	0.0
CPUE	0.0	75.0	0.0	0.0

Brown trout were recorded in both the benthic and pelagic gill nets. No Arctic char were captured. As with Glendalough upper, the large numbers of brown trout taken in the pelagic net suggests that brown trout are taking advantage of this niche (pelagic zone) in the absence of Arctic char. One large trout phenotypically similar to ferox trout was taken. A tissue

sample was taken for genetic analysis. Previous surveys on the lough also noted the apparent presence of ferox trout. Minnow were also recorded in the shallower benthic nets. These were all of a similar size and therefore probably represent the one age class (Length range; 8.1cm to 8.9cm, n=4). The presence of minnow in feeder streams of Lough Dan has been known for some time (Kelly-Quinn, pers. comm.). Although no eel were taken in the gill nets (gill nets are not designed to capture eel) evidence of eel activity was noted in the form of eel predation damage to entangled trout specimens in some of the benthic nets.

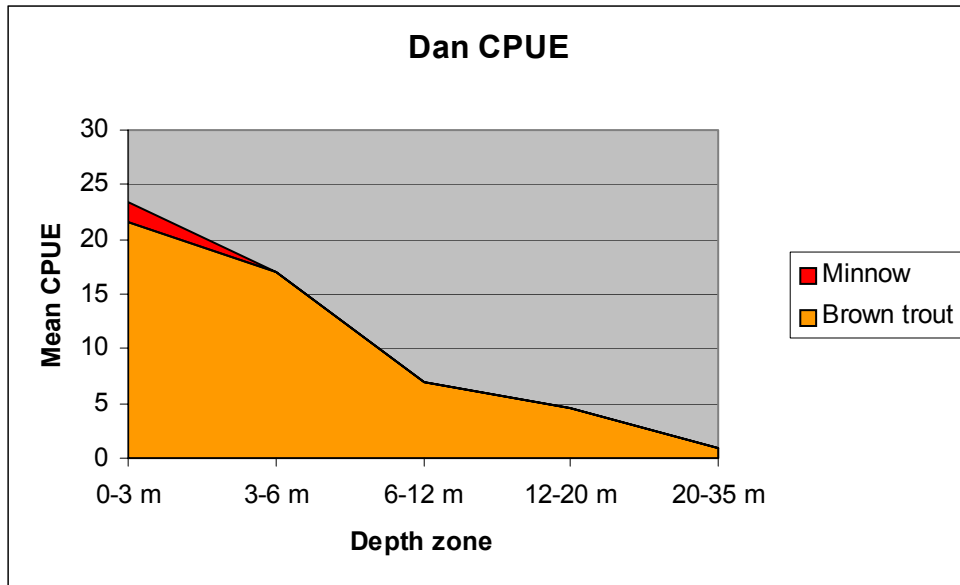


Fig. 3 The relative abundance of brown trout and minnow over the range of depth zones.

The greatest concentrations of both trout and minnow occurred in the shallower depths. For brown trout 42% of the benthic population were in the 0-3m zone and 75% in water less than 6m deep. All of the minnow were taken in water less than 3m. Only two trout were taken in the deeper water (>20m).

Table 5. Basic length statistics for fish recorded.

Lough	Species	n	Mean	Length (mm)	
				Min	Max
Dan	Brown trout	170	20.0	10.3	40.9
Dan	Minnow	4	8.5	8.1	8.9

Individual size of Arctic char was small. Trout lengths could be described as moderate and it is evident from the presence of larger individuals that there is a tendency towards piscivory

(fish eating). Genetic analysis of tissue should determine whether these fish are closely related to the true ferox trout of Lough Melvin.

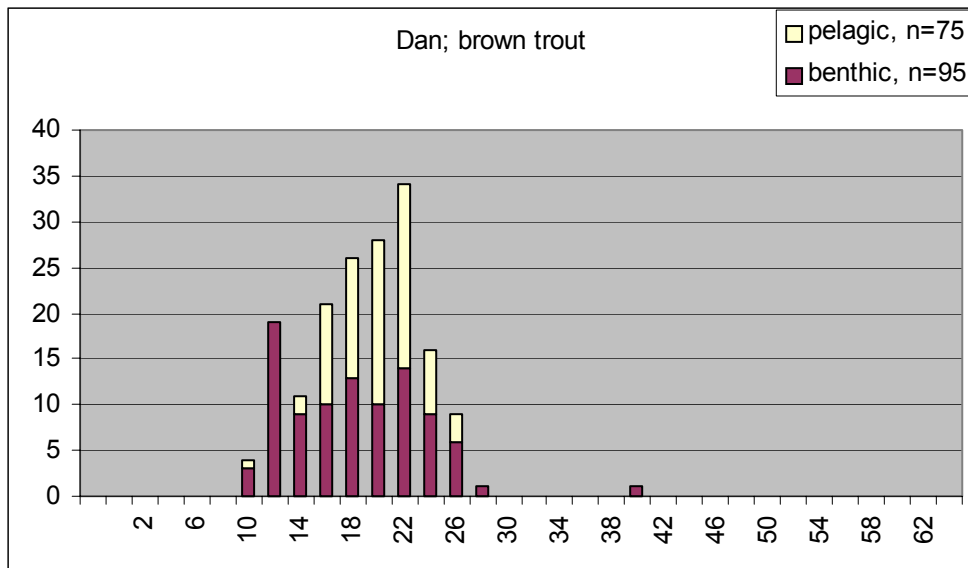


Fig. 4 Length frequency of brown trout caught in Lough Dan in the floating net (pelagic) and benthic nets.

Conclusion

It can be concluded with reasonable certainty that Arctic char are now extinct in Lough Dan. Evidence from the literature suggests that this population was substantial and was well known (e.g., Went 1945). As the last authenticated record was in 1988, clearly this extinction occurred very recently (Igoe and Kelly-Quinn 2002). The loughs still holds a large population of brown trout. Minnow and eel are also present. As with Lough Glendalough upper, brown trout were also noted in the pelagic zone in large numbers which further supports the conclusion that Arctic char are now absent.



Normal brown trout taken in the pelagic net in Lough Dan.

Lough Tay: Fish population survey

Lough Tay, Co. Wicklow

Lat:Long	53.009, 6.4	Maximum Depth:	-30 meters
	19/06/2004		
Survey Dates:	to	Volume:	N/A
	20/06/2004		



Lough Tay

Lough Tay is a small lough (50ha) located at an altitude of 250 masl in County Wicklow. It is a relatively deep lough for its size.

Previous fish records

Tate Regan (1909) assigned the generic name *Salvelinus obtusus* to char from Lough Luggula (i.e., Lough Tay). Went (1945) gives details of historic Arctic char records from Lough Tay. Went (1971) noted that there were no records of char in Lough Tay since the 1930's and two

surveys, one in 1984/85 (Walsh 1987) and the other in 1994 by the ERFB (Anon 1994) failed to record a single specimen.

Results of ICCG fish surveys

A total of 8 benthic gill nets and one pelagic gill net were set in the evenings of June 19th and lifted the following mornings.

Table 6. Results of gill netting in June 2005 survey. CPUE =catch per unit effort, i.e., average number of fish per net.

<u>Survey results: Benthic nets (n=8)</u>				
	<u>Arctic char</u>	<u>Brown trout</u>	<u>Minnow</u>	<u>Eel</u>
Number	0	76		
CPUE	0	9.5		

<u>Survey results: Pelagic net (n=1)</u>				
	<u>Arctic char</u>	<u>Brown trout</u>	<u>Minnow</u>	<u>Eel</u>
Number	0.0	28.0	0.0	0.0
CPUE	0.0	28.0	0.0	0.0

Brown trout were recorded in both the benthic and pelagic gill nets. No Arctic char were captured. As with the other two loughs, large numbers of brown trout taken in the pelagic net suggests that brown trout are taking advantage of this niche (pelagic zone) in the absence of Arctic char. No large brown trout were taken (largest specimen was only 25cm), suggesting that piscivory is absent or limited. No minnow were also recorded and there was no evidence of eel activity.

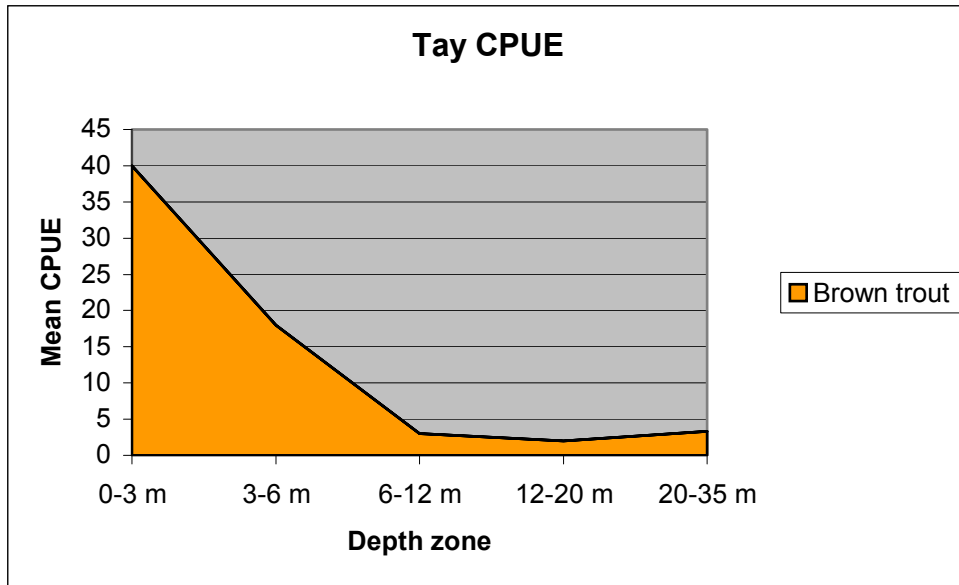


Fig. 5 The relative abundance of brown trout over the range of depth zones.

The greatest concentrations of trout occurred in the shallower depths. For brown trout 60% of the benthic population were in the 0-3m zone and 87% in water less than 6m deep. Ten trout were taken in the deeper water (>20m) which represents a greater proportion of trout in deep water relative to the other loughs sampled.

Table 7. Basic length statistics for fish recorded.

Lough	Species	n	Mean	Length (mm)	
				Min	Max
Tay	Brown trout	104	18.3	9.5	25.0

Individual size of brown trout was small. The absence of larger individuals suggests that piscivory is limited or absent. The absence of minnow as a stepping stone dietary species may partly explain the absence of large trout compared to the other two loughs, where minnow were available as a fodder fish.

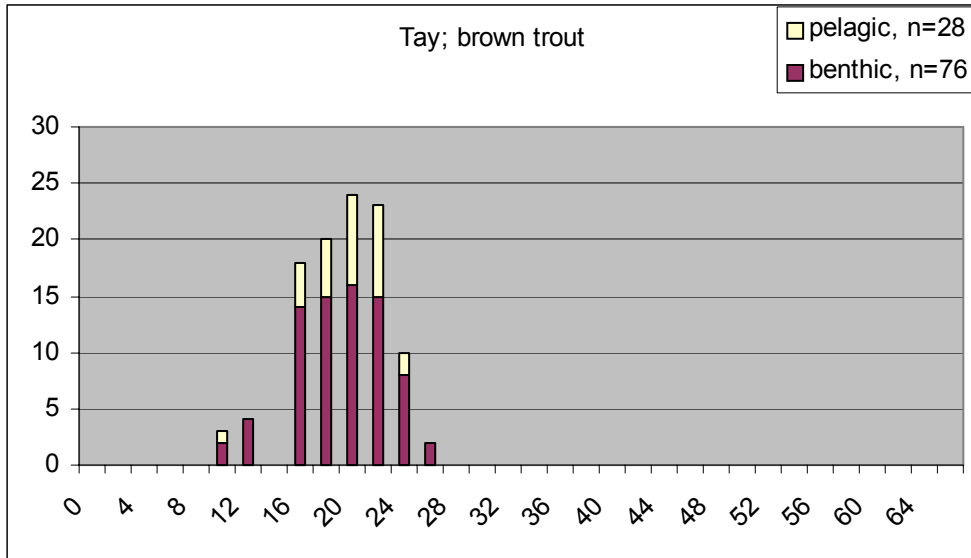


Fig. 8 Length frequency of brown trout caught Lough Tay in the floating net (pelagic) and benthic nets.

Conclusion

It can be concluded with reasonable certainty that Arctic char are now extinct in Lough Tay. The loughs still holds a large population of brown trout. The presence of neither minnow nor eel was apparent, although the latter may be present, albeit in small numbers. As with the other two lough, brown trout were also noted in the pelagic zone in large numbers which further supports the conclusion that Arctic char are now absent.

Summary findings of the report

- The surveys reported in this document were carried out in June 2005 and the data were collected by a recognized international standardized method of gillnetting suitable for salmonid communities (Appelberg 2000). These data can be compared to that collected for other Irish loughs (e.g., Table 8) and can be compared to findings from lakes surveyed, using the same protocol, in other countries.
- NO Arctic char were recorded in any of the loughs. This negative result is of concern as there is clear historical and physical evidence (museum specimens) that Arctic char existed in all three loughs. Furthermore Arctic char are known to have occurred in Lough Dan until the early 1990's.
- From table 8 it is clear that the densities of brown trout as expressed by catch per unit effort (CPUE) was very high in all three loughs and represent some of the highest CPUE values ever recorded in Ireland using these methods
- Brown trout resembling Ferox trout were recorded in both Loughs Dan and Glendalough Upper. It is unclear yet whether these are true Ferox trout and tissue samples have been taken for further examination.
- With the exception of the large “ferox” type trout the main population of trout were relatively small.
- It is likely that the brown trout are important “conservation units²” in their own right, as post glacial relicts characteristic of the east coast of Ireland and therefore important in the biodiversity context from that geographic area.



Brown trout with phenotypic characteristics of “ferox trout” taken in the Lough Dan survey.

² See Ferguson (2004) for more discussion on concepts surrounding “conservation units” in the context of Ireland’s biodiversity and their relative importance in wildlife management.

Table 7. Catch per unit effort for the three Wicklow loughs compared to other Irish loughs using the same survey protocol and gear type (Apperberg 2000, Hammar and Filipsson 1985).

Lough	Date	Trout CPUE	Arctic char CPUE	Salmon CPUE	Minnow CPUE	Stickleback CPUE	Eel CPUE
Dan	Jun-05	10.6	-	-	0.4	-	-
Tay	Jun-05	9.5	-	-	0.0	-	-
Glendalough upper	Jun-05	10.2	-	-	2.3	-	-
Anascaul	Apr-03	5.4	-	-	-	1.9	0.9
Caragh (April)	Apr-03	14.4	0.4	0.3	-	-	0.1
Accose	Apr-03	1.7	1.4	-	-	-	-
Bunaveela	Jul-01	4.63	-	1.75	-	-	-
Coumshingaun	Sep-01	7.29	-	0.00	-	-	-
Altan	Oct-04	4.9	-	3.0	-	-	-
Greenan	Oct-04	9.6	-	0.9	-	-	-
Keel	Oct-04	2.5	-	0.3	-	0.08	-
Salt	Oct-04	9.8	-	-	-	-	-
Reelin	Oct-04	4.6	-	-	-	-	-

What does the data collected mean?

The fish communities of these loughs contain relatively pristine examples of brown trout for the east coast of Ireland and the fish communities within, and they should be considered as important in the Irish biodiversity context, it is clear that the previous impacts on the loughs have driven the native Arctic char to extinction. The evidence for this is now very strong and it is desirable to consider a programme for their re-establishment.

This should entail a carefully planned programme, which follows the four steps outlined at the beginning of this report (page 8). The surveys and this report complete step one.

It is important that the recipient loughs have recovered from any impacts, that the donor stock is appropriate from a biodiversity context and that the stocking strategy follows a clear protocol. If not any restocking programme is likely to lead to failure.

However the re-establishment of Arctic char to Lough Tay, Dan and Glendalough is not only in the public interest and technically a fundamental requirement under the Water Framework Directive, but is also an ideal opportunity to engage the public and improve awareness on

biodiversity and environmental issues in Ireland. This can be achieved most effectively through a multi-agency/organisation approach.

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Adipose fin tissue samples from brown trout have been collected to facilitate genetic analysis and complete specimens have been frozen for further analysis in University College Dublin.

References

- Appelberg, M. (e.d.) 2000 Swedish standard methods for sampling freshwater fish with multi-mesh gillnets. *Stratified random sampling with Nordic multi-mesh gillnets provide reliable whole-lake estimates of the relative abundance and biomass of freshwater fish in temperate lakes*. Fiskeriverket Information (1) 27pp.
- Ferguson, A. 1985 *Lough Melvin: a unique fish community*. Dublin. Royal Dublin Society.
- Ferguson, A. 2004 The importance of identifying conservation units. Brown trout and pollan biodiversity in Ireland. In Irelands threatened freshwater fishes. *Biology and the Environment. Proceedings of the Royal Irish Academy*, Vol. 104B, No. 3, 33-41.
- Flanagan, P.J. and Toner, P.F. (1975) A preliminary survey of Irish lakes. An Foras Forbartha. Water Resources Division. Dublin.164p.
- Hammar, J. and Filipsson, O. 1985. Ecological test-fishing with the Lundgren gillnets of multiple mesh size: the Drottningholm technique modified for Newfoundland Arctic char populations. Report, Institute of Freshwater Research, Drottningholm 62: 12-35.
- Igoe, F. 2004 Ireland's Threatened Freshwater Fishes. In Irelands threatened freshwater fishes. *Biology and the Environment. Proceedings of the Royal Irish Academy*, Vol. 104B, No. 3, 1-3.

- Igoe, F. and J. Hammar 2004 The Arctic char *Salvelinus alpinus* (L.) species complex in Ireland: a secretive and threatened Ice Age relict. In Irelands threatened freshwater fishes. Biology and the Environment. Proceedings of the Royal Irish Academy, Vol. 104B, No. 3, 73-92.
- Igoe, F. and Kelly-Quinn, M.K. 2002 The char (*Salvelinus alpinus* L.) of Lough Dan: extinct? *The Irish Naturalists' Journal* **27**(1), 2–9.
- Johnson, L. (1980) The Arctic char *Salvelinus alpinus* (L.). In E.K. Balon (ed) Charrs; salmonid fishes of the genus *Salvelinus*. 15-98. The Hague. W. Junk Publishers.
- Lindstrom, T and Andersson, G. (1981) Population ecology of salmonid populations on the verge of extinction in acid environments. Institute of Freshwater Research, Drottningholm 59:81-96.
- Maitland (2000) Guide to Freshwater Fish of Britain and Europe. Hamlyn. London.
- Philips, R. & Rix, M. 1985
- Taylor, D, Leira, M., Dalton, C., Jordan, P., Irvine, K., Bennioon, H and Magee, E. (2005) Insight EPA ERTDI Project Number 2002-W-LS/7. Work Package (WP) 2. Months 7-20. Final report. Department of Geography, Trinity College Dublin.
- Thompson, W. 1856 *The Natural History of Ireland*. London. Reeve, Denham and Reeve.
- Went, A. E. J. (1945). "The distribution of Irish char (*Salvelinus* spp.)." Proc. Roy. Irish Acad. **50 B**(8): 167-189.
- Whilde, A. (1993). Threatened mammals, birds, amphibians and fish in Ireland. Irish red data book 2: Vertebrates, HMSO Belfast.