

Arctic Char, Prehistoric Life in our Lakes

Public lecture
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8.00 September 22nd, 2005

Wicklow Mountains National Park Education Centre

Intoduction

Arctic char are Ireland's most ancient freshwater fish species. They belong to the genus *Salvelinus* and are the only example of this genus native to Western Europe. Paleontologists believe they evolved as a separate species between 5 and 10 million years ago.

The history of Arctic char in Ireland dates back to the Glacial Maximum Extent of the last Ice age, at least 18,000 years ago and possibly further. During this cold period the Arctic char probably eked out an existence at the edge of glaciers or survived in one or more glacial refugia further out from what the sea delineates as mainland Ireland today. And unlike many of our other Ice Age fauna such as the giant Irish elk, the Arctic char are still with us today. Just as ancient monuments on our landscape remind us of our past, the Arctic char and some of our other native fish species are surviving examples of our wildlife from that cold period. In fact they were probably an important food source to our early ancestors.

Once widespread throughout Ireland, their distribution has declined in response to the rapid development of our living standards in recent history. So that today it appears that Ireland has lost at least 30% of all known populations. A combination of man made causal agents have been identified, including water pollution, non-native fish species introductions and acidification. Current trends in global warming will now pose even a further threat to their survival.

History of Arctic char in County Wicklow¹

It is known from the work of one of Ireland's best known fisheries scientists, Dr. Arthur Went, that Arctic char were present in at least three loughs in County

¹ For a more detailed early history of Arctic char in County Wicklow readers should check out the classic paper by Went (1945).

Wicklow, and those in Lough Dan and Tay (Luggala) were given separate taxonomic status by the earlier taxonomist Tate Regan. They were described as a separate species *Salvelinus obtusus* or “the blunt nosed char” on account of their stubby nose compared with other specimens he examined throughout the country. So lets take a look at each lough, beginning with Glendalough, then Lough Tay and finally with Lough Dan.

Glendalough (upper)

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 upper lake in Glendalough National Park which we will refer to as 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 (2002) concluded that the population was probably extinct on account of acidification.

Lough Dan

Tate Regan (1909) assigned the generic name *Salvelinus obtusus* to char from Lough Dan. 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 (21.1cm long) captured on 14/7/48 as follows “upper part of body dark with few pink spots above lateral line and more numerous spots below. Pectoral and pelvic fins tipped with scarlet. First fin rays of pelvic fin whitish”.

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

latter survey. In excess of 1,900m 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 (UCD). Again no char were recorded (Igoe and Kelly-Quinn 2002). In the autumn of 1996 an angler presented the head of a salmonid caught on Lough Dan to UCD as proof that Arctic char were still present in the lough, however examination of key meristics showed that it was in fact a trout (Igoe and Kelly-Quinn 2002).

Lough Tay

The first record of Arctic char in Lough Tay is by J. Coad in *The Angling Excursions of Gregory Greendrake* (1832). They are subsequently mentioned in the Dublin Penny Journal in 1832. 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.

Summary history of Arctic char of Arctic char in Co.Wicklow

So it would appear that the only record of Arctic char from Glendalough upper dates back to the early 1800's, but those for Lough Tay and Lough Dan are quiet recent. *Note that the last record for char in Lough Dan was only in 1988.* The absence of recent records and blanks in fishery surveys have led some, to the conclude that, the Arctic char may now be extinct in these three loughs. It is, however, difficult to prove the extinction of a species.

Eastern Regional Fisheries Board and the Irish Char Conservation Group

The Eastern Regional Fisheries Board (ERFB) has been concerned about the plight of Arctic char in Co. Wicklow for some time now, and fisheries inspector Jimmy O'Brien and his colleagues carried out two surveys in Lough Dan and one in Lough Tay as part of their investigations. The Irish Char Conservation Group (ICCG) have also flagged up the status of Arctic char in the Wicklow loughs as an issue requiring attention and published a paper with Dr. Mary Kelly-Quinn from UCD in 2002, in an effort to highlight the issue, and bring available information together. More recently

the ERFB contacted the ICCG with a view to carrying out a restocking programme of the Loughs and the ICCG presented a four point strategy which is as follows.

Strategy for the re-establishment of Arctic char to County Wicklow

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 but that lough conditions have recovered to the extent that re-establishment and survival of Arctic char is a real possibility, then consideration of a restocking programme is warranted. In order to translocate Arctic char to the Wicklow loughs it will be 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 given 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 the 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 a decision to be made on whether ova, fry or hatchery laid fingerlings be introduced. The Irish Char Conservation Group favour the former, provided suitable hatching substrata has been identified. This avoids disease and husbandry problems and allows for more natural development (imprinting etc) in the new habitat. Identification of suitable substrates etc could be done with the help of 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 following extinction meet with failure due to lack of preparation and failure to address the underlying cause of the extinction (J. Hammar, Institute of Freshwater Research, Drottningholm, Sweden, pers comm.).

Step 1: Determine if Arctic char are definitely extinct using the appropriate sampling gear.

The ICCG carried out fish surveys on the three loughs near the end of June this year to determine if the Arctic char were indeed extinct and to find out more about the fish populations in the loughs (Igoe *et al* 2005). Ron Greer and Kristina Lundy carried out the field work with the support of staff of the Wicklow Mountain National Park and Wildlife Service. Wicklow Mountain National Park and Wildlife Service and the Heritage Office of Wicklow Co. Council also provided financial assistance. The gear used is specific to Arctic char and brown trout and has been used very successfully in other Irish Loughs including the identification of five previously undocumented populations of Arctic char.

Results of the June 2005 survey

No Arctic char were captured in either the pelagic or benthic nets. Brown trout were present in very large numbers compared to other Irish loughs and their distribution through out the lough would appear to further support the absence of Arctic char. In Glendalough and Lough Dan there also appear to be “Ferox trout” or pisciverous trout present. These may or may not be analogous with the Lough Melvin Ferox, which should be recognised as a separate fish species (Ferguson 2004). We’ve take tissue samples from the trout captured during the Wicklow surveys for genetic analysis which should provide information on the true relationship of the brown trout in these loughs with those in other Irish loughs and to determine if true ferox are present. Nothing gets wasted and the fish samples will be further worked up in UCD by Dr. Mary Kelly Quinn and her colleagues. Non-native minnow were recorded in both Glendalough and Lough Dan. We can conclude with confidence from these survey results that the Arctic char are indeed extinct –this completes point one of the restoration strategy.

Step 2: The next stage is to understand why they became extinct and to determine if conditions are now right to restore the population.

The historical evidence for Glendalough indicates that, at least initially, pollution from the lead and zinc mines were was a serious problem in the lough (Murray 1999). I quote Wilde (1874) ‘streams of grey material from the mountains pour down the

mountain-sides, poisoning the lakes... and .. pouring down the river's brink have rested wherever a bed lay for their deposit". Later Dr. Declan Murray of UCD carried out paeleolimnological coring and discovered that there was also an acid pulse associated with forestry activity in the 1950's (Murray 1999). Recent coring on Loughs Tay and Dan also show changes in pH (Taylor et al 2005).

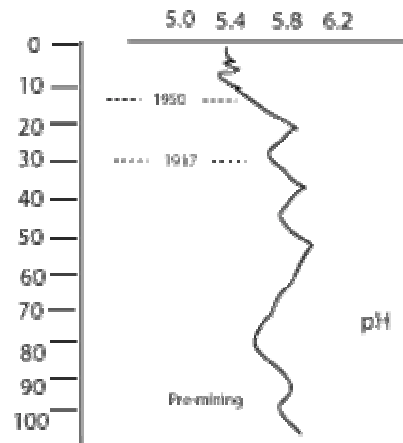


Fig. 1 Modified from Murray 1999 illustrating the fluctuations and drop in pH over time as inferred from the sediments. Drawing is schematic and readers are referred to Murray 1999 for more complete information

The Arctic char are very sensitive to low pH and unlike brown trout they cannot escape up streams to avoid periods of acid stress. The best empirical evidence pointing to acidification relates to work carried out by Dr. Mary Kelly Quinn in Lough Dan (Fig 2)

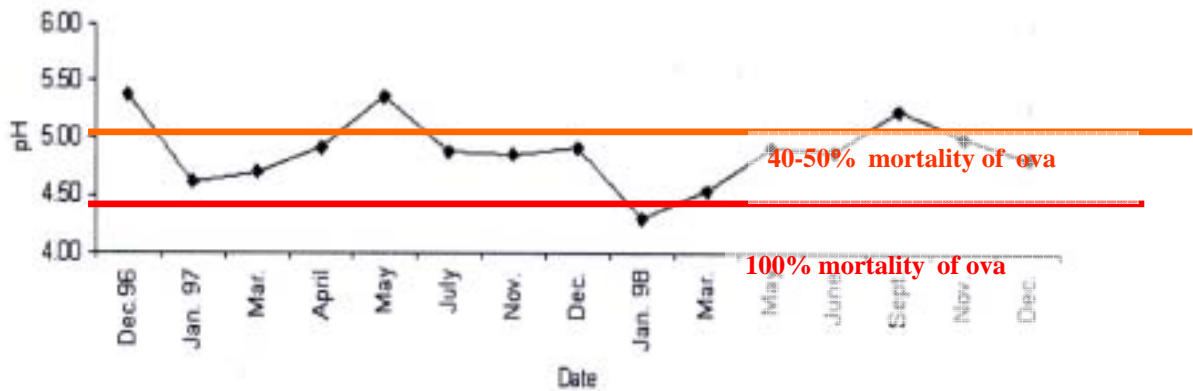


Figure 2. Variation in pH levels recorded in Lough Dan in 1996/1998.

Fig. 2 Extract from Igoe and Kelly-Quinn 2002 illustrating the pH fluctuations recorded monthly over a 2 year period, in the context of Arctic char ova sensitivity (Jago et al 2004).

Here we see a graph showing monthly pH values taken over a 2 year period from 1996 to 1998. The graph peaks during the summer (often a more comfortable time to sample!) but troughs during the winter period dropping to as low as 4.3. These lower values are lethal to Arctic char particularly the juvenile stages.

So the question now is, has the pH on any of the loughs recovered? I understand that environmental officer Donnachadh O'Byrne and his colleagues in the ERFB are collecting water samples to look at this issue and if the Ph is right then consideration may be made for restocking.

Step 3: Getting the appropriate brood stock.

Should it be determined that the lough conditions are ideal for the re-establishment of Arctic char, then the question of determination of the appropriate brood stock needs to be addressed. Regan (1908) assigned the char from both Lough Dan and Tay to *Salvalinus obtusus*. The other members were found in Lough Accose and the Killarney loughs. We know from ICCG investigations that these populations still survive today and we have already archived tissue from them. But now with modern genetic techniques it should be possible to compared DNA fro museum specimens to

get a proper match with the most appropriate surviving sample. Recent DNA work carried out by Dr. Paulo Prodöhl a geneticist with Queens University clearly shows that the char in Irish loughs are clearly different from each other and this could be due to genetic isolation or colonisation history or both. Therefore any proposed stocking would need to take this into account and appropriate genetic genealogical “detective work” should be carried out.



Arctic char (Blunt nosed char) from Muckcross Lough, Killarney, Co. Kerry.

Step 4: Stocking protocol and monitoring

Once the appropriate brood stock has been identified then a stocking strategy needs to be agreed. This will decide whether to stock in wild adult fish, strip wild fish and rear the young in a hatchery prior to stocking or strip wild fish and stock in the eggs directly. The ICCG favour the latter as it avoids the risk of introducing disease and is less costly. It also allows for natural imprinting of hatching young to a suitably selected spawning site. Probable former spawning sites would again need to be identified prior to stocking, the identification of which should be based on characterisations derived from Arctic char spawning bed data collected from other Irish loughs by the ICCG.

The development of the ova should then be monitored throughout their development and recruitment of the population over a 10 year period to ensure that the stocking strategy is a success.

Conclusion

The recent surveys by the ICCG show that the Arctic char are extinct from Glendalough, Lough Tay and Lough Dan. This is very regrettable as they represented the only known populations east of the River Shannon and in addition those from

Lough Tay and Lough Dan were recognised by the taxonomist Tate Regan as the “blunt nosed char” *Salvelinus obtusus*.

Clearly as the literature shows Arctic char were abundant in these loughs and easily caught by anglers. The population was particularly substantial in Lough Dan, which at one time was one of the best known Irish char loughs (Went 1945).

Acidification from a range of sources appears to have resulted in the conditions inimical to the survival of char in these loughs. However recent observations although tentative appear to show signs pointing to recovery (ERFB pers comm.) and therefore the possibility of re-establishment of Arctic char may now be a strong possibility, without out necessarily resorting to extreme measures such as liming of the water to increase the pH. The re-establishment of Arctic char would be a very desirable achievement from a biodiversity perspective and such a project is likely to generate public interest in biodiversity issues in the region. However any attempts to re-introduce must follow a logical framework such as that devised by the ICCG and outlined above, or is likely to fail. Either way the current EU Water Framework Directive requires member states to restore waters to good ecological status, which in effect means that the re-establishment of Arctic char in County Wicklow is a legal imperative for Ireland.

Acknowledgements

I would like to thank the following who have provided information and advice over the last few years on Arctic char and the issues that led to their extinction in Co. Wicklow. Alan McGurdy, Gretta Hannigan, Brian Beckett, Donnacha Byrne and Pat Doherty provided background material and comment over the years. Jimmy O’Brien who carried out the original surveys in the 1990’s and provided me with material on char not just from County Wicklow, but for other Irish loughs and a few laughs along the way. Thanks Jim. Mary-Kelly Quinn and colleagues provided information on the water chemistry of Lough Dan and advice on acidification and afforestation issues in the region. Dr. Jim Bowman of the Environmental Protection Agency also provided advice and comment on acidification and potential causes in the region. Dr. Declan Murray provided information on the paleolimnology and the Wilde (1872) reference. Ron Greer and Kristina Lundy carried out the field survey work in June 2005. Wesley Atkinson, Stewart Mc Grane, Paul Duffy and John Griffin of Wicklow Mountain

National Park assisted with logistics and with the field work. Access to Lough Dan was courtesy of Scouting Ireland and Lough Tay courtesy of Tom Clinton Estate Manager. Deirdre Burns of Wicklow Co. Council also provided support. Wicklow Mountain National Parks and the Heritage Office of Wicklow Co. Council provided financial support for the field work in June 2005. Finally to my colleagues in the Irish Char Conservation Group who provide continuing support and assistance. The research is not over as the genetic analysis of the brown trout has yet to be undertaken in Queens University Belfast and basic biological characteristics of the brown trout will be described by University College Dublin. For more information check out www.charr.org

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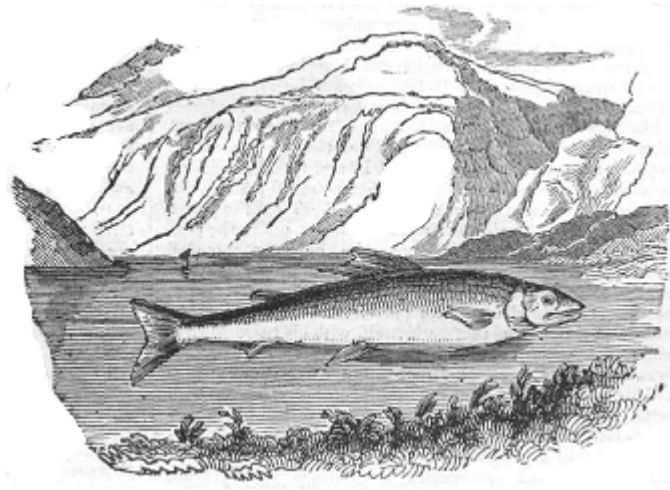
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[Extract from the *Dublin Penny Journal*, Vol. 1, No. 17, October 20, 1832]

The Char – or *Salmo Alpinus*²



Char, with View of Lough Dan.

"The char," says Sir Humphrey Davy, "is always in its colour a very brilliant fish, but in different countries there are many varieties in the tint." Those of the Wicklow lakes are of a bluish black on the back, and on the belly, silvery, with a slight tinge of red - the pectoral fins of a decided red.

The Irish Char Conservation Group are a voluntary not-for-profit organization dedicated to the promotion of conservation of Arctic char and other rare native freshwater fish species in Ireland, through development of practical conservation recommendations based on sound scientific research, partnership initiatives with NGO and state agencies and through the promotion of public awareness of the issues concerned. If you are interested in what we do please contact us at



info@charr.org or www.charr.org.

² Note Arctic char are now classified as *Salvelinus alpinus* and are no longer placed in the salmon genus.