THE NORTHERN PIKE

(Esox lucius)

PRESENT PAST & FUTURE

by

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A presentation to the Scientific Panel of Inland Fisheries Ireland
Dublin 13 September 2017

[PP1] Introduction

Good afternoon ladies and gentlemen. Firstly, thank-you to IFI for giving me this slot and secondly, apologies for any repetition of pike-data that some of you around this table may already be aware of. I'm Roderick O'Sullivan, I'm a retired dental surgeon and I use my Master of Science degree in Environmental Pollution on a pro-bono basis to campaign on environmental issues. I like to believe that my 1989 treatise exposing the environmental impacts of salmon farming was instrumental in keeping our Great Western lakes free of salmon farms. In 1995 I carried out Ireland's largest ever Irish water quality survey on an Irish lake – on L Corrib – and used my findings to successfully prosecute the Irish State in the EU Court for its failure to protect the lake's fish stocks. I'm here today because whatever scientific rationale existed in this pike debate has become distorted by entrenched views and vested interests. IFI claims all its future pike regulations will be based on scientific evidence, evidence that rests on two publications: a PhD financially and materially supported by IFI and a Survey of Irish Anglers' Preferences, also funded by IFI. I intend to question the scientific validity of both papers. My talk sequence will be (1) an historical overview of the pike in Western culture (2) in-depth analysis of IFI's two reports, (3) concluding with the current international and national ramifications of the pike's environmental footprint.

Pike Today

Anyone who fishes for or studies this magnificent fish quickly appreciates its resilience and adaptability. When it comes to describing it, I see it as a combination of a great white shark and a Panzer tank, fuelled by the pugnaciousness of a tyrannosaurus rex. **[PP 2]** The pike is one of nature's supreme predators.

It acclimatises to most aquatic conditions and while absent from parts of Norway and northern Scotland, separate races are present in Northern and Southern Europe, North America and Siberia. Little genetic variation exits between the different races and they survive in shallow or deep waterways from oligotrophic to eutrophic, fast flowing or sluggish. They tolerate brackish conditions, withstand wide variations in pH and unlike salmon and trout can survive in dissolved oxygen levels below 0.4 mg/l. The pike's sole requirement is the availability of prey.

Distant Past

The pike's morphology has remained virtually unchanged since it evolved 60 –> 80 million years ago during the Cretaceous Period. Whether the pike originated in the Northern hemisphere then entered N. America or visa versa is still debated but fossil evidence suggests pike inhabited N America for 30 –> 50 million years prior to entering European waters.

The earliest references **[Hoffman 1987]** to pike originate in Ancient Greece **[PP 3]** where historians Herodotus and Strabo both write of a pike-like fish called *oxyrinchus.* Aristotle also describes a *"lupus"* or wolf fish but all three depictions are too vague to provide positive identification. In 72 AD Pliny the Elder tells of a 1000 lb pike being hauled from the Rhine using chains but this was a fishy tale; the catch was a giant catfish, not a pike. We have to wait until the 4th century AD for the first definitive reference to a pike to appear in a Roman poem where it is identified as a *lucius* or "water wolf": and the author writes: *"The lucius' meat is not for the dining table, but sold in cheap shops smoking with its reeking stink." Lucius* was then a common man's-name in Rome, why it became associated with pike is unclear.

Post Christian Period [Hoffman 1987]

The Norse and Saxon languages supposedly coined the name *pike* because the fish's pointed body resembled that ancient weapon of war, the long pike. An 11th century Bavarian fairy-tale describes pike as *"wolves among fishes for they devour fish whenever they can catch them"* while a later Scandinavian poem lists pike as *"among the most harmful things created by the Devil to vex God."* In the early 12th century, English pike are described as *"aquatic wolves,"* while in France, technical references to the farming of pike in large ponds became widespread. To increase the weight of larger fish, pike were utilised in carp farming to kill off the smaller carp on the farm. In the 13th century, King Philip of France established gear restrictions, closed seasons and size limits for pike. Chaucer alludes to pike being reared in 14th century English ponds **[Canterbury Tales 1997]** while shops sold fresh, salted, pickled and dried pike. Pike was served in hospitals, convents and orphanages and by the 16th century, the first scientific treatise on pike was published by the Swiss author, Kondad Von Gesser, the father of modern zoology. He describes the pike as delicious, claiming that pike ashes relieved pain "in shameful places." Asserting that the pike is "a wolf" he describes how its sandpaper-like tongue allows the pike to turn fish around to be swallowed **[PP 4]** head first while its backward angled teeth ensure that once caught, prey rarely escape. The first English book on fishing, **[William Samuel 1577]** describes pike as "freshwater wolves" while perhaps the most famous book on fishing **[Walton 1654]** notes, *"The salmon is king of freshwater, pike is the tyrant".* The pike was finally classified as *Esox lucius* by the Swedish biologist Linnaeus in 1785. **[PP 5]**

Pike in Ireland

In Ireland, the historical record of pike is particularly sketchy. Whereas alphabetical writing had been in use for almost 3000 years, Ireland's earliest written language – Primitive Irish – appears as late as the 4th century AD as Ogham where no reference to pike appears. By the 6th century Ogham had evolved into Old Irish which was spoken up to the 10th century and Old Irish does not have a word for pike. Neither does Middle-Irish which was spoken from the 10th to the 12th century. The earliest written reference to pike – in Latin – chronicles, its absence in 12th century Ireland **[Went 1957]** while the earliest reference to its presence in Ireland is recorded in the 16thcentury. Coincidental with the pike's arrival, the majority of Ireland's freshwater fish species were imported from England during this epoch; carp and tench in the early 17th century; bream, gudgeon, minnow, loach and rudd a little later; roach in 1889. Much of rural Ireland had no Gaelic word for the pike while in other vicinities it was described as the "gaill-iasc" or fish-of-the-foreigner. So all available historical, linguistic and oral evidence indicate that pike were unknown in Ireland prior to the 15th Century and by the late 17th century were still absent from Ulster, much of Connaught and most of Munster.

Ms PEDRESCHI's (MP) Paper

Prior to my analysis of MP's paper, it is important to appreciate that distinguishing between native and non-native varieties of many species within the British Isles has always proved problematic. These are generally categorised into four main divisions **[PP 6]** and until MP's publication, it was accepted that pike was non-native to Ireland, a consensus previously shared by all Fishery Boards in Ireland. On genetic information gleaned from comparing Irish, British and Continental pike samples, MP makes two hypotheses. (1) Pike swam across to Ireland at the end of the Ice Age hence their descendants should be categorised as native; (2) all pike descendants from the human introduction of pike from 16th century Britain be regarded as non-native. Whereas MP's interesting and well-presented paper introduces some novel theories, it is blighted by three major flaws.

(1) First Major Flaw: Insufficient Sample Size [PP 7]

MP compared pike genetic data from 15 Irish sites to those in Britain and the Continent of Europe. However, her

Irish Samples: involved mainly sites from Leinster and the Great Western lakes and only one from Munster. No pike from Ulster or Northern Ireland were included therefore her analyses was not an All-Ireland study but one involving the Republic of Ireland only.

British Samples: All her sites are English, not British as she claims; no pike from Scotland or Wales are included. Of the four English sites, she rejected a quarter from her analysis – those from the Leven Canal in Yorkshire. Was this puzzling exclusion based on the likelihood that east of England samples would prove unlikely to be related to Irish pike?

Continental Samples: MP next excluded 40% of her five "Continental" sites, those from the Danube and Baltic, claiming that these samples were *"unlikely to be the direct source of Irish pike populations."* Her coming to another premature conclusion without prior evaluation of genetic evidence is not proper scientific procedure. Her rejection of so many sites reduced her Continental sampling range to two from Germany, one from France. A mere three English and three Franco-German sites are insufficient to assess valid pan-European genetic similarities or to produce credible scientific comparisons with the fifteen Republic sites.

(2) Second Major Flaw: Incorrect Glacial Chronology

After the melting of the last British-Irish Ice Sheet no land corridor existed between Continental Europe and Ireland so MP's pike would have had to swim 55 miles from Britain across the Irish Sea. If swimming from MP's nearest sampling point (L Windermere) the distance involved would have been 150 miles. Because the pike cannot tolerate seawater, MP conjectures that melting ice must have somehow provided a layer of freshwater for her pike to cross the sea. She further speculates that Irish and British pike populations became separate entities when *"the Irish Sea assumed its contemporary marine nature between 3500 and 4000 years ago."* This is simply incorrect as is shown by the latest findings on the chronology of the melting of the melting of the British-Irish Ice Sheet **[Clark 2010] [Brooks 2007]**. The first series of three pictograms **[PP 8]** indicate the ice-cover retreating from 25,000 BC –> 17,000 BC –> 16,000BC; the second series **[PP 9]** the more rapid retreat from 15,000 –> 14,000 –> 13,000 BC. The final picture shows how all intervening ice had melted and that the Irish Sea was a fully saline maritime entity by 13,000 BC and NOT 3500 BC as MP claimed. Core sampling also shows that unlike the North Sea and the English Channel, the Irish Sea was never brackish, was always impassable to freshwater fish hence pike could not have swum from Britain. If such a journey was feasible then surely pike would have been accompanied by other freshwater species from England?

(3) **Third Major Flaw: Lack of Archaeological Evidence**
Whereas genetic information is a helpful tool in historical analyses, archaeology plays an even more important role. **The Mesolithic Period** covers 10,000 BC to 5000 BC and according to MP's various scenarios, her first wave of pike occurred c 8000 BC. Ireland's earliest hunter/gatherer colonisers arrived c 7000 BC **[Cronin 2005]** so, prior to these newcomers, pike would have had over a thousand years to spread and propagate. Such easily trapped fish would have formed a substantial part of the colonisers' diet as it did for settlers elsewhere in Europe e.g. in Denmark, the bones of pike are commonplace throughout Mesolithic settlements - in the Svaerberg site, of the 1013 identifiable fish bones found, 99% were pike **[Fischer 2015]**. A similar abundance of pike bones have been unearthed from sites in Poland **[Zalinska-Kunek 2016]** and Germany **[Robson 2016]**, demonstrating that pike were eaten on a very regular basis. The same picture emerges from the numerous bog settlements excavated throughout Central Russia - all show a preponderance of pike bones **[Zhiliv 2014]**. England is no different; of the c200 Mesolithic sites investigated, pike remnants are commonplace throughout all **[Serjeantson 2011]**. The earliest pike remains in England (Norfolk) were over half a million years old while the first record of *any* live fish transportation into Britain was that of the common carp into southwest England by monks in the 15th century **[Lever 1997]**.
In Ireland the two most thoroughly investigated Mesolithic sites are Mt Sandel on the River Bann and L. Boora on the Shannon **[PP 10]** **[Woodmark 2015]**. Whereas these sites display marked dissimilarities in the number of fish bones from different species, neither contained any pike remnants. The following prehistoric sites were similarly investigated:
(1) Derragh (Meath/Cavan border)
(2) Clowanstown (Co Meath)
(3) Belderg (Co Mayo)
(4) Spenser Dock (Dublin)
No traces of pike were found in any.

Ireland's Early Medieval Period [400 AD –> 1000 AD]
During this epoch, Ireland's numerous lakes supported crannógs. **[PP 11]** These single or communal groupings of wooden dwellings were constructed on stilts and driven into a lake floor. They were usually connected to the mainland via a gangplank or primitive walkway and were in use from 3200 BC until the coming of the Normans in 1069 perhaps even later. Large numbers of rural dwellers used these structures, especially in Ulster and Connaught which allowed them easy access to fishing. **[PP 12]** Numerous middens, which are ancient rubbish dumps, have also been forensically examined yet neither crannóg **[Ulster Archaeology 1955]** **[Murphy 2007]** **[Brady & O'Connor 2010]** nor midden has produced a single pike bone despite the presence of **[PP 13]** many other species **[Edwards 2004]**.
To conclude, pike remnants are commonplace throughout virtually every site in Britain, Continental Europe and Russia yet no pike remains prior to the 13/14th century AD have been found <u>anywhere</u> in Ireland. **[PP 14]**

ANGLERS' SURVEY

Prior to my assessment of the Anglers' Preferences Survey, a quick personal anecdote about surveys. Ten years ago I was invited by a marketing company to be part of a 10-man panel of London dentists to assess an unspecified new dental product. The pleasant 45 minute meeting took place in a West-End hotel, food with drink laid on and all we had to do was answer a series of very straightforward questions i.e.;
Would we, as dentists recommend a product that helped fight tooth decay – yes we would!
Would we recommend a product that fought gum disease and reduced sensitivity – of course we would! Etc, etc
For participating, we each received £50 plus an electric toothbrush and three months later, lo-and-behold a brand new de-sensitising toothpaste appeared on radio and TV with the punch-line – **Nine Out of Ten Dentists Recommend SENSODYNE!** We had been duped into endorsing a product we had never seen nor even knew existed; we weren't to know that the questions we had been asked dictated the answers. So when it comes to surveys, it's helpful to know who's funding the exercise and why.
Before analysing Mr Curtis' paper I'd like to state that I am associated with both sides of the fishing divide having happily fished for both trout and pike for many years. **[PP 15]**
The rational of Mr Curtis' paper was "to examine anglers' preferences towards active stock management of pike within wild brown trout fisheries in Ireland."
The paper contains the following major flaws:
(1) **MAJOR FLAW No1: [PP 16]**
Considering this was a survey of Irish fishermen concerning an Irish problem, Mr Curtis' inclusion of so many European fishermen was puzzling. Would not their lack of English as a mother tongue and being unfamiliar with Ireland's geography render them ill-equipped to provide accurate answers? Would a corresponding angling survey in Poland, the Czech Republic or Germany specifically seek the participation of Irish anglers?
(3) MAJOR FLAW No 3 Unreliable Results [PP 18]
(4) MAJOR FLAW No 4 [PP 19]
Fishermen are unlikely ever to be confronted by such unanswerable, loaded questions:
Q 1: This subjective question cannot be provided with an objective answer. Rather like asking somebody are they a good listener or a good lover.
Q.2: Of course the answer will be yes every time – who likes staring into filthy water?
Q.3: Most participants would not have had any knowledge or experience of *lagarosiphon* so Mr Curtis obligingly showed them film-clips of IFI removing this weed from L Corrib using the herbicide, dichlobenil. However, Mr Curtis neglected to inform his audience about this compound's history: **[PP 20]**
To surmount the international ban, the Minister of Agriculture issued his personal "derogation" to use dichlobenil. Using a FOI request, I asked what tonnages of dichlobenil had been used on L Corrib and IFI sent me a black and white photograph displaying a small stack of herbicide, sufficient to clean two municipal swimming pools. No covering letter; no text; no written information.
So, returning to Mr Curtis' complex 5-part *lagarosiphon* question, without being given full background information, providing valid answers would have been impossible. **[PP 21]**

Esox lucius

Whereas **[PP 22]** the pike has punched through history with the indestructibility of a Panzer tank, it's time to review the other aspects of this fish's make-up. Pike grow rapidly, reaching 15 cm by their first year and undergo bursts of hunting energy. When reaching 70 cm, they turn to eating larger fish, tending to consume as much prey as possible within short time spans, hence their particularly fast growth rates. They cannibalise their own species when food becomes scarce or whenever their growth rate decelerates. While varying with (1) water temperature and (2) metabolic rate, the pike's food conversion ratio (FCR) is 5:1 i.e. a pike must eat five kilos of fish to increase its weight by one kilo. [**Johnston 1978**] In Canada, adult pike annually eat an average of 45 kgs of fish (species unspecified) **[Casselman & Lewis 1995]**. Data from L. Corrib show than the average pike (56.7 cm) consumes 18 kgs of trout annually **[O'Grady 1995**]. Pike predation on the Karet River (flowing into Russia's White Sea) accounts for 35% of all Atlantic salmon while up to fifty percent of Baltic salmon are similarly depleted by pike predation in other rivers **[Larson 1985] [Petrozvanski 1988].** On the Pjhajoki River in Finland, 29% of released salmon smolts were eaten by pike in one week **[Kekalainen 2007]** while In Sweden, a countrywide survey of 1029 lakes concluded that in smaller lakes, the introduction of pike inevitably leads to the eradication of all brown trout **[Spens 2008]**.

Pike are an easy species to introduce and whereas desirability as a sport fish is the main reason for this, their speed of colonisation is rapid as is exemplified by what has occurred in **[PP 23]** North America:

(1) In 1881 native pike were only present around the Great Lakes and parts of Alaska (marked in brown) with three pike introductions in the Appalachian Mountains. (Pike introductions are marked in red) **[PP 24]**

(2) By 1917 nine invasions had taken place in the west and east, a situation that remained fairly static due to two World Wars. **[PP 25]**.

(3) The 60's **[PP 26]** saw an increased spread westward.

(4) In 1972 **[PP 27]** by the first invasion of non-native pike into Alaska.

(5) Today **[PP 28]** pike are regarded as an invasive nuisance species throughout much of the US especially where salmonids are affected and these invasions require increasingly large sums to be spent annually on complex pike-management programmes.

The two States most affected are Alaska and California. Alaska's situation is compounded by pike being native to the north and west of the State; elsewhere in the country it is regarded with dread and apprehension. **[PP 29] [Management Plan 2006]** The Alaskan Fish & Game Dept. declare, "Pike are the greatest threat to the diversity and abundance of all native species in Alaska." [**Dunker** 2009] In California it is illegal to possess a dead pike or a live pike. **[California 2009]** On one Californian lake, $16 million has already been spent on pike eradication **[New York Times 2007]**. Although the map does not show pike infestation in Canada, the Provinces of British Columbia, Manitoba, Yukon, Alberta and Saskatchewan state, "Pike are a long-term disaster to our native fisheries."

The Irish Experience

In 2008, pike were deliberately introduced into an Irish river, the Owenriff River **[PP 30]** in Co Galway. For 13,000 years, pike, being unable to jump rapids, had been unable to gain access to the river's upper reaches due to an impassable waterfall outside the town of Oughterard. **[PP 31]**

This 15 km-long river, rises in Connemara and flows through wild sparsely populated countryside with low agricultural activity. Other than the recent placement of multiple wind

farms in the uplands, no other industry is present. Where utilised, the land is principally given over to sheep rearing, turf cutting and Sitka spruce plantations. Water quality is excellent throughout the catchment; all watercourses are graded as oligotrophic **[A Study of the Owenriff River 2007]**. It was never a major salmon-angling waterway nor had it a large resident-trout population but the river is the annual spawning destination for 25,000 brown trout from L Corrib and for 6% of the lake's salmon **[Personal Communication 2017]**. The Owenriff also contained a sizeable population of minnow and eel. After nine years of unchecked predation, pike have either displaced or eradicated much of the catchment's unique aquatic life. **[PP 32]**

Trout

The latest electro-fishing assessment [2017] of the Owenriff system **[IFI report 2017]** located only one trout hence it must be assumed that virtually ALL resident trout have been consumed along with all minnow and eel. Increased carnage annually takes place at spawning time when thousands of defenceless brown trout move upwards from L Corrib to breed amid the lakes and tributaries. Should some succeed in producing eggs and engender fry, the fledging trout make easy pike-meals. **[PP 33]** Heavy pike are regularly hooked throughout the system, their size far in excess of that expected from small, historically unproductive lakes. A female pike lays between 25,000 –>250,000 eggs; large females can produce 600,000 eggs. An Owenriff trout lay 3000 eggs, a salmon 1500 –> 8000, so its far greater number of eggs provide the pike with another evolutionary advantage over the salmonids.

Adult Salmon **[PP 34]**

These fish are now under serious threat of extinction on the river. 78% of the Owenriff's resident fish were salmon **[Catchment Survey 2008]** and prior to the introduction of pike, salmon stocks were particularly healthy; **[PP 35]** in a two-day stock analysis, over a hundred salmon were counted in one stretch, a ten-fold increase on previous years. Shoals of pike await the salmon returning from their feeding grounds in the Norwegian Sea. Salmon that survive the initial ambushes will be tracked by the pike which find even easier pickings at the spawning beds among exhausted male salmon, post-spawned females and their unprotected eggs. This is typified in the next slide **[PP 36]** which shows a freshly caught 12 lb pike with a fish tail visible in its gullet. On removal, the partially digested fish was identified as a small salmon, weighing four pounds.

[PP 37]

Juvenile Salmon

Attempting to return to sea, the juvenile salmon have no natural defence against pike and few are likely to come through. Global data attests to pike consumption of salmon being high relative to salmon numbers – even in low-salmonid abundance ecosystems. **[PP 38]** In a single Alaskan stream, 600 juvenile salmon were found in pike stomachs; some pike had consumed in excess of twenty young salmon **[Sepulveda 2013]** **[PP 39]**

[PP 40]

Freshwater Pearl Mussels

These remarkable creatures are capable of producing pearls. Some historians claim that the presence of so many pearl-producing mussel-farms in Ancient Britain was one of the reasons Julius Caesar invaded in 55 BC. The mussel requires pristine freshwater conditions to survive and although once plentiful throughout Europe, Russia and North America, today it is threatened with extinction. Ireland holds 46% of Europe's mussel populations, the majority lie within the Owenriff. The eradication of Owenriff's salmon directly threatens the

future of the FPM because it needs the salmon to complete its life cycle. **[PP 41]** Reproduction is particularly perilous for the FPM. When they release their tiny larvae called *glochidia,* 99.9996% of these tiny creatures die yet remarkably, some survive to be inhaled into the gills of passing salmonids. Of these a further 80 –> 95% perish. Those that have survived within the salmon gills eventually drop off, burrow into the river bed where they remain buried for six years before emerging. **[PP 42]**

The Otter [PP 43]

This animal's main diet is also salmon hence the key to its survival is maintaining a healthy population of these fish. Anecdotal evidence suggest a healthy population of otters previously inhabited the Owenriff catchment, no recent sightings have been reported. The EU safeguards these animals with specials laws and has designated Special Areas of Conservation [SACs] for their protection. **[PP 44]** Despite the Owenriff catchment being included in two such SACs: **Connemara Bog Complex Special Area of Conservation (002034)** and the **L Corrib Special Area of Conservation (000297)** otters are now absent.

Even bird-life has been seriously affected. Once common aquatic species such as mallard, water-hen, mute swan and dabchick are now absent from the catchment **[PP 45]** because waterfowl are part of the pike's diet, small **[PP 46]** or large**.** Although sometimes the pike bites off more than it can chew! **[PP 47]**

Legal Protection

What is so disturbing about the widespread of wildlife is that three of the creatures I have highlighted – the Salmon, FPM and the Otter are each individually protected by specific Irish, EU and International laws **[PP 48]** <u>In theory!</u> In practice, the overseeing Irish Authorities i.e. **Inland Fisheries Ireland** and the **National Parks and Wildlife Service** have remained inactive in the fulfilling their statutory protective duties. Other than suggesting holding pike-fishing competitions on the Owenriff, IFI have taken neither remedial nor interceptive action since 2008. A quarter of the 300,000 euros lavished on Mr Curtis for his Anglers' Survey would by now have saved much of the river's wildlife from destruction. Because of this neglect of the Owenriff River, I have submitted a Formal Complaint to the EU authorities in Brussels.

[PP 49] The desecration and destruction of the Owenriff River is a typical example of what happens when pike invade trout and salmon waters.

CONCLUSION

In October 2013 IFI announced that "new scientific breakthroughs" <u>proved</u> that pike were native to Ireland. Without explaining how the average fishermen would recognise differences between native and introduced pike, IFI further claimed that the pike's unsavoury reputation was due to flawed studies rather the pike's own nature. These claims were wildly inaccurate. A satisfactory resolution to this pike conundrum will only be achieved by cold clinical appraisal of facts not by attempting to polarise public opinion towards either admiration or condemnation of this magnificent fish. Unlike many European countries, Ireland does not enjoy an abundance of wildlife and a sizeable percentage of the creatures we do possess face increasing threats to their survival. The unique geographical and meteorological conditions that are responsible for our major brown trout waterways cannot be replicated elsewhere in Europe. High summer temperatures create stratification on Continental lakes, producing warm upper and deoxygenated lower water-layers which repel salmon and trout. On the other hand, Atlantic wind and rain constantly oxygenate our waterways and temperatures rarely remain high, thereby attracting trout and salmon.

Allowing pike uninterrupted access into these waters will not alone lead to their degradation but will massively infringe EU Habitat Directives, violate salmonid-protection laws and be at variance with global salmonid-protective policies. Pike are not under serious threat anywhere in Ireland; salmon and trout are, hence only pike fishermen and upper echelons of IFI will benefit from proposed politico-financial changes in pike regulation. Salmonids are doomed if IFI allows pike to roam freely through our wild fisheries - this is not intended nor is it - an alarmist statement. Neither is time on the side of these fish. In common with the majority of the Irish public, I've always regarded IFI and its skilled staff as the only State agency capable of protecting our threatened aquatic environment. I urge caution that IFI does not lose that well-earned respect or that of the majority of Ireland's fisher-folk and that this august organisation contemplates long and hard before making decisions that will have irreversible environmental repercussions in the future.
Thank you for your attention.

REFERENCES

A Study of the Chemistry & Flows of the Owenfiff River. Dept. of Earth & Ocean Sciences (EOS) NUI **2007**

Brady N & O'Connor K: *The Later Medieval Use of Crannogs in Ireland.* Pamatky Archeologicke Supplementum 17 Ruralia V p 127 – 136 **2010**

Brooks A et al: *Postglacial relative sea-level observations from Ireland and their role in glacial rebound modelling.* Journal of Quaternary Science (2008) 175 – 192 Wiley InterScience **2007**

California Department of Game & Fisheries: *Lake Davis Pike Eradication Project.* Draft EIS/EIR http://www.dfg.ca.gov/northernpoke/EIS-EIR/index.html **2009**

Casselman J & Lewis C: *Age growth and environmental requirements of pike*. In Pike Biology and Exploitation eds Craig J. Chapman & Hale London 69 – 101. **1995**

Canterbury Tales: l 353 Prologue. Penguin Classics London **1997**

Catchment Wide Fish Survey For The Owenriff River. Western Fisheries Board. Galway**. 2008**

Clark C et al: *Pattern & Timing of retreat of the last British-Irish Ice Sheet*. Quaternary Science Reviews Elsevier **2010**

Cronin D: *A New History of Prehistoric & Early Ireland*. OUP **2005**

Dunker K: *Pike control in South Central Alaska*. Alaska Dept. of Fish & Game Anchorage. **2009**

Edwards N: *The Archaeology of Early Medieval Ireland* Routlidge **2004**

Fischer A: *Coastal Fishing in Stone Age Denmark – Evidence from Below and Above.* In the Oxford Handbook of Neolithic Europe, eds Fowler C et al. OUP **2015**

Hoffman R: *Proto-history of Pike in Western Culture.* University of Toronto Press **1987**

IFI unpublished report **2017**

Kekalainen J et al: *Pike predation on hatchery-released Atlantic salmon in a Northern Baltic River.* Ecology of Freshwater Fish. University of East Finland. DOI. **10/1111/j.1600.2007.00263.x**

Johnston L: *Experimental determination of food consumption of pike for growth and maintenance.* Journal of Fisheries Research Board of Canada 23: 1497 – 1505**. 1978**

Lever C: *Naturalised Animals of the British Isles.* Hutchison. London **1997**

Larson K: *The food of northern pike.* Medd.Damn. Fisheri-og. Havunders (Ny-Ser) 271 – 326 **1985**

4

Management Plan for Invasive Northern Pike in Alaska. South Central Alaskan Northern Pike Control Committee. Anchorage **2006**

Moorkens E: *Freshwater Pearl Mussel.* Owenriff Sub-Basin Management Plan. Dublin. **2010**

Moorkens E: "*Conservation Management of the Freshwater Pearl Mussel.* Irish Wildlife Manual. No 8. Heritage Service. Dublin. **1999**

Moorkens E: *"Addressing the conservation and rehabilitation of the Margaritafera populations in the Republic of Ireland within the framework of the Habitats and species Directive."* Journal of Conchology **40**. 339 – 350. **2010**

Murphy E et al: *Environmental Archaeology in Ireland.* Oxbow Books **2007**

New York Times, Sept 12 **2007**

North America: 2017
https://nas.er.usgs.gov/queries/SpeciesAnimatedMap.aspx?speciesID=676

O'Grady M*: The necessity of pike culling in managing Irelands' premier salmonid lake fisheries.* Central Fisheries Board Dublin **1995**

Personal Communication. Inland Fisheries Ireland. Dublin. **2017**

Petrozvanski V et al: *Some ecological characteristics of Northern Pike on the Karet, a salmon river in the White Sea.* Journal of Ichthyology of Canada. Vol 8: 136 – 140. **1988**

Robson H: *Identification and interpretation of Fish Remnants at Friestack 4.* University of York **2016**

Sepulveda A et al: *Introduced Northern Pike predation on salmonids in SC Alaska.* Ecol. Freshwater Fish 22. 268 – 279. **2013**

Serjeantson D: *Review of Animal Remains from the Neolithic & Early Bronze Age of Southern Britain.* English Heritage Research Dept. Report Series 29 -2011 University of Southampton **2011**

Spens J & Ball J: *Salmonid or non-salmond lakes: predicting the fate of Northern boreal fish.* Canadian Journal of Fish and Aquatic Sciences 65(9): 1945 – 1955 **2008**

Skinner A: *"Ecology on the Freshwater Mussel in Conserving Natura 2000 Rivers."* EcologySeries No 2. English Nature. Peterborough. **2000**

Ulster Journal of Archaeology. P 78 **1955**

Walton I: *The Compleat Angler* **1654**

Went A: *The Pike in Ireland.* Irish Naturalists' Journal Vol XII No 7. **1957**

Woodmark P: *Ireland's First Settlers – Time & the Mesolithic.* Oxbow Books **2015**

William Samuel: *Arte of Angling.* Published anonymously **1577**

Zalinska-Kunek M: *Mesolithic Fishery in Polish Lowland; Fish remains at Site 7.* Environmental Archaeology Tallin University Estonia **2016**

Zhiliv M: *Early Mesolithic Hunting & Fishing Activities in Central Russia.* In Journal of Wetland Archaeology Vol 14 **2014**