north western international river basin district

North South Shared Aquatic Resource (NS SHARE)

neagh bann international river basin district

North South Shared Aquatic Resource (NS SHARE)

north eastern river basin district

North South Shared Aquatic Resource (NS SHARE)

North South Shared Aquatic Resource (NS Share)

Methods Manual
V Fish

Environment & Heritage Service
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DEPARTMENT OF THE ENVIRONMENT, HERITAGE AND LOCAL GOVERNMENT

INTERREG IIIA

North South Shared Aquatic Resource (NS Share)

Water Framework Directive

A Directive establishing a new framework for Community action in the field of water policy (2000/60/EC) came into force in December 2000. This Water Framework Directive (WFD) rationalises and updates existing legislation and provides for water management on the basis of River Basin Districts (RBDs). The WFD was transposed into national law in Northern Ireland by the Water Environment (Water Framework Directive) Regulations (Northern Ireland) 2003 and in the Republic of Ireland by the European Communities (Water Policy) Regulations 2003. The primary objective of the WFD is to maintain the "high status" of waters where it exists, prevent deterioration in existing status of waters and to achieve at least *"good status"* in relation to all waters by 2015.

NS Share Study Area

NS Share is a cross border project and incorporates three River Basin Districts as set out in the joint North/South Consultation paper *Managing our Shared Waters*:

1. North Western International River Basin District (NWIRBD);
2. Neagh Bann International river Basin District (NBIRBD);
3. North Eastern River Basin District (NERBD).

The NW and NB are International River Basin Districts as they share their waters between Northern Ireland (NI) and Republic of Ireland (ROI). The NERBD is contained wholly within NI.

NS Share Project

The overall objective of the project is to strengthen inter-regional capacity for environmental monitoring and management at the river basin district level, to improve public awareness and participation in water management issues, and to protect and enhance the aquatic environment and dependent ecosystems.

The NS Share project aims to facilitate delivery of the objectives of the WFD within the project area between August 2004 and March 2008.

The NS Share project is funded by the EU INTERREG IIIA Programme for Ireland / Northern Ireland. The Department of the Environment (NI) and the Department of the Environment, Heritage and Local Government (ROI) are implementing agents for the project. Donegal County Council is the project promoter. Technical support is proivded by the Environment and Heritage Service an agency within the Department of the Environment (NI), and the Environmental Protection Agency (ROI). RPS Consulting Engineers in association with Jennings O'Donovan are the principal consultants.

Assistance was also provided by the Marine Institute, Central Fisheries Board, Geological survey Ireland, Geological survey Northern Ireland, Loughs Agency, North West Regional Fisheries Board, and Cavan, Leitrim, Longford, Louth, Meath, Monaghan, and Sligo County Councils.

Project publications are available at www.nsshare.com/publications

PREFACE

The work presented in this paper was carried out as part of the NS SHARE project, which is funded by the European Union INTERREG IIIA programme for Ireland/Northern Ireland. The implementing agents for the NS SHARE project are the Department of Environment (DOE), Northern Ireland, and the Department of Environment Heritage and Local Government (DEHLG), Republic of Ireland. Donegal County Council (DCC) is the project promoter.

All data, drawings, reports, documents, databases, software and coding, website and digital media and publicity material produced as part of this project shall be the property of the DOE/DEHLG who will use, reproduce and distribute same as they see fit.

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NORTH SOUTH SHARED AQUATIC RESOURCE (NS Share)

Methods Manual

V Fish

Introduction

Ireland has a depauperate fish community when compared with the rest of Europe. There are 13 species of native freshwater fish, including euryhaline species entering freshwater, and a further estimated 12 or more introductions, some of which, such as pike (*Esox lucius),* were probably introduced in medieval times. Maitland and Campbell (1992) estimate that *circa* 215 freshwater fish species occur in Europe generally of which about 80 species exist in the north-western part; they identify 55 species as present in Britain and Ireland. A full list of species occurring in Irish freshwaters is presented in Appendix 1. The native fish community of lakes in the absence of anthropogenic influence, is one dominated by salmonids, including at some sites the glacial relicts Arctic Char (*Salvelinus alpinus*) and Pollan (*Coregonus autumnalis*). Standard national sampling programmes rarely exist (Kestemont and Goffaux, 2002); although there is some standardisation at regional level (Appelberg, 2000; Gassner *et al*., 2003; Mehner *et al*., 2005). There is little history of systematic sampling for fish in lakes anywhere in Europe, although the Nordic countries have a survey programme based on gill-netting (Appelberg, 2000; Helminen *et al*., 2000). Gill netting is the most common method of lake fish stock assessment followed by hydro-acoustic surveys and seine netting (Kelly *et al*., 2006a). With the possible exception of poisoning in small water bodies, no single sampling method collects all fish of all sizes and species from a defined area (Gulland, 1980). Comprehensive sampling requires a combination of methods (CEN, 2005a; Bonar *et al*., 2000; Drake and Perreira, 2002; Gassner *et al*., 2003).

Published European standards relevant to sampling fish in lakes comprise BS EN 14962:2005 *Water Quality – Guidance on the scope and selection of fish sampling methods* (CEN, 2005a), and BS EN 14757:2005 *Water Quality – Sampling of fish with multi-mesh gill nets* (CEN, 2005b). The latter method provides a whole lake estimate for species occurrence, quantitative relative fish abundance, biomass expressed as catch per unit effort (CPUE) and size structure (length frequency) of fish assemblages. There is no current international standard for the use of acoustic methods to survey freshwater fish populations, although a CEN standard is under development. This will be based on best established practice, with reference, for ground-truthing to the standards for “sampling fish with electricity” (EN14011) and “multi-mesh gill nets” (EN14757).

This manual sets out a standard method for sampling fish populations in Water Framework Directive (WFD) monitoring in lakes throughout the island of Ireland. It is intended that this method will be applied to establish lake fish population community composition, abundance and age structure throughout Eco-region 17, in compliance with Article 8 of the WFD (2000/60/EC). These parameters and selected component metrics will be used to establish the ecological status of lakes in accordance with the normative definitions set out in Annex V

of the Directive. Hydro-acoustics have not been included as part of the standardized methodology at this stage, however a separate report has been prepared highlighting developments to date and the possibility of future inclusion in WFD monitoring (Harrison *et al*., 2008).

Safety Statement

Sampling water bodies has inherent dangers of which fieldworkers must be aware, and which must be minimized by risk assessment, used to define good fieldwork practice. This field manual cannot identify all hazards and it is the responsibility of those sampling, and their managers, to assess risks and act upon those risks to establish compliance with EU and national safety legislation, and other regulatory issues identified by their employers. Safe boat-handling procedures are advised, for instance, by the UK Royal Yachting Association and training manuals. Staff undertaking small boat work must also adhere to internal standard operating procedures and safety instructions (AFBI, 2006b, CFB, 2002). Where surveys require access over private, or otherwise protected land, appropriate permission or legal authorisation should be obtained prior to embarking on reconnaissance or survey work.

All chemicals, must be used, transported and stored as per information on the label and material safety data sheets (MSDS) or UK Hazard Data Sheet (HDS) and team members must wear the personal protective equipment recommended (CFB, 2002), or required for compliance with UK COSHH (Control of Substances Hazardous to Health) regulation. The lakes team should carry a copy of the relevant MSDS or HDS when transporting any chemical.

When sampling fish in lakes, all field team members should be experienced and trained at least to minimum level in safe boat handling and operation. Each team member should have knowledge of boat handling and netting procedures. A minimum crew of two persons must be involved in the netting exercise, or in any related boat work, including depth surveys and water sampling. It is of paramount importance that all crew members have sufficient boat handling skills to take the helm and effect a rescue of an overboard casualty. Each team member must wear appropriate clothing for the weather conditions. Life jackets giving full face up buoyancy for a potentially unconscious adult must be worn at all times. Dry suits must be worn in winter, in adverse conditions or as specified in the dry suit policy e.g. CFB Safety Statement, 2002; AFBI Boat handling Standard Operating Procedure (AFBI, 2006).

Netting is not recommended in windy conditions (greater than force 4 on the Beaufort scale). The weather forecast should be obtained in advance of the netting exercise covering both planned set and retrieval times. For Republic of Ireland operations, there must be shore back up at all times for large lakes (person with vehicle, binoculars and operational radio/phone). For Northern Ireland operations, crews must be in communication with a phone or radio base expecting regular communication, time and assurance of safe return, and with a defined emergency response plan in case of failure of safe return call. In the

event of an emergency/engine failure etc., the boat may have to be rowed ashore, or assistance may be required from additional crews or other boaters to tow the boat ashore. The stability of the boat must be maintained and the boat never overloaded. Net boxes and bins must be evenly distributed in the boat. A boat hook should be used to retrieve nets. Care should be taken when pulling nets which are caught on the lake bed, and nets should be let go rather than risk being pulled overboard (AFBI, 2006). A knife should be readily available at all times to allow a net to be cut away. All clothing should be as free as possible from catches, exposed buckles or anything which might snag in a net (AFBI. 2006). If a field team member accidentally falls into the water during a netting operation immediately switch the outboard engine off. Make sure the necessary safety equipment is to hand. When you first discover someone has fallen overboard, the most important thing to remember is **Don't Panic**. The immediate approach will vary depending on the size and type of boat. If the boat is being crewed by only two people then alert shore back-up advising that one crew member is in the water; if crew consists of more than two raise the alarm by shouting "**Man Overboard**", stop the boat immediately and throw a lifebuoy overboard. Start your recovery manoeuver. The initial approach to the person in the water will vary depending on weather conditions and the type of boat. Whenever possible the person should be approached from downwind to avoid the risk of the boat being blown onto the person. Engines should if at all possible be cut to neutral on final approach to a casualty in the water. In a small boat, the safe recovery for a conscious and capable person overboard is likely to be over the stern transom. If you have any doubt about your ability to recover him/her, contact the shore back up or send a mayday call using your radio/mobile phone.

IMPORTANT

FIELD CREWS MUST ADHERE TO THE INSTRUCTIONS OF THEIR SUPERVISOR. BEHAVIOUR WHICH COULD ENDANGER LIFE OR CAUSE INJURY WILL NOT BE TOLERATED.

Safety checks

- The fuel tank should be specific to the engine and should be marked accordingly
- Make sure there is sufficient fuel for your intended journey
- Check the engine and fuel line visually for fuel leaks
- Make sure there is a first aid kit on board
- Carry a set of oars as an alternative means of propulsion and a set of rowlocks or pins as appropriate.
- Safe lifting techniques must be employed
- All equipment must be safely stowed or lashed down.
- Keep all essential small gear (such as flares) in a water tight container (e.g. float bottle) (make sure flares are in date and that the field team know how to use them)
- Make sure that the engine is secured to the transom properly (and should be tied with a rope or chain), check the tilt and lock mechanisms.
- Make sure that no one is standing in the water near the propeller and that no one is behind you when you pull the starting cord.
- At least one team member should be on the lookout for rocks, shallow water and items in the water
- Surplus water should be baled out
- No smoking is allowed on board or anywhere near fuels.

Safety equipment check list for netting surveys

VHF radio or mobile phone in waterproof pocket
Baler
2 Oars and row locks/pins
Lifejackets
Lifejacket spares
Painter/spare rope
1st aid kit
Gloves
Flares
Fire extinguisher
Polarized sunglasses
Lifebuoy/rope

Scope

The method has been developed for the assessment of ecological status of fish communities in freshwater lakes within the NS SHARE region, with a view to applicability to all lakes on the Island of Ireland (Ecoregion 17). Some of the method details will be generally applicable to other lakes in Ecoregion 18, although species complement and techniques permitted in local situations may vary. Assessment of ecological status is based on the normative definitions given in Annex V of the EU Water Framework Directive (CEC, 2000), and reproduced below. The determination of class boundaries will be subject to further refinement through continual review and inter-calibration exercises within and between eco-regions. The method can, however, be adapted to accommodate agreement among EU member states and national agencies on those boundaries, and on the composition of fish communities associated with reference conditions ratified by the North-South Technical Advisory Group (NS-TAG). Further testing and validation of the method is expected. Estimation of uncertainty of class estimates requires further development and agreement at national level.

Fish fauna are one of the biological elements listed in Annex V of the Water Framework Directive. In order to collect data on the composition, abundance and age structure of all species in all habitats, it is necessary that all habitats in a lake are sampled to accommodate the various stages of the fish life cycle. The timing of sampling should be linked to an understanding of the life history strategies of the target species. In most circumstances sampling should be carried out towards the end of the growing season when juveniles are of a sufficiently large size to be susceptible to capture and distinguishable from similar species (CEN, 2005a). Temperature also affects the efficacy of passive gear such as gill and fyke nets (Linlokken & Haugen 2006), and netting should coincide with peak activity periods. Therefore, fish stock assessment in Ireland should, ideally, be carried out between July and September. Subsequent, repeat sampling should be carried out at the same time of year.

Normative definitions

The key variables to be used in any WFD compliant fish index are species composition, abundance and age class structure. In high quality or reference sites, species composition and abundance must correspond totally or nearly totally to undisturbed conditions; i.e. all type specific disturbance sensitive species are present; the age structure of the fish communities show little sign of anthropogenic disturbance with no indication of failure in the reproduction or development of any particular species. Other quality classes (good, moderate, poor and bad) will show a gradual decrease in these variables (Table 1.1).

Table 1.1: Normative definitions of ecological status class for fish as per EC Directive 2000/60/EC (CEC, 2000).

Status	Fish fauna
High	Species composition and abundance correspond totally or nearly totally to undisturbed conditions All the type-specific sensitive species are present The age structures of the fish communities show little sign of anthropogenic disturbance and are not indicative of a failure in the reproduction or development of any particular species
Good	There are slight changes in species composition and abundance from the type-specific communities attributable to anthropogenic impacts on physico-chemical and hydromorphological quality elements. The age structure of the fish communities shows signs of disturbance attributable to anthropogenic impacts on physico-chemical or hydromorphological quality elements and in a few instances are indicative of a failure in the reproduction and development of a particular species, to the extent that some age classes may be missing.
Moderate	The composition and abundance of fish species differ moderately from the type-specific communities attributable to anthropogenic impacts on physico-chemical or hydromorphological quality elements. The age structure of the fish communities show major signs of anthropogenic disturbance, to the extent that a moderate proportion of the type specific species are absent or of very low abundance.
Poor	Waters showing evidence of major alterations to the values of the biological quality elements for the surface water body type and in which the relevant fish communities deviate substantially from those normally associated with the surface water body type under undisturbed conditions, shall be classified as poor.
Bad	Waters showing evidence of severe alterations to the values of the biological quality elements for the surface water body type and in which large portions of the fish community normally associated with the surface water body type under undisturbed conditions are absent shall be classified as bad.

Terms and definitions

Gill net

Gill netting is the capture of fish by entanglement in a fabric mesh that is not actively moved by man or machine. Gill nets consist of vertical walls of netting attached to a lead line and float line, normally set out in a straight line (Hubert, 1996). They can be used in benthic and pelagic zones of lakes and may be fished horizontally or vertically (CEN, 2005a). Gill nets can be made of various types of material, such as cotton, nylon in monofilament or multifilament twine (Hamley, 1980). Monofilament mesh is considered superior to other materials as it is less visible to fish (Hamley, 1980; Hubert, 1996).

Fyke net

A fyke net is a cylindrical or conical net which is hung around a series of hoops or frames. The net has a number of internal funnel-shaped throats whose tapered ends are directed inwards from the mouth. The closed end where the fish accumulate is called the cod end. The mouth of the fyke net has a leader attached to guide fish into the enclosure (Hubert, 1996).

Hydroacoustics

Hydro-acoustics is the use of high frequency sound to measure the densities, spatial distributions and sizes of fish.

Coarse fish

This is a term applied in UK and Ireland inland fishery legislation to all fish other than the “Game” fish (which are salmon, trouts and char). The “Coarse” fish are pike, perch, and all cyprinids (roach, rudd, bream, tench, carp, dace, chub, gudgeon and minnow).

CPUE

Catch per unit effort is (as per 1.3.3.) and is expressed as the arithmetic mean for the catch of each species.

CVM

Coefficient of variation of the mean is defined as the ratio of the Standard Error to the mean (CVM=S.E./Mean)

Principle

This method describes the sampling of fish communities in lakes. The lake survey methodology described here has been developed using CEN guidance for the surveying of fish applicable to lakes (CEN, 2005a and b), with reference to O' Grady (1983) and DARD (1994). The method is designed to estimate relative abundance of all species and their life stages in the lake using a combination of net types. Species are sampled using multi-mesh or "survey" gill nets and fyke nets at pre-determined sites, the number of which will vary according to lake size and depth. The design and principles of gill and fyke netting are usefully described in the FAO catalogue of small scale fishing gear (FAO, 1975)

Standard multi-mesh monofilament gill nets ("Norden") were used in the development of the method, and have been described in detail by CEN (2005b). The gill nets are 30m in length and 1.5m deep and are composed of 12 different mesh sizes ranging from 5 to 55mm knot to knot following a geometric series (Table 1.2)

Table 1.2: **Mesh size distribution (knot to knot) and thread diameter in the standard multi-mesh gillnets (Norden)**

	Mesh No.											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Mesh size (mm)	43	19.5	6.25	10	55	8	12.5	24	15.5	5	35	29
Thread diameter (mm)	0.2	0.15	0.10	0.12	0.25	0.10	0.12	0.17	0.15	0.10	0.2	0.17

Plate 1: Example of a multi-mesh monofilament gill net

"Dutch" type fyke nets were also used in the development of the method. The "Dutch" fykes are 15m in length overall with a 0.8m diameter front hoop joined by an 8m leader (Plate 2). Three "Dutch" fyke nets are joined in a series to form one unit. Fyke nets and leader material are 10mm square mesh.

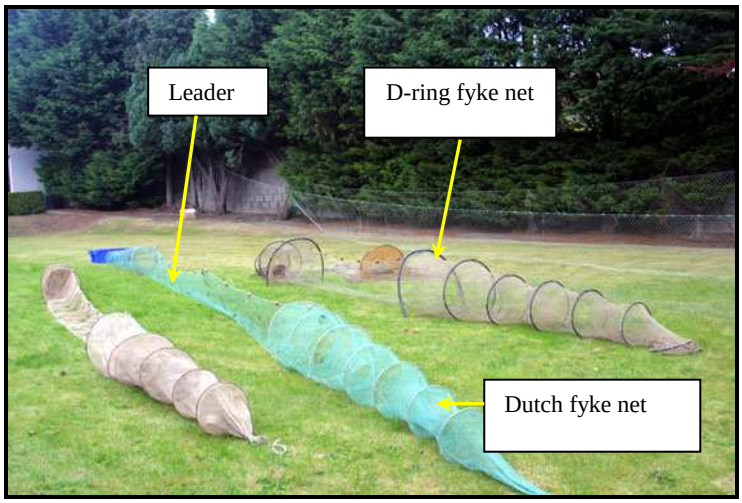

Plate 2: Examples of Dutch and D-ring fyke nets used by the Central Fisheries Board.

Each unit is weighted by two anchors (concrete or lead anchors) and two marker buoys are attached to either end.

The netting method provides data on:

1) Species composition (number of each species)
2) Age composition
3) Length frequency distribution
4) Biomass (kg/ha)

The methods described above are applicable to all lake typologies (Table 1.3)

Table 1.3: Lake Typology for Ecoregion 17 (Free *et al.*, 2006).

	Alkalinity (mg/l $CaCO_3$)			**Mean depth (max depth) (m)**		**Lake area (ha)**	
Lake Type	<20	20-100	>100	<4(12)	>4(12)	<50	>50
1	■			■		■	
2	■			■			■
3	■				■	■	
4	■				■		■
5		■		■		■	
6		■		■			■
7		■			■	■	
8		■			■		■
9			■	■		■	
10			■	■			■
11			■		■	■	
12			■		■		■
13	lakes > 300 m altitude						

Operatives engaged in lake fish stock assessment should have received basic training in sampling procedures, handling fish and possess the fundamental skills required for the operation and handling of small boats.

Equipment

The following equipment is required on a netting survey (NB: test/inspect all equipment before leaving base):

- Nets (monofilament, fyke nets etc.) and appropriate net boxes/bins
- Rope (8 to 10mm - for attaching marker buoys and anchors to nets)
- Marker buoys (two for each net)
- Egg shaped floats (for floating nets, approx 6 per 30m net)
- Anchors/weights (two for each net)
- Grapnel hook or boat hook (for retrieving nets)
- Appropriate Personal Protection Equipment
  - Life jackets, waders/wellies, rain gear, mobile telephones,
  - 2-way radio, head cover, flares, sunblock and insect repellent,
- Polarized sunglasses
- Maps (with net locations marked)
- Digital depth sounder (CFB use a Bottomline 1200 fish finder which can be secured on the transom with a bracket)
- GPS unit (for marking net locations)
- Secchi disc
- Conductivity/temperature probe
- Camera (store in a water tight container)
- Measuring boards (50cm min.)
- Balance (gram scale). Various types may be required, e.g. *Pesola* type (100g or 1000g), top pan balance or larger balance such as a *Salter* 10kg for larger fish
- Clear plastic bags (for weighing)
- Large plastic bags (for storage of fish from each net)
- Labels (for labelling each net when retrieved)
- Permanent markers (for marking bags and samples)
- Scale envelopes (for storing scales etc.)
- Knife (for removing scales from fish)
- Waterproof notebook and data sheets
- Pencils and clipboard
- Bottles for water samples and reference material
- Appropriate licence (if applicable)

Equipment check list for netting surveys

Monofilament gill nets
Fyke nets
Net boxes/bins
Rope
Marker buoys
Weights
Grapnel
Boat hook
PPE
Polarized sunglasses
Maps
Digital depth sounder (fish finder)
GPS unit
Secchi disc
Conductivity/temperature probe
Camera
Measuring board
Balance(s)
Plastic bags (small & large)
Labels
Markers
Scale envelopes
Knife
Waterproof notebook and data sheets
Pencils, clipboard, etc.
Bottles for water samples/reference material

Survey Planning and Preparation

Lake fish sampling should be carried out between July and September. Comparative surveys in subsequent years should be undertaken at the same time and at the same locations as in previous years.

Prior to visiting the lake, the following steps should be taken:

1. Identify the location of the lake (minimum 6 figure Irish grid reference for a midpoint on the lake)
2. Contact the relevant fishery authority for assistance in sampling and provision of boat(s) and outboard engine(s)
3. Check accessibility (easiest launching point) and identify any potential risks
4. Check that authorisation (permission of landowner) to visit the site has been obtained
5. Obtain appropriate licence if applicable
6. Assemble the necessary equipment
7. Organise copies of datasheets as outlined in Appendix 2
8. Prepare maps including numbered grid (and contour lines if available) and select sites using the randomisation procedure described in section 1.1.2

Procedure

Summary

The netting procedure involves stratified random sampling using a combination of standard benthic monofilament, floating monofilament gill nets and fyke nets. The procedure is an adaptation of the CEN standard for sampling fish using multi-mesh gill nets (time series method) (CEN, 2005b). Nets are set randomly over the lake in various depth strata and are set for approximately 18 hours. The procedure for setting and retrieving nets is described and the variables to be recorded are listed.

Details of sampling procedure

Using bathymetric maps, the lake is divided into depth strata (0-2.9m, 3-5.9m, 6-11.9m, 12-19.9m, 20-34.9m, 35-49.9m and >50m strata) and random sampling is performed within each depth stratum. Sampling is with standard multimesh monofilament gill nets (CEN, 2005b). The angle of each gill net in relation to the shoreline is randomized. Mesh sizes can be modified if large fish of certain species (e.g. ferox type trout, bream, pike and tench) are likely to be caught as these are difficult to catch with the standard mesh sizes. Where these species are present, it is suggested that additional 30m panels of 60mm, 65mm or 75mm are added to the effort unit at a ratio of one mesh panel to every 4 “Norden” nets. Fyke nets are set perpendicular to the shore. A minimum of three fyke net units should be set on each lake, rising to 6 or 9 depending on size of the lake (Table 1.6).

CEN (2005b) recommends that, in general, at least 4 gill nets should be used in a lake. In lakes <6 ha and <3 m in depth, however, this should be reduced to two or three nets. The CEN standard also recommends that lakes larger than 5,000 ha should be divided into separate basins and that each basin is treated as a separate lake.

The current method differs from CEN (2005b) which recommends that pelagic fish are sampled using a pelagic gill net of 27.5m in length and 6m deep (mesh size ranging from 6.75mm to 55mm) set over the deepest part of the lake. These nets are difficult to use from small boats, the potential impact on fish stocks is substantial, handling time is excessive and the nets are expensive. Because most pelagic fish in Irish lakes will feed on or near the surface at night, a number of benthic gill nets are adapted as “floating nets” and these are set over the deeper open water areas of the lake, where suitable.

1.1.1 Sampling effort

Following CEN (2005b) two methods can be employed:

1. Inventory method
2. Time series method

The time series method is recommended for WFD fish monitoring in lakes (as it is designed to detect a 50% change in the relative abundance of the fish population), to quantify relative abundance or biomass of different fish species and to compare differences over time and among lakes. In accordance with CEN (2005b) the lakes are divided up into six size classes (≤20ha, 21 to 50ha, 51 to 100ha, 101 to 250ha, 251 to 1000ha, and 1001 to 5000ha) and recommendations are given on the number of nets to set in each depth layer. The number of nets required to achieve a precision which makes it possible to determine statistically a 50% difference between sampling occasions in Irish lakes is shown in Table 1.4. The number of gill nets increases depending on the desired degree of precision required and on the depth and surface area of the lake.

Table 1.4: Distribution of benthic multi-mesh gill nets at different depth strata in lakes with different area and maximum depth for Irish lakes (adapted from CEN, 2005b)

Lake area (ha)	Depth zone (m)	Maximum depth (m) and no. of nets per zone							
		<3	**<6**	**6-11.9**	**12-19.9**	**20-34.9**	**35-49.9**	**50-75**	**>75**
<20	<3	4	2	2	2	2	2		
	3-5.9		2	2	2	2	2		
	6-11.9			2	2	2	2		
	12-19.9				2	2	2		
	20-34.9					2	1		
	35-49.9						1		
Total number of gill net nights		**4**	**4**	**6**	**8**	**10**	**10**		
21 to 50	<3	4	2	2	2	2	2		
	3-5.9		2	3	2	2	2		
	6-11.9			2	2	2	3		
	12-19.9				2	2	3		
	20-34.9					2	3		
	35-49.9						2		
Total number of gill net nights		**4**	**4**	**7**	**8**	**10**	**15**		
51 to 100	<3		4	4	4	4	4	4	
	3-5.9		4	4	4	4	4	4	
	6-11.9			4	2	5	4	5	
	12-19.9				2	3	2	2	
	20-34.9					2	2	2	
	35-49.9						2	2	
	50-75							2	
Total number of gill net nights			**8**	**12**	**12**	**18**	**18**	**21**	
101 to 250	<3		4	4	4	4	4	4	
	3-5.9		4	4	4	4	4	4	
	6-11.9			4	4	5	5	3	
	12-19.9				4	4	3	3	
	20-34.9					4	3	3	
	35-49.9						2	2	
	50-75							2	

Total number of gill net nights			**8**	**12**	**16**	**21**	**21**	**21**	
251 to 1000	<3		6	5	5	5	5	5	5
	3-5.9		6	5	5	5	5	5	5
	6-11.9			5	5	5	5	5	5
	12-19.9				5	5	4	4	4
	20-34.9					4	3	4	4
	35-49.9						3	3	3
	50-75							3	3
Total number of gill net nights			**12**	**15**	**20**	**24**	**25**	**29**	**29**
1000 to 5000	<3		6	5	5	5	5	5	5
	3-5.9		6	5	5	5	5	5	5
	6-11.9			5	5	6	6	5	5
	12-19.9				5	6	4	5	5
	20-34.9					6	4	5	5
	35-49.9						4	5	5
	50-75							3	3
Total number of gill net nights			**12**	**15**	**20**	**28**	**28**	**33**	**33**

Floating nets should be set over the deepest part of the lake (when maximum lake depth is greater than 8m). The number of floating surface nets to be set in a lake is shown in Table 1.5.

Table 1.5: The number of floating surface nets to be set in lakes

	Lake area (Ha)					
	<20	**21 to 50**	**51 to 100**	**101 to 250**	**251 to 1000**	**1001 to 5000**
Number of floating nets	2	2	4	4	6	8

Fyke nets should be set near the margins of the lake (perpendicular to the shore) and cover a number of different habitat types (e.g. weeded areas, stony substrate, muddy substrate). The number of fyke nets recommended for each lake is shown in Table 1.6.

Table 1.6: The number of fyke net units to be set in lakes

	Lake area (Ha)					
	<20	**21 to 50**	**51 to 100**	**101 to 250**	**251 to 1000**	**1001 to 5000**
Number of fyke nets	3	3	3	6	6	9

1.1.2 Siting of gill nets and fyke nets

Gill nets are set randomly over the lake. A prepared numbered grid is placed over the depth contour map for the lake (Fig. 1). If a depth contour map is not available, a bathymetry survey must be carried out prior to the netting survey. The numbered grid must be drawn to scale and each box should not represent less than 50m x 50m, in order for the nets not to span more than one numbered box. Using a randomization procedure (see example 1 below) sampling locations are selected in each depth stratum (CEN, 2005b). Some degree of targeted netting may have to be included to incorporate all habitats in the lake (it is especially important to sample weeded shallows which may be very localised in some lakes and this may not be picked up in random selection procedure). Open deep water areas may need to be targeted with floating nets.

Each team should have a copy of the map with them at all times when on the lake

Example 1

A grid with 54 numbered boxes has been drawn over the lake, using a blank excel worksheet, type =RANDBETWEEN (1,40) into a blank cell (for the 0-2.9m depth stratum) and press return. This gives a random number between 1 and 40. To obtain additional random numbers for this depth stratum (netting sites) drag the cell down by the number of cells required (2 cells for the 0-2.9m zone) to extend the series. A similar procedure should be followed for each depth stratum. The gill net locations are then marked on the map according to where the random numbers fall within the relevant depth stratum (See Fig. 1).

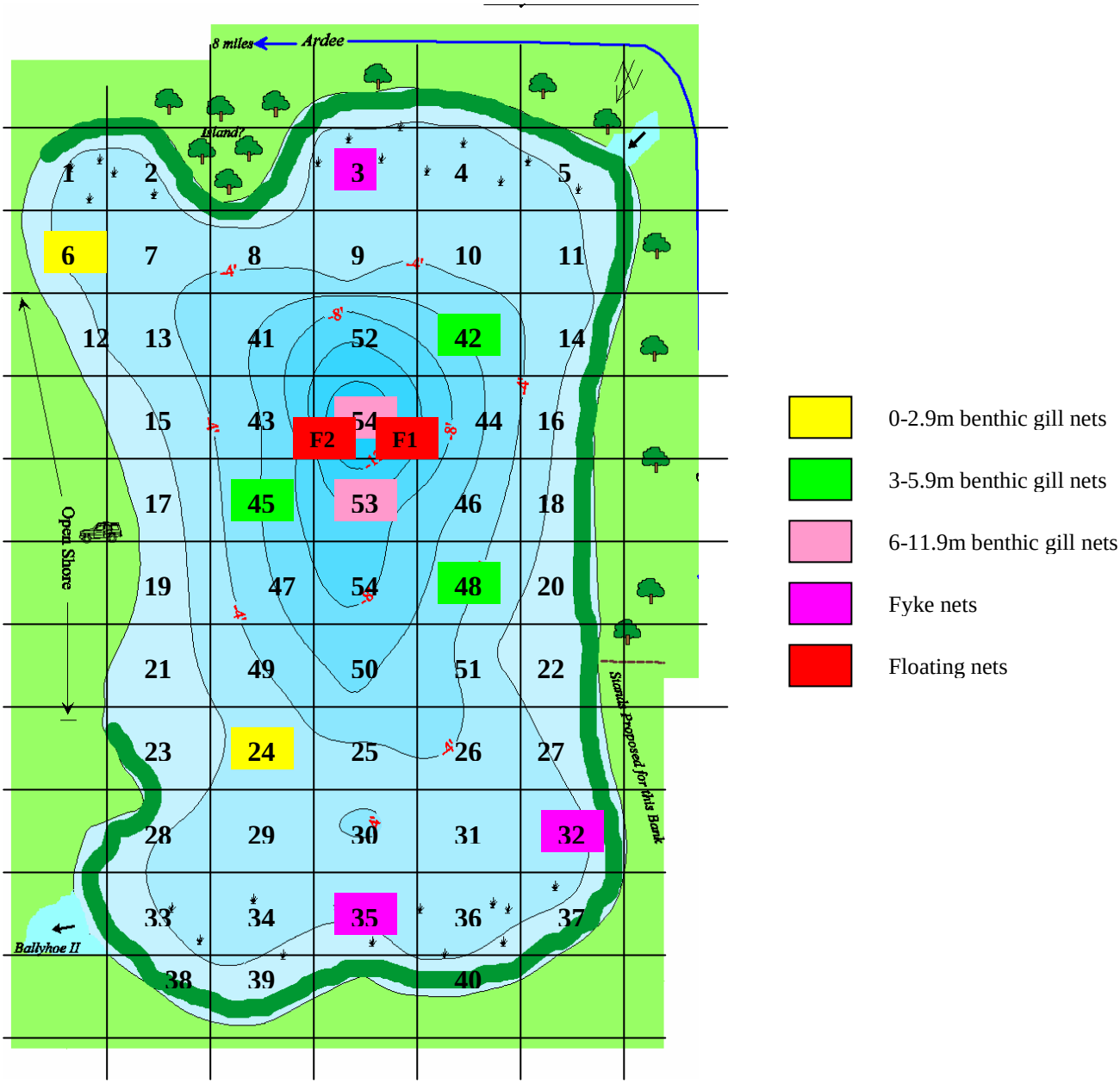

Figure 1: Example of a bathymetric map of a lake (30 ha and 12m max depth), includes a numbered grid for location of benthic gill nets, floating gill nets and fyke nets (not drawn to scale). Benthic gill nets, floating gill nets and fyke nets are shown.

1.1.3 Duration of netting

CEN recommends setting nets for 12 hours, between 6 and 8pm and retrieving them between 6 and 8am the following morning in order to ensure that the activity peaks of each fish species are included. However, it is recommended that in Irish lakes nets should be set between 3 and 6pm and lifted between 9.00am and 12.00 midday (approximately 18 hours), in order for the sampling programme to fit into the normal working day. However, nets may

be lifted or set outside of these times on some occasions (e.g. lakes used for navigation) as long as each net is deployed for one dawn and one dusk period.

Time has also to be allowed for travelling to the lake, travelling to the net locations by boat, processing the fish, transport of fish to freezers etc. Nets should never be set for more than 24 hours. In lakes used for navigation, nets should be lifted between 5 and 7 am.

1.1.4 Setting nets

To ensure repeatability, fishing effort, fishing equipment, fishing protocols and fishing locations should be the same on each sampling occasion. In all cases specify (on the data sheets) number and make of each type of net and duration of setting. Gill nets are set in straight lines and at random angles from the shore. Fyke nets are set in straight lines and perpendicular to the shore. The catch from each net should be treated as a separate sample and labelled accordingly. Once set, the location of each net is noted on a portable GPS.

i) Nets are set between 3 and 6pm.

ii) Plan the route you will take across the lake to deploy the nets

iii) To begin the sampling one or more operatives should prepare lengths of rope for marker buoys and anchors. Length of the rope will vary with depth of water, for example, in 0-3m depth stratum, the rope on the marker buoy should be 4m in length (minimum), in 3-6m depth, the rope should be 7m (minimum) in length, etc. The rope on the anchors should not be more than 1m in length unless used as a floating net

iv) Once the relevant marker buoys and anchors are attached to the net, the depth of the area where the net is to be deployed should be checked using a digital depth sounder. To avoid loss of nets, it is imperative that the marker buoys used are capable of suspending the entire net and all attached weights if accidentally set too deep.

v) Nets are then deployed over the side from a standing position (the standard gill nets are set from plastic hooks) as the boat reverses away from the net, making sure at all times that the net is set at the correct depth. Each net should be given an identification number prior to deployment. Gill nets can also be deployed from baskets or boxes if laid without handling hooks. Fyke nets are deployed from a large plastic bin. Fyke nets should be set perpendicular to the shore. When the entire fyke net unit is deployed the end buoy rope should be pulled to straighten and tighten the leader. If marker buoy lines are of inadequate depth and the buoys are dragged tight, approach the buoy and attach more line as necessary.

vi) Using a GPS, take a waypoint of each net location before leaving the site. This should be recorded both electronically on the GPS instrument and in a waterproof notebook.

vii) The depth at each end of the net should also be recorded before leaving the netting site.

1.1.5 Retrieving nets

i) The day after the setting the nets are lifted between 9.00 am and 12.00 midday.

ii) Nets must be lifted in the same sequence in which they were set. (see vi below for exceptions to this rule)

iii) When ever possible nets should be approached from downwind to avoid the risk of being blown into the net and fouling the propeller.

iv) Nets are hauled by hand into a plastic box/bin. A label indicating type of net and net number and depth layer should be placed in the box to accompany each net.

v) The duration of each netting should be recorded (i.e. time set and time lifted for each nets must be recorded).

vi) Any live fish should be removed from the nets and processed on board the boat, i.e. net location/net number should be recorded for each live fish, lengths, weights and scales should be taken and the fish then returned to the lake (see below). In waters where they have been deployed, the extra large mesh nets should be lifted first to minimise mortality of specimen fish.

vii) Back on shore remaining fish should be removed from each net and processed separately following the procedure at vi) above.

viii) Fish samples should then be placed in marked bags for each individual net for further examinations (keep species separate) and placed in a freezer.

ix) Nets should be cleaned and dried for the next setting.

x) After fish have been processed the nets are set again between 3 and 6pm.

1.1.6 Species composition and abundance.

Back on shore, once the fish have been carefully removed from the nets, one field team member should examine and measure the length of each fish whilst the other records date set, time set, date out, time out, lake name, grid reference, net information, number of each species type, lengths and weights etc. (See appendix 2 for standard survey sheet). All

species present must be listed and counted. Where very large numbers of any species are captured, sub-sampling (see 1.1.13 below) will provide sufficient information.

Where there is insufficient time for field measurement, or as an alternative procedure, all fish can be sorted by individual net and species, bagged and placed in a freezer for later laboratory examination. In this case, it is imperative that the numbers of each species caught in each net are recorded on a field data sheet prior to placing them in bags. This field record must be made available to the lab team when undertaking the measurements.

1.1.7 Data reporting

For each sampling occasion the identification number of all nets used, the geographical location of each net in the lake, the duration of sampling and the maximum and minimum depth for each net should be recorded (Table 1.7). Each fish should be traceable from capture through processing to aging. Each individual fish is weighed and measured, fish lengths (tip of snout to centre of fork of tail) are determined to the nearest mm and weight to the nearest gram. The catch within each gill net is recorded as number of individuals and total weight for each species (CEN, 2005b).

Data should be stored in the “Lakes” database using Lake Name, date for fishing, easting and northing and gill net number as ID variables.

1.1.8 Supplementary data

The distribution and abundance of fish is influenced by many factors such as lake size and depth, water transparency, temperature, and weather conditions. Additional data should be recorded during each lake survey (Table 1.7).

Table 1.7: Requirements for fish data recording and reporting (CEN, 2005b)

Net information	
Type of nets	If standard CEN gill nets are used, the length and depth of the gill nets are known, this makes it possible to calculate the catch in terms of fish per linear meter. If other types of gill nets are used this information must be recorded.
Number of each net type	The total number of each type of net used on the lake
No of nets in each depth stratum	The total number of each type of net used in each depth stratum
Gill net depth (m)	The depth of water at each end of each net should be recorded (m)
Time of gill netting	The time (precise) for setting and lifting the nets should be given. This makes it possible to calculate the catch in relation to number of fish per hour.
Fish information	
List of species caught	List of species caught in the gill nets should always be provided.
Total number of fish caught	The total number of each species
Total weight of fish caught	The total weight of each species
Number or catch per unit effort (NPUE or CPUE)	The arithmetic mean for the catch of each species. The variance estimates will be larger if stratification is considered. By estimating the mean and variance for each single depth stratum, the variance may be minimised. CPUE should also be given in a way that it is possible to calculate the mean value for the lake and to describe depth distribution of each species
Weight per unit effort (WPUE)	Should be calculated as CPUE above
Length (and/or weight) frequency distribution	Length (and/or weight) frequency distributions should be given for all dominant species in the lake. When there is special interest for some species, the frequency distributions can be corrected for gill net selectivity (CEN, 2005b)
Geographical information	
Lake name	The official national name of the lake (use national code number if available)
Catchment name	The official catchment name
Altitude	The altitude of the lake in metres above sea level, can be obtained from 1:50,000 maps (Discovery)
Lake area (ha)	Should be given in ha
Lake depth (m)	Mean depth and maximum depth (m) should be recorded
Date for fishing	Day/Month/Year
Easting	National map grid coordinates, first direction (e.g. North-South)
Northing	National map grid coordinates, second direction (e.g. East-west)
Geology	Dominant bedrock geology and indicate if siliceous or calcareous (based on dominating category)
Gill net number	Each gill net should be given a number which corresponds to a location on the map of the lake
Supplementary data	
Water transparency	This is usually measured as Secchi disc depth (m)
Temperature (^{o}C)	Temperature should be taken at the deepest part of the lake, a Temperature/DO profile can be done at the surface and then every subsequent 5m down to the maximum depth of the lake
Water chemistry	Nutrients (TP, MRP, TON, TN), alkalinity, pH, colour
Responsibility	Person and institute responsible for the sampling and the data should be given
Weather conditions	Weather conditions at setting and lifting should be given, strength and wind direction, air temperature, clear/partly cloudy, cloudy/fog/rain etc.

1.1.9 Sampling efficiency

Sampling efficiency can be affected by a number of factors such as weather, gill net condition, temperature, location of the gill net and water transparency (CEN, 2005b). Weather conditions at setting and lifting should be recorded (i.e. strength and wind direction, air temperature, clear/partly cloudy, cloudy/fog/rain etc. see Appendix 2). Secchi disc depth and a temperature profile should also be recorded on each sampling occasion.

The survey team using the nets should make certain that they are functioning properly by inspecting them before they are used. Nets which have been damaged should be replaced with new nets whenever they are suspected to be less efficient (CEN, 2005b).

1.1.10 Decontamination/disinfection procedures

A standard protocol for disinfecting all equipment (nets, anchors, boats etc.) has been drawn up by the NS Share "Fish in Lakes" team (Kelly *et al*., 2006b). This protocol describes procedures for decontamination of field equipment and boats in order to prevent unintentional translocation of species. All equipment must be disinfected using appropriate methods before travelling to another lake (Kelly *et al*., 2006b)

1.1.11 Anaesthetic (OPTIONAL)- for examination of fish intended for live release

Note: (CFB use 2-phenoxyethanol)

i) Add 3 litres of lake water to a bucket. Add a small amount of anaesthetic (two drops with a dropper – add a drop at a time if more is needed) and stir to dissolve.

ii) **Care must be taken** as the effect of the anaesthetic is influenced by water temperature, fish numbers and dissolved oxygen content.

iii) A small number of fish (6-12) should be transferred to the anaesthetic. Ideally the fish should begin to display signs of anaesthesia after approximately 3 minutes. However, the condition of the fish should be monitored continuously throughout the operation and, if necessary,

iv) the anaesthetic should be diluted with fresh well-oxygenated water.

v) After processing, fish should be transferred to a bucket containing clean lake water for recovery before returning to the lake.

vi) Anaesthetic should be used, transported and stored as per information on the material safety data sheets (MSDS). Team members must wear appropriate gloves and eye protection.

1.1.12 Scale (or other structures) collection

(Based on Environment Agency UK recommendations, (Environment Agency, 2000)

- A set of scales of each species should be taken from a representative range of sizes for back-calculation of length-at-age and examination of growth pattern at each site. Other structures, such as otoliths (e.g. eels and char) and opercular bones (e.g. perch) may be required in some cases for age assessment. Pike, if killed, may be aged from opercular bones or cleithra, but may by difficult from scales due to scale loss and replacement. The weight of each individual scaled should be recorded.
- Care should be taken to minimise damage or stress to live fish. The fish should be placed on its right flank on a non abrasive, **wet surface**. Scales should be removed from the recommended area for each fish group (Figure 2). Gently scrape off the scales with a blunt scalpel or knife in a snout to tail direction. Once removed, scales from each fish should be placed in individual scale envelopes. All relevant details for the fish should be written on the scale packet. The following information should accompany each scale:

Information to accompany scales	
Species	Weight of fish
Fork length	Sex of fish
Date of capture	General physical condition of fish (optional)
Place of capture (Lake name)	Net number

- In populations that are sampled frequently, some variation in the site of scale removal may be necessary to avoid replacement scales.
- The number of scales collected should be kept to a minimum although this will vary depending on the size and species of fish.

1.1.13 Sub-sampling of age structures

Where very large numbers of any species are captured (>100), sub-sampling will provide sufficient information.

In this case, scales or other age structures should be taken from five fish within each 1cm size class (NB. lengths and weights should still be taken for all fish captured).
As scales from larger fish can be more difficult to interpret, scales should be taken from all individuals greater than 20cm in length to ensure accuracy in interpretation.

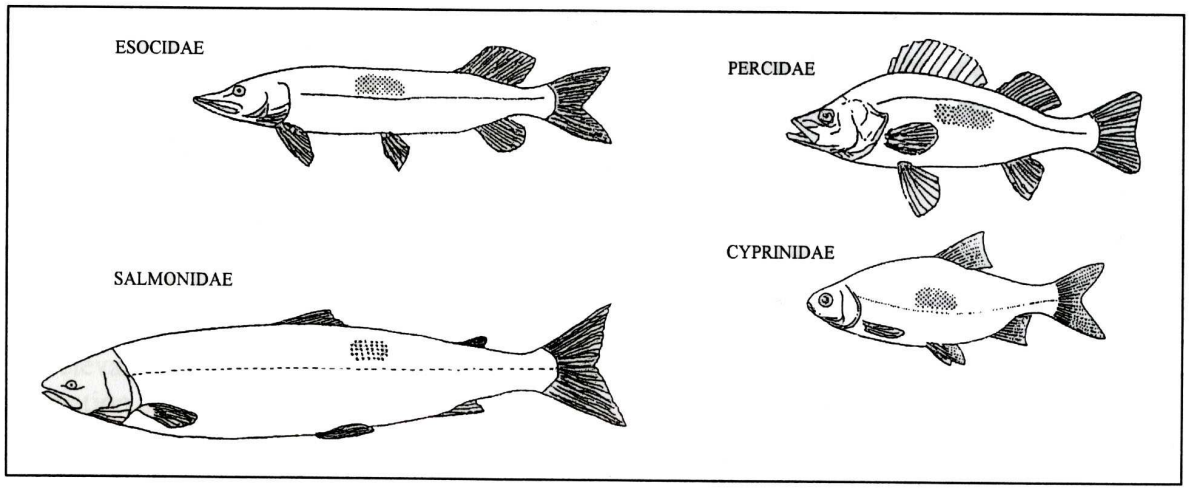

Figure 2: Recommended body area for removal of scales from different fish groups (after Environment Agency, 2000).

1.2 Quality Assurance

CEN (2005b) recommends that all activities in the fish sampling method (e.g. training of the lakes team, handling of equipment, handling of fish, fish identification, data analyses, and reporting) should be subjected to a quality assurance programme in order to produce consistent results of high quality.

1.2.1 Fish identification

There is a need for quality control for fish identification by operators, particularly in relation to hybrids of coarse fish. Samples of each fish species must be retained when the operative is in any doubt in relation to the identity of the species, e.g. rudd and/or roach hybrids.

1.2.2 Scale and bone reading

In the laboratory every tenth scale or bone from each species should be checked by a second biologist experienced in age analysis techniques. Inter-calibration between laboratories provides the most reliable means of quality assurance and should be undertaken if available.

1.2.3 Field sheet

Field sheet design should enable the data to be input easily into a spreadsheet in the format in which it is to be used, and therefore should follow the same format as far as possible. The field sheet should be printed double sided. Examples of the field record sheet and a catch data sheet used by CFB and AFBI are shown in Appendix 2.

1.3 Data Analysis

1.3.1 Fish species composition

The total number of each species should be recorded as a percentage of the total number of individuals captured using the three net types for each lake.

1.3.2 Species richness

Species richness is calculated as the total number of species collected during a lake survey. This is presented as a number or as a percentage of the total number of species known to be present in the lake (or as a percentage of the total number of species caught with all gears at all sites where a lake has not been surveyed previously, i.e. where details of fish community composition do not exist).

1.3.3 Fish abundance

Fish abundance is expressed as CPUE and BPUE.

> CPUE = mean catch per unit effort for all species combined and for each individual species per overnight set. It is expressed as number of fish per linear metre of net (for fyke nets use total length, i.e. length of traps plus leader) (No. fish/m net). CPUE should also be recorded as the mean number of fish caught in each depth stratum (e.g. CPUE 0-2.9m, CPUE 3-5.9m etc.).
>
> BPUE = mean biomass per unit effort should be calculated as per CPUE

1.3.4 Length frequency distributions, age and growth analysis

Length frequency distributions (1cm length classes) should be given for all dominant species in the lake.

1.3.5 Growth

Mean length at age data for each age class (L1, L2, L3 etc.) must also be calculated for the dominant fish species at each lake.

1.4 Ecological Status Class calculation

1.4.1 Scope of ecological classification tool

This ecological classification tool is designed to assign lakes in Ecoregion 17 to ecological status classes ranging from high to bad using fish population parameters relating to abundance, species composition and age structure. The metrics required for each lake fish community type are described and an ecological classification tool spreadsheet is included to convert derived metric values into a discrete ecological status class.

1.4.2 Definitions used to describe metrics

Various categories and descriptions have been used to describe components of the fish community and definitions for those needed for this ecological classification tool are provided (Table 1.8).

Table 1.8: Definitions of fish groups used in the lake fish classification tool

DESCRIPTION	DEFINITION
Group 1 species	Native species – brown trout, sea trout, salmon, char, pollan, eel, shad, 3-spined stickleback, 9-spined stickleback, brook lamprey, river lamprey, sea lamprey, flounder
Group 2 species	Non-native species influencing ecology – roach, perch, pike, bream, dace, carp, rainbow trout, chub, minnow
Salmonid species	Brown trout, sea trout, salmon, char
Cyprinid species	Roach, bream, carp, minnow, rudd, gudgeon, stoneloach, tench, chub, dace.,
Intolerant species	River, brook & sea lamprey, brown trout, sea trout and salmon (FAME classification) excluding char, pollan and shad
Tolerant species	Bream, eel, carp, 3-spined stickleback, perch, 9-spined stickleback, roach and tench (as per FAME classification)
Piscivores	Total length: trout >40cm, perch >20cm, pike >20cm

1.4.3 Establishing lake fish community type

Before calculating metrics for a lake, it is first necessary to establish which fish community type the lake belongs to. Table 1.9 summarises the characteristics of the four fish community types, and should be used to assign a surveyed lake to the appropriate type before using the ecological classification tool to assign status class.

Table 1.9: Definition of fish community types in Ecoregion 17.

Fish Community Type	Definition
Salmonid lakes	Salmonid lakes contain brown trout and/or char. Other species of fish may also be present, including 'coarse fish'
Perch lakes	Perch lakes do not contain brown trout or char or any other salmonid species, and contain perch as the numerically dominant species. Other species may also be present, such as roach and pike
Roach lakes	Roach lakes do not contain brown trout or char or any other salmonid species, and contain roach as the numerically dominant species. Other species may also be present, such as perch and pike

1.4.4 Calculating metrics for each fish community type

Salmonid lakes

A total of 17 metrics are used in the salmonid lakes tool. Metric descriptions, codes and definitions of how each metric is calculated are given in Table 1.10.

Table 1.10: Definition of metrics used in the salmonid lakes tool

METRIC	METRIC CODE	DEFINITION
Brown trout length at 2 years	BT_L2	Back calculated length (cm) of brown trout at 2 years
Number of species	SPE_NUM	Number of species recorded in the lake
% Group 1 species	SPE_1_%	% of species that are Group 1* species
Number of Group 2 species	SPE_2_NUM	Number of group 2 species recorded in the lake
% Group 2 species	SPE_2_%	% of species that are Group 2* species
Number of piscivorous species	PISC_NUM	Number of piscivorous* species recorded
% individuals of piscivore species	PISC_%_IND	% of individuals that are piscivorous* (excluding eels and adult salmon)
% individuals of salmonid species	SALM_%_IND	% of individuals (based on CPUE – excluding eels and adult salmon) that are salmonids*
% biomass of salmonid species	SALM_%_BIO	% of biomass that are salmonids (based on BPUE – excluding eels and adult salmon)
% individuals of tolerant species	TOL_%_IND	% of individuals (excluding adult salmon) that are tolerant* species
% biomass of tolerant species	TOL_%_BIO	% of biomass (excluding eels) that are tolerant* species

Table 1.10 contd.: Definition of metrics used in the salmonid lakes tool

METRIC	METRIC CODE	DEFINITION
Total Catch Per Unit Effort	TOTAL_CPUE	Catch Per Unit Effort of all fish combined (mean of all nets in lakes) CPUE of gill net = number of fish per linear metre of net CPUE of fyke net = number of fish per TOTAL (ie leader + traps) linear metre of net
Total Biomass Per Unit Effort	TOTAL_BPUE	Biomass Per Unit Effort of all fish combined (mean of all nets in lakes) BPUE of gill net = biomass of fish per linear metre of net BPUE of fyke net = biomass of fish per TOTAL (ie leader + traps) linear metre of net
Brown trout Catch per Unit Effort	TROUT_CPUE	Catch per Unit Effort of brown trout (mean of all nets in the lake) CPUE of gill net =number of fish per linear metre of net CPUE of fyke net=number of fish per TOTAL (i.e. leader + traps) linear metre of net
Brown Trout Biomass per Unit Effort	TROUT_BPUE	Biomass (grams) per Unit Effort of brown trout (mean of all nets in lake) BPUE of gill net =biomass of fish per TOTAL linear metre of net BPUE of fyke net= biomass fish per TOTAL (i.e. leader + traps) linear metre of net
Char Catch per Unit Effort	CHAR_CPUE	Catch Per Unit Effort of char (mean of all nets in lake) CPUE of gill net = number of fish per linear metre of net CPUE of fyke net = number of fish per TOTAL (ie leader + traps) linear metre of net
Char Biomass per Unit Effort	CHAR_BPUE	Biomass (grams) Per Unit Effort of char (mean of all nets in lake) BPUE of gill net = biomass of fish per linear metre of net BPUE of fyke net = biomass of fish per TOTAL (ie leader + traps) linear metre of net

*See definitions in Table 1.8

Perch lakes

A total of 13 metrics are used in the perch lakes tool. Metric descriptions, codes and definitions of how each metric is calculated are given below (Table 1.11).

Table 1.11: Definition of metrics used in the perch lakes tool

METRIC	METRIC CODE	DEFINITION
Perch length at 1 year	PERCH_L1	Back calculated length (cm) of perch at 1 year
Number of species	SPE_NUM	Number of species recorded
% cyprinid species	CYP_%	% of species that are cyprinid* species
% individuals of perch	PERCH_%_IND	% of individuals (excluding eels and adult salmon) that are perch
% biomass of perch	PERCH_%_BIO	% of total biomass (excluding eels and adult salmon) that are perch
% biomass of cyprinid species	CYP_%_BIO	% of total biomass (excluding eels and adult salmon) that are cyprinid* species
% individuals that are piscivores	PISC_%_IND	% of individuals (excluding eels and adult salmon) that are piscivores*
Total Catch Per Unit Effort	TOTAL_CPUE	Catch Per Unit Effort of all fish combined (mean of all nets in lakes) CPUE of gill net = number of fish per linear metre of net CPUE of fyke net = number of fish per TOTAL (ie leader + traps) linear metre of net
Total Biomass Per Unit Effort	TOTAL_BPUE	Biomass Per Unit Effort of all fish combined (mean of all nets in lakes) BPUE of gill net = biomass of fish per linear metre of net BPUE of fyke net = biomass of fish per TOTAL (ie leader + traps) linear metre of net
Perch Catch Per Unit Effort	PERCH_CPUE	Catch Per Unit Effort of perch (mean of all nets in lakes) CPUE of gill net = number of fish per linear metre of net CPUE of fyke net = number of fish per TOTAL (ie leader + traps) linear metre of net
Perch Biomass Per Unit Effort	PERCH_BPUE	Biomass Per Unit Effort of perch (mean of all nets in lakes) BPUE of gill net = biomass of fish per linear metre of net BPUE of fyke net = biomass of fish per TOTAL (ie leader + traps) linear metre of net

Table 1.11 contd.: Definition of metrics used in the perch lakes tool

METRIC	METRIC CODE	DEFINITION
Roach Catch Per Unit Effort	ROACH_CPUE	Catch Per Unit Effort of roach (mean of all nets in lakes) CPUE of gill net = number of fish per linear metre of net CPUE of fyke net = number of fish per TOTAL (ie leader + traps) linear metre of net
Roach Biomass Per Unit Effort	ROACH_BPUE	Biomass Per Unit Effort of roach (mean of all nets in lakes) BPUE of gill net = biomass of fish per linear metre of net BPUE of fyke net = biomass of fish per TOTAL (ie leader + traps) linear metre of net

*See definitions in Table 1.8

Roach lakes

A total of 13 metrics are used in the roach lakes tool. Metric descriptions, codes and definitions of how each metric is calculated are given below (Table 1.12).

Table 1.12: Definition of metrics used in the roach lakes tool

METRIC	METRIC CODE	DEFINITION
Roach length at 3 years	ROACH_L3	Back calculated length (cm) of roach at 3 years
Number of species	SPE_NUM	Number of species recorded
% cyprinid species	CYP_%	% of species that are cyprinid* species
% individuals of perch	PERCH_%_IND	% of total individuals (excluding eels and adult salmon) that are perch
% biomass of perch	PERCH_%_BIO	% of total biomass (excluding eels and adult salmon) that are perch
% individuals of roach	ROACH_%_IND	% of total individuals (excluding eels and adult salmon) that are roach
% biomass of roach	ROACH_%_BIO	% of total biomass (excluding eels and adult salmon) that are roach
% biomass of cyprinid species	CYP_%_BIO	% of total biomass (excluding eels and adult salmon) that are cyprinid* species
% individuals that are piscivores	PISC_%_IND	% of total individuals (excluding eels and adult salmon) that are piscivores*

Table 1.12 contd.: Definition of metrics used in the roach lakes tool

METRIC	METRIC CODE	DEFINITION
Total Catch Per Unit Effort	TOTAL_CPUE	Catch Per Unit Effort of all fish combined (mean of all nets in lakes) CPUE of gill net = number of fish per linear metre of net CPUE of fyke net = number of fish per TOTAL (ie leader + traps) linear metre of net
Total Biomass Per Unit Effort	TOTAL_BPUE	Biomass Per Unit Effort of all fish combined (mean of all nets in lakes) BPUE of gill net = biomass of fish per linear metre of net BPUE of fyke net = biomass of fish per TOTAL (ie leader + traps) linear metre of net
Roach Catch Per Unit Effort	ROACH_CPUE	Catch Per Unit Effort of roach (mean of all nets in lakes) CPUE of gill net = number of fish per linear metre of net CPUE of fyke net = number of fish per TOTAL (ie leader + traps) linear metre of net
Roach Biomass Per Unit Effort	ROACH_BPUE	Biomass Per Unit Effort of roach (mean of all nets in lakes) BPUE of gill net = biomass of fish per linear metre of net BPUE of fyke net = biomass of fish per TOTAL (ie leader + traps) linear metre of net

*See definitions in Table 1.8

1.4.5 Inputting metric data into the ecological classification tool

Once all the metrics have been calculated, the data should be entered into the ecological classification tool program, following the instructions below:

1. Open the Ecological Classification Tool file named 'fish_in_lakes_ECT_2008.01.22'.

2. If prompted to enable or disable macros, click 'Enable Macros'.

3. A page should be displayed prompting the user to select a fish community type.

4. Click on the appropriate Fish Community Type for the lake in question.

5. An input form will be displayed with blank fields for the metric values to be entered.

6. Clicking a '?' beside each metric field will display a short description of that metric.

7. Enter the value of each metric in the appropriate field (**NOTE: ALL fields must be filled in to continue**).

8. When all metric values are entered, click 'Calculate Ecological Status Class'.

9. The Ecological Status of the lake will be displayed in a new window as High, Good, Moderate, Poor or Bad.

10. Click 'Close' in the results window to return to the input form.

11. To input data for another lake, click 'Clear All' to reset the form and then repeat steps 7 – 9 with the new data.

12. To **change the Fish Community Type**, click 'Choose different Fish Community Type'.

13. To exit the Ecological Classification Tool program, click 'Quit' and then 'Exit'.

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Appendix 1
List of freshwater fish species of Ireland

Category 1: Freshwater fish native to Ireland, North and/or south (Ecoregion 17)

Common name	Scientific name
Brook lamprey	*Lampetra planeri* (Bloch, 1784)
River Lamprey	*Lampetra fluviatilis* (Linnaeus, 1758)
Sea lamprey	*Petromyzon marinus* (Linnaeus, 1758)
Eel	*Anguilla anguilla* (Linnaeus, 1758)
Pollan	*Coregonus autumnalis* (Pallas, 1776)
Atlantic Salmon	*Salmo salar* Linnaeus, 1758
Trout/Sea trout	*Salmo trutta* Linnaeus 1758
Arctic char	*Salvelinus alpinus* (Linnaeus, 1758)
Allis shad	*Alosa alosa* (Lacépéde, 1803)
Twaite Shad	*Alosa fallax* (Lacépède, 1758)
Killarney Shad	*Alosa fallax Killarnensis* Regan 1908
Three spined Stickleback	*Gasterosteus aculeatus* Linnaeus, 1758
Nine spined stickleback	*Pungitius pungitius* Linnaeus, 1758
Flounder	*Platichthys flesus* (Linnaeus, 1758)

Category 2: Freshwater fish present but not native to Ireland (post glacial human introductions) influencing ecology (Species in bold are established in the wild)

Common name	Species name	Date of first record/introduction?
Roach	*Rutilus rutilus* (Linnaeus, 1758)	1889
Perch	*Perca fluviatilis* Linnaeus, 1758	After 1200
Pike	*Esox lucius* Linnaeus, 1758	After 1200
Bream	*Abramis brama* (Linnaeus, 1758)	No specific early records?
Dace	*Leuciscus leucuscus* (Linnaeus, 1758)	1889
Carp	*Cyprinus carpio* Linnaeus, 1758	1634
Rainbow trout*	*Onchorhynchus mykiss* (Walbaum, 1792)	Late 1800s
Chub	*Leuciscus cephalus* (Linnaeus, 1758)	2002 R.Inny (Shannon trib.)
Minnow	*Phoxinus phoxinus* (Linnaeus, 1758)	No specific early records?

*** only two known incidences of spawning populations in the wild**

Category 3: Freshwater fish present but not native to Ireland (post glacial human introductions) generally not influencing ecology (Species in bold established in the wild)

Common name	Species name	Date of first record/introduction?
Tench	*Tinca tinca* (Linnaeus, 1758)	1634
Rudd	*Scardinius erythrophthalmus* (Linnaeus, 1758)	No specific early records?
Stoneloach	*Barbatula barbatula* (Linnaeus, 1758)	After 1200
Gudgeon	*Gobio gobio* (Linnaeus, 1758)	No specific early records
Goldfish	*Carassius auratus* (Linnaeus, 1758)	Ongoing escapes regular
Orfe	*Leuciscus idus* (Linnaeus, 1758)	Ongoing escapes likely

Appendix 2

Example of NSSHARE field record sheet

NSSHARE FISH IN LAKES FIELD RECORD SHEET

NOTE: For NET ID use G1 = Gill net 1, G2 = Gill net 2, F1 = Fyke net 1, etc…

LAKE		**AIR TEMP** (℃)		**BATHYMETRY** (Y/N)	
IRISH GRID REF				**PHOTO** (Y/N)	
		SKY:	CLEAR/CLOUDY/MIST	**PERSONNEL**	
DATE SET					
DATE LIFT		**PRECIPITATION**:	DRY/LIGHT RAIN/HEAVY RAIN		
LAKE AREA (ha)		**WIND**:	CALM/LIGHT/MODERATE/STRONG	**BANK TYPE**	
MAX DEPTH (m)					
MEAN DEPTH (m)		**WIND DIRECTION**			

DPTH (m)	TEMP (℃)	DO (%)	DPTH (m)	TEMP (℃)	DO (%)
0			15		
1			20		
2			25		
3			30		
4			35		
6			40		
8			45		
10			50		

SECCHI DEPTH (m)	
pH	
CONDUCTIVITY (µS/cm)	
WATER SAMPLE TAKEN (Y/N)	
ZOOPLANKTON HAUL (Y/N)	

NET ID	TYPE	DEPTH RANGE (m)	TIME SET	TIME LIFT	IRISH GRID REF

Example of NSSHARE catch data sheet

NSSHARE FISH IN LAKES CATCH DATA SHEET								
NOTE: For NET ID use G1 = Gill net 1, F1 = Fyke net 1, etc…								
LAKE					**DATE SET**			
IRISH GRID REF					**DATE LIFT**			
FISH No.	**NET ID**	**MESH SIZE**	**SPECIES**	**LENGTH (cm)**	**WEIGHT (g)**	**SEX**	**SCALES TAKEN**	**AGE**