

NATIONAL PARKS AND WILDLIFE SERVICE



A STUDY OF LAKES WITH  
SLENDER NAIAD (*NAJAS  
FLEXILIS*) – APPENDIX V  
SITE REPORTS



Cilian Roden, Paul Murphy & Jim B.  
Ryan



An Roinn Tithíochta,  
Rialtais Áitiúil agus Oidhreachta  
Department of Housing,  
Local Government and Heritage

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Front cover, small photographs from top row:

**Limestone pavement**, Bricklieve Mountains, Co. Sligo, Andy Bleasdale; **Meadow Saffron** *Colchicum autumnale*, Lorcan Scott; **Garden Tiger** *Arctia caja*, Brian Nelson; **Fulmar** *Fulmarus glacialis*, David Tierney; **Common Newt** *Lissotriton vulgaris*, Brian Nelson; **Scots Pine** *Pinus sylvestris*, Jenni Roche; **Raised bog pool**, Derrinea Bog, Co. Roscommon, Fernando Fernandez Valverde; **Coastal heath**, Howth Head, Co. Dublin, Maurice Eakin; **A deep water fly trap anemone** *Phelliactis* sp., Yvonne Leahy; **Violet Crystalwort** *Riccia huebeneriana*, Robert Thompson

Main photograph:

**Slender Naiad** *Najas flexilis* growing in a carpet of *Chara virgata* and *Chara aspera* in Kiltorris Lough at 2 m  
Cilian Roden



## A study of lakes with Slender Naiad (*Najas flexilis*) – Appendix V Site Reports

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## Introduction to Appendix V

This file accompanies the main report:

Roden, C., Murphy, P. & Ryan, J.B. (2021) A study of lakes with Slender Naiad (*Najas flexilis*). *Irish Wildlife Manuals*, No. 132 National Parks and Wildlife Service, Department of Housing, Local Government and Heritage, Ireland.

It contains Appendix V, the Site Reports for lakes surveyed in 2016, 2017 and 2018.

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## Appendix V Site Reports

This appendix includes site reports for each of the lakes surveyed in 2016, 2017 and 2018. Reports are ordered alphabetically by lake name.

Most site reports follow a consistent format composed of the following sections and tables

1. A table of summary data for the lake (see template below)
2. A 'previous accounts' section providing notes on earlier surveys of aquatic vegetation at the lake
3. A 'species recorded' section providing data, in a standardised table, on species recorded in the lake during the project (2016-2018) and by previous surveyors, as well as associated notes on interesting, rare or characteristic species
4. A '*Najas flexilis*' section providing information on the distribution and abundance of the species, where recorded in the lake
5. A 'vegetation' section providing data on the vegetation communities recorded during the project (2016-2018), including a lake map
6. A 'water chemistry data' section providing summary hydrochemical data
7. A 'pressures and threats' section providing information on any pressures or threats documented in the lake and its catchment during the survey
8. A 'conservation condition' section providing details of the assessment of the conservation condition of the habitat and species, where present, in the lake. This includes a standardised condition assessment table.

The following is a key to the table provided at the start of each site report:

<b>Name</b>	Lake name used in survey	<b>Code</b>	Codes used in graphs in main text
<b>Alternative name(s)</b>	Other names used in maps, literature, by Environmental Protection Agency (EPA) or other sources.		
<b>Grid Reference</b>	10-figure with grid square for lake centroid	<b>Max. depth (m)</b>	Maximum depth in metres from bathymetric or other sources, where available
<b>County</b>	County/ies within which lake is situated	<b>EPA code</b>	EPA WFD lake water body code
<b>Area (ha)</b>	Approximate lake surface area in hectares (ha)	<b>OSi 1:50,000 sheet</b>	OSi Discovery Series, 1:50,000 map sheet
<b>Maximum length (km)</b>	Maximum lake surface length, estimated using GIS	<b>Nutrient data</b>	Source and date-span
<b>Altitude (m)</b>	Altitude above sea level in metres from OSi Discovery Series, 1:50,000	<b>SAC</b>	6-digit code and name of Special Area of Conservation (SAC), where applicable
<b>Geology</b>	Main bedrock type(s) underlying and surrounding the lake basin		
<b>Previous survey</b>	Surveyor, survey date and/or citation for previous vegetation survey		
<b>Previous <i>Najas flexilis</i> records</b>	Year and recorder for pre-2016 records of the species		
<b>Other Noteworthy species</b>	Lists any noteworthy macrophyte records for the lake from previous surveys		
<b>Snorkel survey date(s)</b>	Date(s) of conservation condition snorkel survey of submerged vegetation	<b>Number of species</b>	The number of macrophyte species/taxa recorded during the survey

<b>Surveyors</b>	Names of surveyors, including snorkellers and recorder: Cilian Roden (CR), Paul Murphy (PM), Jim Ryan (JR)	<b>Alkalinity (mg/l CaCO<sub>3</sub>)</b>	Alkalinity of water
<b>Number of transects</b>	Number of transects sampled during the survey	<b>Total phosphorus (mg/l TP)</b>	Total phosphorus concentration
<b>Number of relevés</b>	Total number of relevés sampled across all transects	<b>Colour (Hazen units)</b>	Water colour
<b>Euphotic depth (m)</b>	Maximum depth of colonisation of vegetation, in metres, across transects surveyed	<b>Secchi depth (m)</b>	Secchi depth, where recorded during the survey
<b><i>Najas flexilis</i></b>	Brief notes on Slender Naiad <i>Najas flexilis</i> population, if found		
<b>Deep-water vegetation</b>	Characteristic <i>Najas flexilis</i> -type lake deep-water vegetation, if recorded		
<b>Noteworthy species</b>	Lists of noteworthy macrophytes recorded during the survey		
<b>Introduced species</b>	Introduced, non-native species, commonly <i>Elodea canadensis</i> , not previously known from the lake and with potential to impact (through competition or otherwise) on <i>Najas flexilis</i> or other sensitive species		
<b>Substrates</b>	Substrates recorded in relevés during the survey		
<b>Summary</b>	Summary description of lake, its conservation value and conservation condition		
<b>Lake score</b>	Score based on area, species richness, number of relevés with <i>Najas flexilis</i> and euphotic depth (See Chapter 6)	<b>Lake rank</b>	Ranking of lake relative to other study sites, based on lake score (see Chapter 6)
<b>CONSERVATION CONDITION</b>	Conservation condition of the lake		

The following is a key to the conservation condition assessment table provided at the end of each site report. The conservation condition assessment parameters and targets used are as follows (see also Sections 5.1 and 5.3):

Parameter	Favourable or Good	Unfavourable-Inadequate or Poor	Unfavourable-Bad or Bad
Area of habitat	Stable or increasing	Decrease <10%	Decrease >10%
Deep-water community	Full development	Marginal	Absent
Number of species	Stable or increase in number	10% decline in species	>10% decline in species
Typical species	9 or more indicator species	<9	undefined
<i>Najas flexilis</i> population	Evidence indicates stable population (in terms of extent, size & health)	Evidence of decline in population	Population extinct or reduced to a few plants/single location
Introduced Species	Not present or having no impact on <i>Najas flexilis</i> population or deep water community	Abundant introduced species ⇒ decline in <i>Najas flexilis</i> population or deep water community	<i>Najas flexilis</i> or deep-water community entirely replaced by introduced species
Euphotic depth	≥3 m	2-3 m	<2 m
Colour	<40	40-80	>80
Total phosphorus	<0.015	≥0.015	undefined
Hydrological regime	Summer levels: <50% <i>Lobelia</i> – <i>Littorella</i> zone exposed	Summer levels: >50% <i>Lobelia</i> – <i>Littorella</i> zone exposed	Summer levels: at/below top of the <i>Isoetes</i> zone

The condition assessment tables in each site report are formatted as follows:

Parameter	Target for Good	Lake-specific data	Condition
Area of habitat	Stable or increasing		Good/Poor/Bad
Deep-water community	Full development		Good/Poor/Bad
Number of species	Stable or increase	*	Good/Poor/Bad
Typical species	≥9 indicator species		Good/Poor/Bad
<i>Najas flexilis</i> population	Stable population		Good/Poor/Bad
Introduced species	Not present/not impacting on <i>Najas flexilis</i> / deep-water community		Good/Poor/Bad
Euphotic depth (m)	≥3		Good/Poor/Bad
Colour (Hazen units)	<40		Good/Poor/Bad
Total phosphorus (TP) (mg/l)	<0.015		Good/Poor/Bad
Hydrological regime	<50% <i>Lobelia</i> – <i>Littorella</i> zone exposed in summer		Good/Poor/Bad
<b>Overall assessment</b>			Good/Poor/Bad

\* any recorded increases in numbers of species results from more thorough survey and does not represent an actual increase in species-richness at the lake; the number of species recorded during this survey is given in parenthesis

Three maps are provided with most site reports:

1. The first shows the locations of all relevés sampled, labelled by unique relevé code
2. The second shows the locations of relevés containing *Najas flexilis*. Relevés with the species are shown as red discs, scaled in accordance with the cover abundance of *Najas flexilis*. The largest discs represent cover abundance 5, or more than 75% cover (see table below). Relevés without the species are shown as white discs
3. The third map shows the vegetation community found in each relevé.

Modified Braun-Blanquet cover scale

Braun-Blanquet scale	Braun-Blanquet % cover	Modified marl lake scale	Modified marl lake % cover
5	75–100%	5	>75%
4	50–75%	4	50–75%
3	25–50%	3	25–50%
2	5–25%	2	5–25%
1	<5%; numerous individuals	1	1–5%
+	<5%; few individuals	0.1	<1%

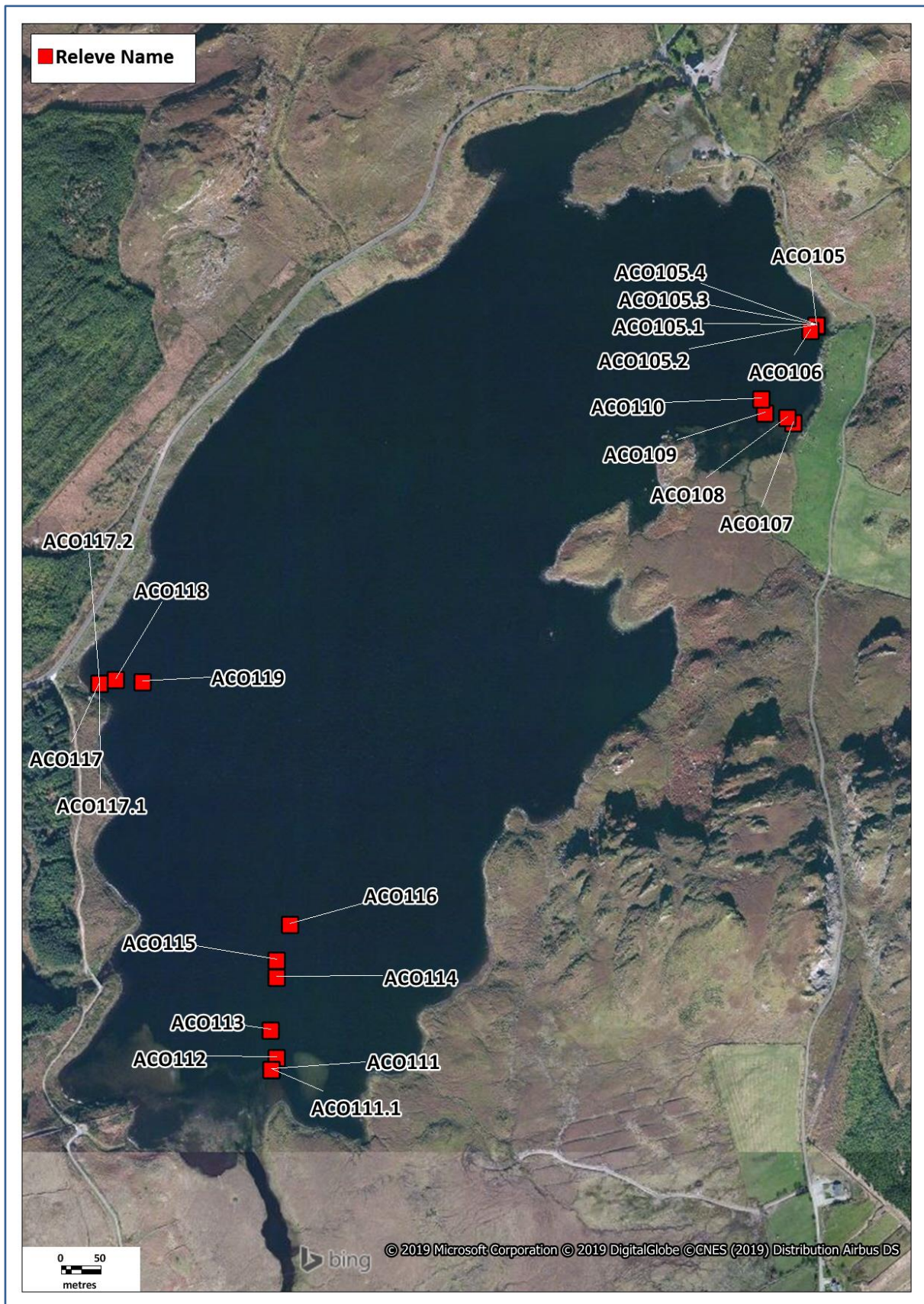
Lough Acoose, 2018			
Name	Lough Acoose		Code ACO
Alternative name(s)			
Grid reference	V7561585251	Max. depth (m)	19 (Connor <i>et al.</i> , 2018)
County	Kerry	EPA code	22_208
Area (ha)	67	OSi 1:50,000 sheet	78
Maximum length (km)	1.4	Nutrient data	EPA 2009-2015
Altitude (m)	158	SAC	000365, Killamey National Park, Macgillycuddy's Reeks and Caragh River Catchment SAC
Geology	Old Red Sandstone		
Previous survey	Visser & Zoer (1972, 1976), FitzGerald & Preston (1994), Roden (2004), EPA in 2008, 2011, 2014		
Previous <i>Najas flexilis</i> records	G. Visser and J.A. Zoer 28/07/1971, R. FitzGerald 08/09/1994, C. Roden 31/08/2004, EPA 05/08/2011		
Other noteworthy species	<i>Potamogeton praelongus</i> , <i>Subularia aquatica</i> . A 2011 record for <i>Potamogeton obtusifolius</i> requires confirmation		
Snorkel survey date(s)	04/09/2018	Number of species	24
Surveyors	PM, CR, JR	Alkalinity (mg/l CaCO <sub>3</sub> )	6.1
Number of transects	4	Total phosphorus (mg/l TP)	0.009
Number of relevés	21	Colour (Hazen units)	30
Euphotic depth (m)	2.9	Secchi depth (m)	4.5
<i>Najas flexilis</i>	Large population throughout the lake		
Deep-water vegetation	Full development		
Noteworthy species	<i>Isoetes echinospora</i> , <i>Najas flexilis</i> , <i>Potamogeton praelongus</i>		
Introduced species	None noted		
Substrates	Fine mud sand cobbles, rock		
Summary	Lough Acoose is an oligotrophic lake on Devonian sandstone. It is in good conservation condition with a <i>Najas flexilis</i> population first recorded in 1971		
Lake score	174	Lake rank	3
CONSERVATION CONDITION	<b>GOOD</b>		

### Previous accounts

1. Scully (1916) noted *Potamogeton praelongus*, an unusual plant for an oligotrophic lake. *Subularia aquatica* was also noted in the lake in 1882 by Hart and subsequently by Scully (Scully, 1916). It was not seen in the present survey.
2. A reference in FitzGerald & Preston (1994) to a record of *Najas flexilis* in Lough Acoose by Scully in 1899, appears to have been a result of a misinterpretation on an NPWS database of the locality of 'Glencar'. Praeger (1901) refers to a record by Scully in 1899 as 'Glencar', separate to Scully's 1896 record from Lough Caragh. Scully (1916), however, stated that *Najas flexilis* was known from only three lakes in Kerry: Upper, Leane and Caragh; his record from the latter being 'In the south-western corner of Caragh Lake, Glencar, 1896-1906'. The reference in Praeger (1901) to 'Glencar' appears to have been erroneously attributed to 'Lough Acoose?' in an internal NPWS database.
3. The earliest record of *Najas flexilis* in Lough Acoose, therefore, appears to have been by two Dutch ecologists who found *Najas flexilis* in the southern part of the lake in 1971 (Visser & Zoer, 1972, 1976).
4. In September 1994, Lady Rosemary FitzGerald dredging from a rubber dinghy found *Najas flexilis* in the north-eastern sector of the lake (FitzGerald & Preston, 1994).
5. Roden (2004) snorkelled a transect in the north-eastern corner of the lake and recorded *Najas* and the associated flora. He distinguished a *Littorella* shore zone, followed by a *Isoetes lacustris* zone and then *Najas*, *Potamogeton berchtoldii* and *Nitella translucens*.

- In 2011 and 2014, the EPA examined the vegetation along four transects spaced around the lake. No written account is provided but the data yield a species list. In addition chemical data were also collected.

See also NPWS (2017d, e).



## Species recorded

During the 2018 survey, 24 species were recorded from Lough Acoose, most of which are widespread in soft-water lakes. In total, 27 species have been recorded (see table below). In addition, a record for *Potamogeton obtusifolius*, not included in the table, requires confirmation.

Taxon –Acoose	Before this survey	In this survey (2018)	Taxon –Acoose	Before this survey	In this survey (2018)
Charophytes			<i>Isoetes lacustris</i>	1	1
<i>Chara aspera</i>			<i>Juncus bulbosus</i>		1
<i>Chara curta</i>			<i>Lemna minor</i>		
<i>Chara globularis</i>			<i>Lemna trisulca</i>		
<i>Chara rudis</i>			<i>Littorella uniflora</i>	1	1
<i>Chara virgata</i>	1	1	<i>Lobelia dortmanna</i>	1	1
<i>Nitella confervacea</i>			<i>Myriophyllum alterniflorum</i>	1	1
<i>Nitella flexilis</i>	1	1	<i>Myriophyllum spicatum</i>		
<i>Nitella gracilis</i>			<i>Najas flexilis</i>	1	1
<i>Nitella opaca</i>			<i>Nuphar lutea</i>	1	1
<i>Nitella translucens</i>	1	1	<i>Nymphaea alba</i>		
<i>Tolypella glomerata</i>			<i>Oenanthe fluviatilis</i>		
<i>Chara cf. muscosa</i>			<i>Phragmites australis</i>	1	
Other algae			<i>Pilularia globulifera</i>		
<i>Ophrydium versatile</i>			<i>Potamogeton alpinus</i>		
Bryophytes			<i>Potamogeton berchtoldii</i>	1	1
<i>Fissidens fontanus</i>			<i>Potamogeton crispus</i>		
<i>Fontinalis antipyretica</i>	1	1	<i>Potamogeton filiformis</i>		
<i>Sphagnum</i> sp.		1	<i>Potamogeton gramineus</i>		
Vascular Plants			<i>Potamogeton lucens</i>		
<i>Alisma plantago-aquatica</i>			<i>Potamogeton natans</i>	1	1
<i>Apium inundatum</i>			<i>Potamogeton obtusifolius</i>		
<i>Baldellia ranunculoides</i> subsp. <i>ranunculoides</i>			<i>Potamogeton pectinatus</i>		
<i>Baldellia ranunculoides</i> subsp. <i>repens</i>			<i>Potamogeton perfoliatus</i>	1	
<i>Callitriche brutia</i> subsp. <i>hamulata</i>		1	<i>Potamogeton polygonifolius</i>		
<i>Callitriche hermaphroditica</i>			<i>Potamogeton praelongus</i>	1	1
<i>Carex rostrata</i>			<i>Potamogeton pusillus</i>		
<i>Ceratophyllum demersum</i>			<i>Potamogeton × angustifolius</i>		
<i>Cladium mariscus</i>			<i>Potamogeton × nitens</i>		
<i>Elatine hexandra</i>		1	<i>Ranunculus</i> sp.		
<i>Eleocharis acicularis</i>			<i>Schoenoplectus lacustris</i>		1
<i>Eleocharis multicaulis</i>			<i>Sparganium angustifolium</i>		1
<i>Eleocharis palustris</i>			<i>Sparganium emersum</i>		
<i>Eleogiton fluitans</i>		1	<i>Sparganium erectum</i>		1
<i>Elodea canadensis</i>			<i>Sparganium natans</i>		
<i>Equisetum fluviatile</i>	1	1	<i>Subularia aquatica</i>	1	
<i>Eriocaulon aquaticum</i>			<i>Typha angustifolia</i>		
<i>Hydrilla verticillata</i>			<i>Utricularia</i> sp.		1
<i>Isoetes echinospora</i>		1	<i>Zannichellia palustris</i>		

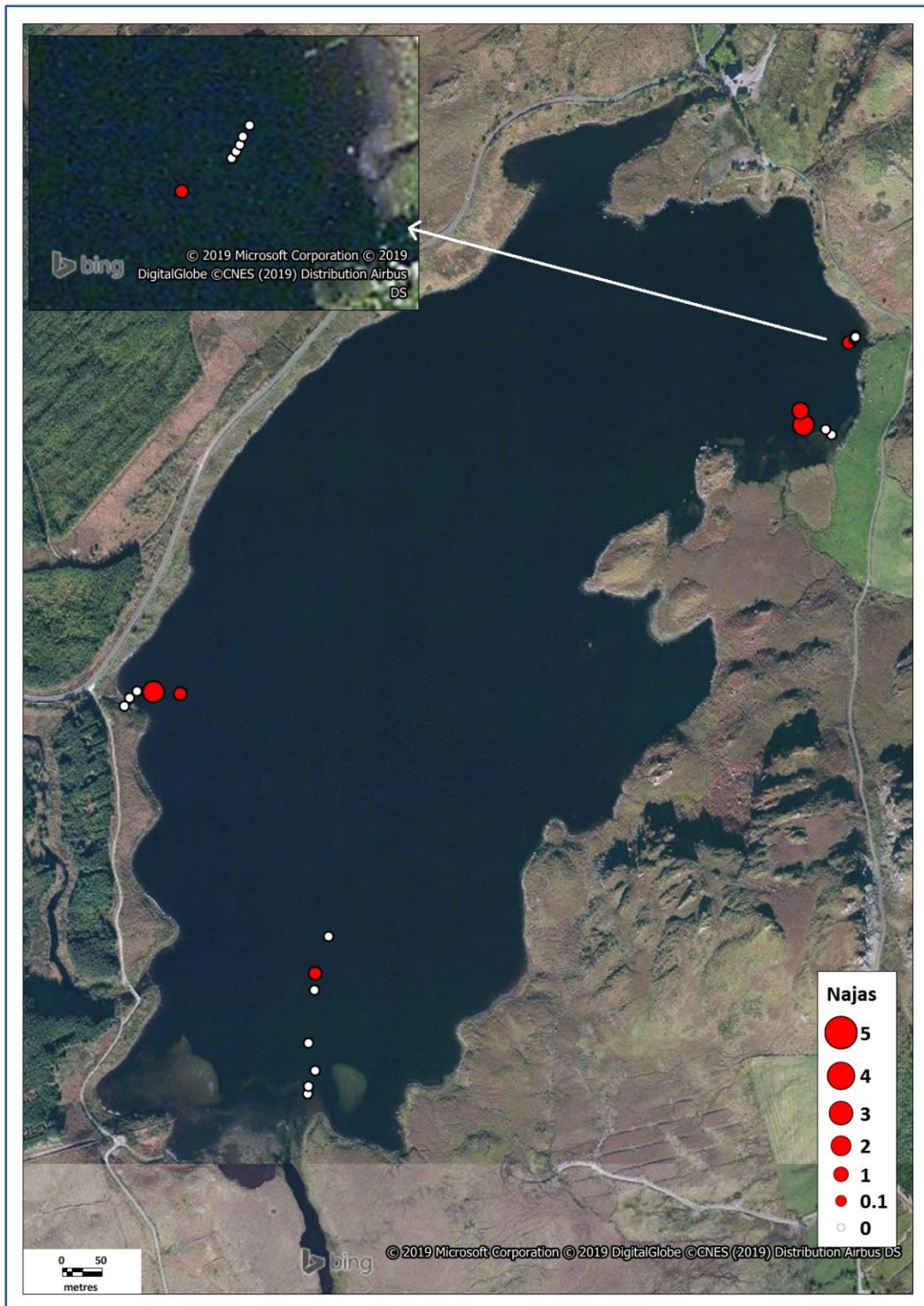
Noteworthy species recorded from Lough Acoose include *Najas flexilis*, *Isoetes echinospora*, *Potamogeton praelongus*, *Subularia aquatica*. A record for *Potamogeton obtusifolius* by the EPA in 2011 requires confirmation as the species is very rare in the south-west of Ireland.

- *Isoetes echinospora* occurs in the north-eastern sector and might be more widespread. It is probably under-recorded in Irish habitats.

- *Potamogeton praelongus* is usually a species of base-rich lakes, its presence in an oligotrophic sandstone lake is unusual.

### *Najas flexilis*

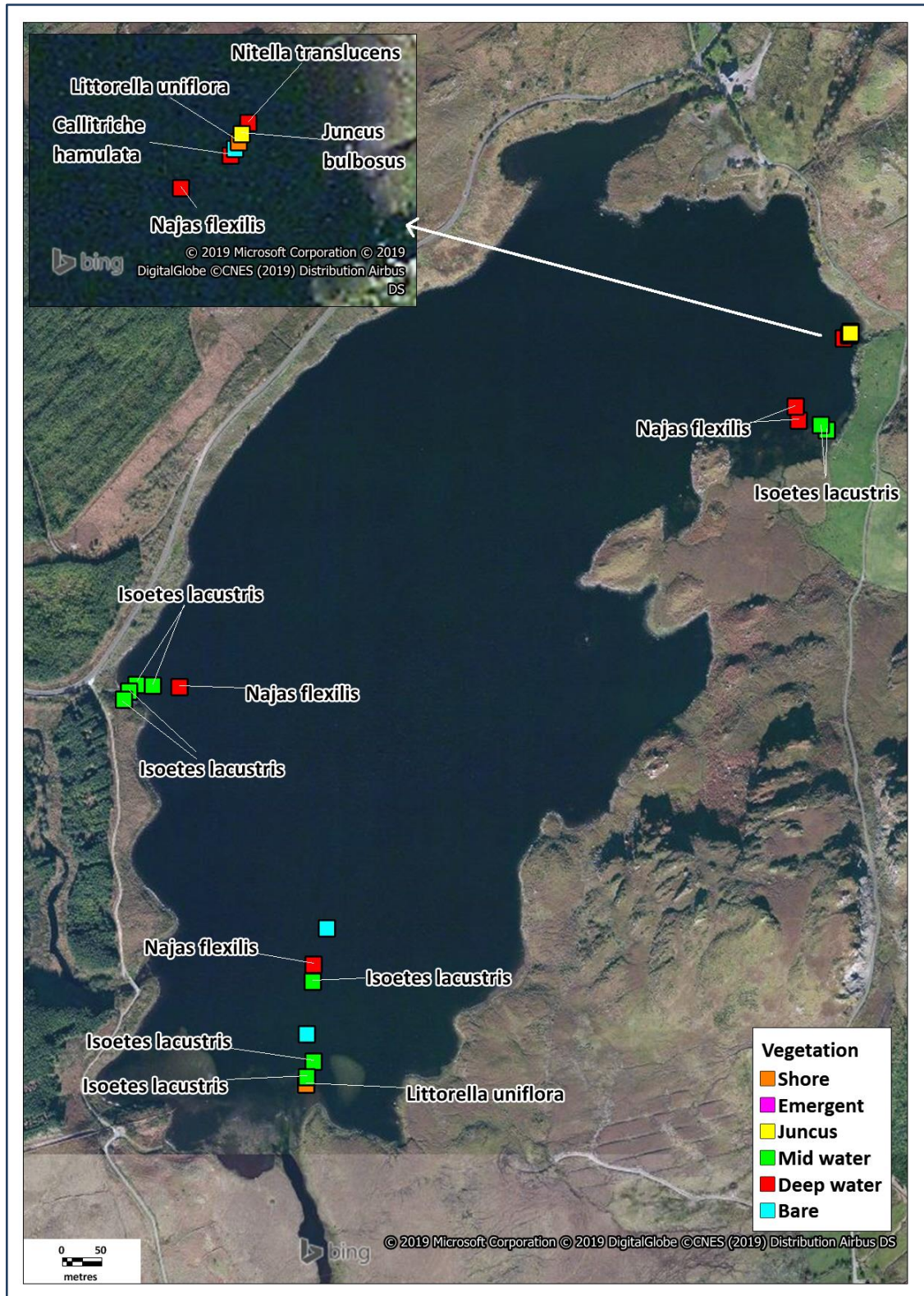
The plant was recorded on all four transects, with a depth range from 1.8-3 m, at densities of up to 25% cover. The plant grows on reddish silt. It appears to occur throughout the lake. Assuming it occupies a band of about 10 m wide between 2 m and 3 m depth, the species habitat is about 4.0 ha in Lough Acoose. There are no obvious threats to the plant at present. Given that *Najas* was not found in Lough Leane or the Upper Lake in 2018, it's abundance in the nearby Lough Acoose suggests a certain resilience in the population, reinforced by the fact that the species has always been located when searched for since discovery in 1971.





## Vegetation

Most of the shore of Lough Acoose has large cobbles, bedrock or gravel. With increasing depth, sand becomes more common and gives way in turn to silt and mud. The lake is nutrient-poor. Shore vegetation is sparse and consists of *Littorella*, *Lobelia* and some *Isoetes lacustris* and *Elatine hexandra*. In sheltered, more silty areas stands of *Equisetum fluviatile*, *Nuphar lutea* and *Potamogeton natans* also occur. Below 1 m, *Isoetes lacustris* is dominant with associates such as *Elatine hexandra*, *Nitella translucens*, *Myriophyllum alterniflorum*, *Juncus bulbosus* and *Fontinalis antipyretica*. Below 2 m to the base of the euphotic zone, deep-water *Najas flexilis* vegetation occurs. Vegetation ceases at 2.9-3.0 m.



## Water chemistry data

Water quality data for the period 2009 to 2015 were made available by the EPA, for many samples from multiple depths. Values presented and used in assessment are averages of all data.

Parameter	Unit	Lough Acoose EPA 2009-2015
Alkalinity	mg/l	6.1
Calcium	mg/l	1.5
Chloride	mg/l	11.6
Chlorophyll	µg/l	7.5
Colour	Hazen units	30
Conductivity	µS/cm	51
Magnesium	mg/l	1.2
pH		6.7
Potassium	mg/l	0.3
Secchi	m	3.5
Sulphate	mg/l	2.99
Total oxidised nitrogen	mg/l	0.15
Total phosphorus	mg/l	0.009

## Pressures and threats

No current pressures were identified during this field survey to Lough Acoose. The lake appears to be in good conservation condition and is rated as in good ecological status by the EPA in the 2015 reporting period. Lough Acoose is within the Kerry Life project area as it is an important system (Caragh) for the Freshwater Pearl Mussel *Margaritifera margaritifera*.

## Conservation condition

While the number of species recorded is less than 30, there is no evidence of species loss over time other than a failure to relocate *Subularia aquatica*. All other metrics are good.

Parameter	Target for Good	Lough Acoose 2018	Condition
Area of habitat	Stable or increasing	Stable or increasing	Good
Deep-water community	Full development	Full development	Good
Number of species	Stable or increase	Increase (24)	Good
Typical species	≥9 indicator species	9	Good
<i>Najas flexilis</i> population	Stable population	Stable	Good
Introduced species	Not present/not impacting on <i>Najas flexilis</i> / deep-water community	Not present	Good
Euphotic depth (m)	≥3	2.9-3.0	Good
Colour (Hazen units)	<40	30	Good
Total phosphorus (TP) (mg/l)	<0.015	0.009	Good
Hydrological regime	<50% <i>Lobelia – Littorella</i> zone exposed in summer	-	Good
<b>Overall assessment</b>			<b>Good</b>

Lough Akibbon, 2018			
Name	Akibbon	Code	AKI
Alternative name(s)			
Grid reference	C0686318565	Max. depth (m)	>3
County	Donegal	EPA code	39_11
Area (ha)	45	OS 1:50,000 sheet	6
Maximum length (km)	1.3	Nutrient data	EPA 2009-2015, Heuff 1977, AFF 1973
Altitude (m)	68	SAC	002176, Leannan River SAC
Geology	Dalradian schist and marble		
Previous survey	Heuff (1984), C.D. Preston and N.F. Stewart in 1991, Roden (2002), EPA in 2009, 2012, 2015		
Previous <i>Najas flexilis</i> records	H. Heuff and J. Ryan 22/09/1977, N.F. Stewart 14/07/1991 and 07/09/1991, C. Roden 01/08/2002, D.T. Holyoak 04/08/2002, EPA 11/06/2009 and 2012		
Other noteworthy species	<i>Nitella conferva</i> , <i>Pilularia globulifera</i>		
Snorkel survey date(s)	22/08/2018	Number of species	27
Surveyors	PM, CR, JR	Alkalinity (mg/l CaCO <sub>3</sub> )	37.8
Number of transects	3	Total phosphorus (mg/l TP)	0.012
Number of relevés	23	Colour (Hazen units)	56
Euphotic depth (m)	3.0	Secchi depth (m)	-
<i>Najas flexilis</i>	Large population throughout the lake		
Deep-water vegetation	Full development		
Noteworthy species	<i>Nitella conferva</i> , <i>Pilularia globulifera</i>		
Introduced species	None noted		
Substrates	Fine mud sand cobbles, rock		
Summary	A mesotrophic lake which may be somewhat eutrophicated. Nevertheless it contains a very well-developed benthic flora and an important population of <i>Najas flexilis</i>		
Lake score	186	Lake rank	3
CONSERVATION CONDITION	GOOD / POOR		

### Previous accounts

1. Hart (1898) noted *Potamogeton alpinus* in the lake outflow to Gartan Lough.
2. Heuff (1984) gave the first description based on a snorkelling survey in September 1977. This description is not very different to that from the 2018 survey. The presence of *Najas flexilis* was noted, as well as many *Potamogeton* species and *Pilularia globulifera* (not seen in present survey). Vegetation included emergents on the western shore (*Carex rostrata*, *Phragmites australis* and *Schoenoplectus lacustris*) but not on the exposed eastern shore where *Littorella* occurred. The submergent zone consisted of patches of *Najas flexilis*, *Sparganium emersum* and *Chara virgata* also with some *Pilularia*, but with *Isoetes lacustris* dominant.
3. N.F. Stewart and C.D. Preston recorded *Najas flexilis* in 1991.
4. Roden (2002, 2004) examined the site in 2002 (see copy of his report below).
5. The EPA surveyed the vegetation in 2009, 2012 and 2015. As noted elsewhere, the boat-based method used is not as accurate as snorkelling and some very common species in the lake, such as *Chara virgata* and *Isoetes lacustris*, were not recorded. *Najas*, while apparently common in 2009, did not occur in 2015. The species list from all three EPA surveys is consistent with other lists although *Potamogeton pectinatus* is a surprising species. Because of these problems with the methodology, it is not possible to use the EPA data for a vegetation map but it is clear that several recognisable communities occur. These include a *Najas*—*Nitella*—*Potamogeton perfoliatus*—*Callitriche* community at depth, a *Littorella* community and several emergent species (e.g. *Schoenoplectus* and *Equisetum fluviatile*).

Roden (2002) data

<b><i>Najas flexilis</i></b>	<b>Discovery series map:</b> 6	<b>Grid reference:</b> C074190
<b>Locality:</b> Lough Akibbon	<b>Vice county:</b> H35	<b>SAC/NHA name &amp;no:</b> 002176
<b>Date:</b> 01/08/2002	<b>Recorder:</b> Cilian Roden	

**Site description:** Lough Akibbon is a large dystrophic lake surrounded by hills. The north-east end is floored with sand gravel and silt. The water is strongly stained with bog runoff. The greatest depth recorded was 4 m.

**Population:** A sparse population was found at the north-east end midway between the east and west shores at a depth of 4 m. Given the large size of the lake, the total population may be large (>1000 plants).

**Vegetation:** The plant occurs with *Nitella batrachosperma*, *Nitella flexilis*, *Potamogeton berchtoldii* and *Potamogeton perfoliatus*. Only the two *Nitella* species occur in any great density.

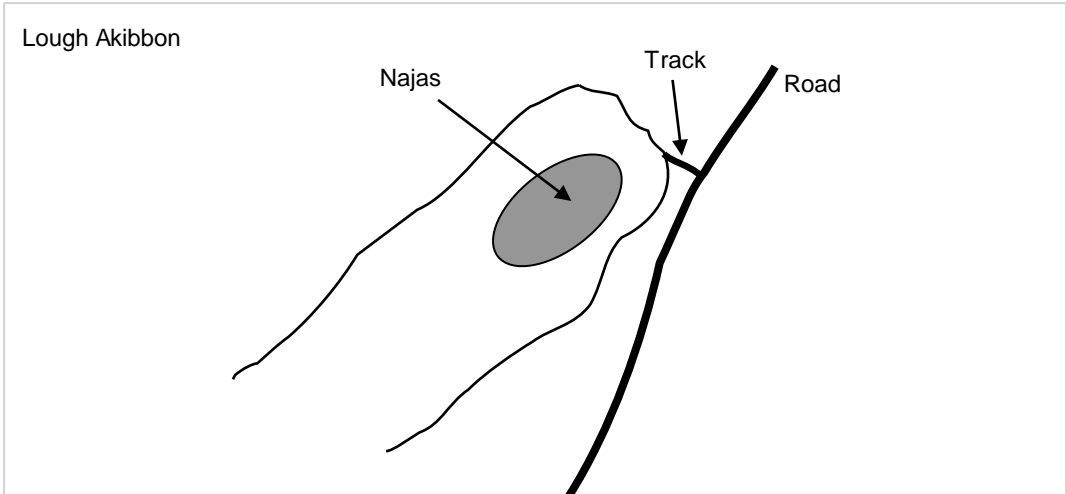
**Management:**

**Threats:** No obvious threats

**Access:** By track from the road to the east of the lake.

**Conservation:** The lake is an unusual habitat for *Najas* which tends to occur in clearer and less oligotrophic sites.

**Remarks:** The most inland and dystrophic site in Donegal for *Najas*.



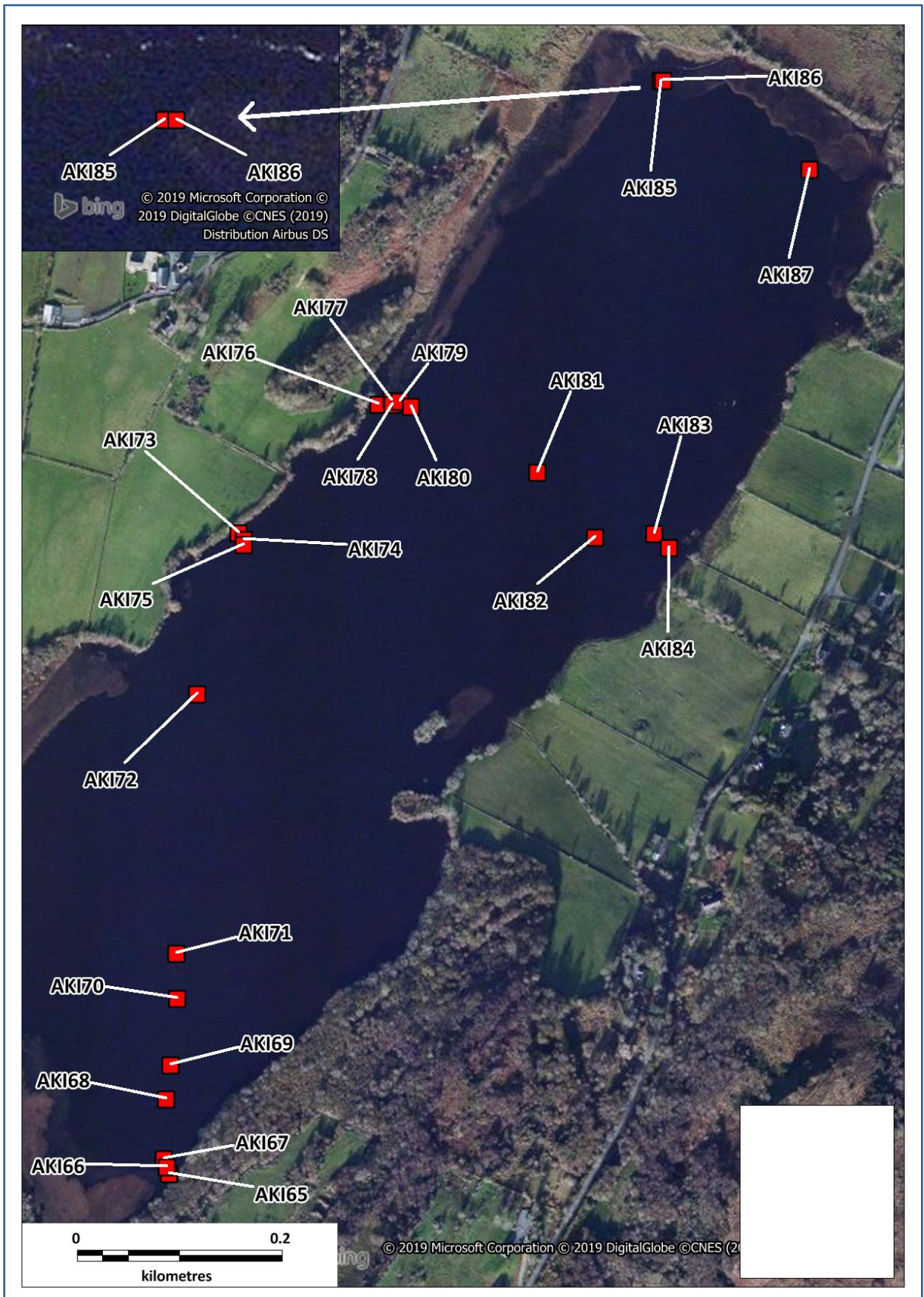
See also NPWS (2019a, b).

### Species recorded

During the 2018 survey, 27 species were recorded from Lough Akibbon. Most are widespread in soft-water lakes. In total, 34 species have been recorded (see table below). Noteworthy species recorded from Akibbon include *Najas flexilis* (see below), *Nitella confervacea* and *Pilularia globulifera*.

- *Nitella confervacea* is known at present from c. 25 hectads (10 × 10 km squares) and this is one of four recent records from Co. Donegal. The plant is occasional at 2-3 m throughout the lake and was first noted in 2002 by Roden (2002).

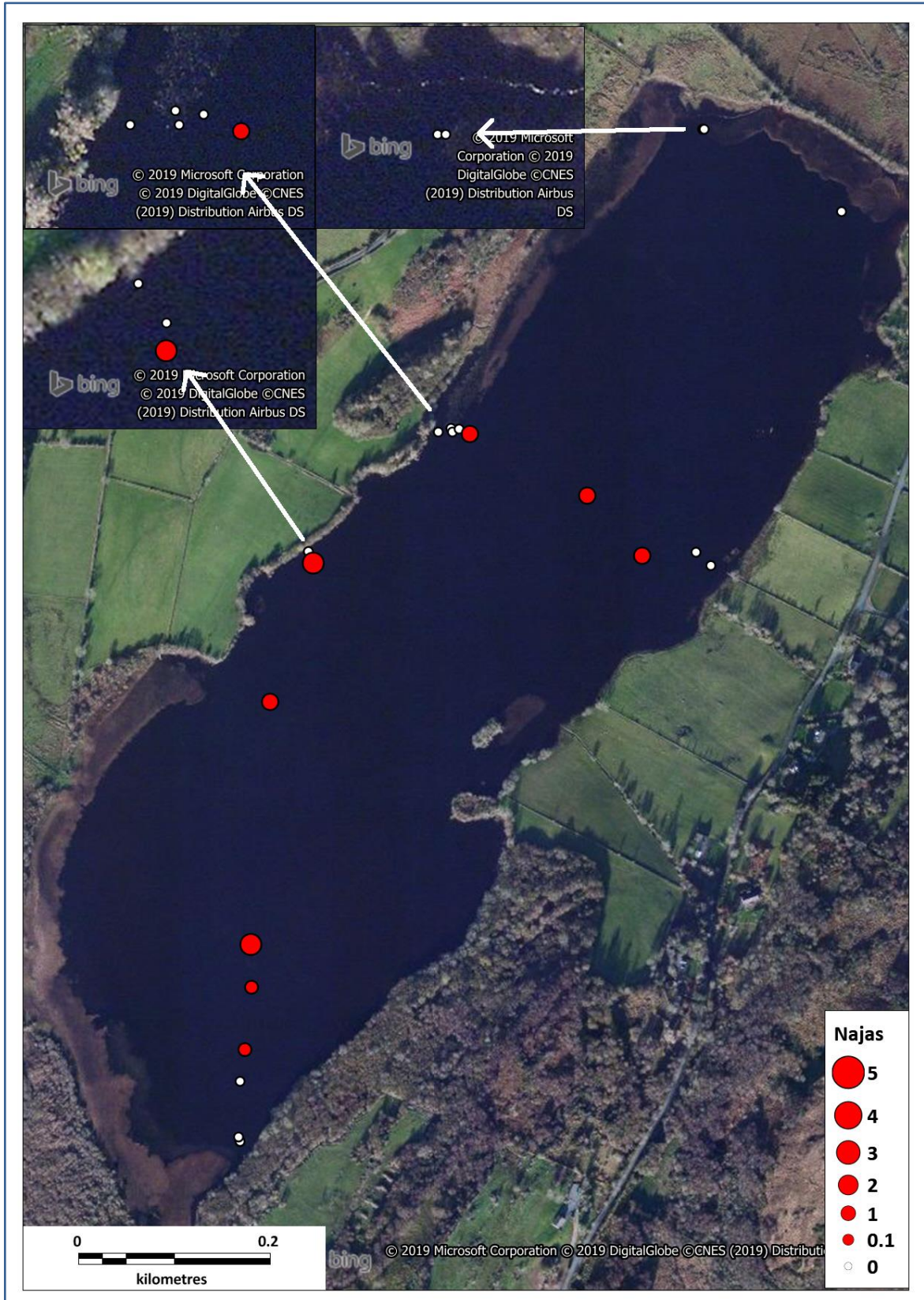
- *Pilularia globulifera* was recorded in 1977 by H. Heuff and J. Ryan at one location on the eastern shore of the lake (Heuff, 1984) but was not seen in the present survey. It probably still occurs but cannot be widespread in the lake.
- In this survey, plants of *Potamogeton pusillus* were confirmed but it is almost certain that plants of the very similar *Potamogeton berchtoldii* occurred as well.



Taxon –Akibbon	Before this survey	In this survey (2018)	Taxon –Akibbon	Before this survey	In this survey (2018)
Charophytes			<i>Isoetes lacustris</i>	1	1
<i>Chara aspera</i>			<i>Juncus bulbosus</i>		
<i>Chara curta</i>			<i>Lemna minor</i>		
<i>Chara globularis</i>			<i>Lemna trisulca</i>		
<i>Chara rudis</i>			<i>Littorella uniflora</i>	1	1
<i>Chara virgata</i>	1	1	<i>Lobelia dortmanna</i>	1	
<i>Nitella confervacea</i>	1	1	<i>Myriophyllum alterniflorum</i>	1	1
<i>Nitella flexilis</i>	1	1	<i>Myriophyllum spicatum</i>		
<i>Nitella gracilis</i>			<i>Najas flexilis</i>	1	1
<i>Nitella opaca</i>			<i>Nuphar lutea</i>	1	
<i>Nitella translucens</i>		1	<i>Nymphaea alba</i>	1	1
<i>Tolypella glomerata</i>			<i>Oenanthe fluviatilis</i>		
<i>Chara cf. muscosa</i>			<i>Phragmites australis</i>	1	1
Other algae			<i>Pilularia globulifera</i>	1	
<i>Ophrydium versatile</i>			<i>Potamogeton alpinus</i>	1	1
Bryophytes			<i>Potamogeton berchtoldii</i>	1	1
<i>Fissidens fontanus</i>			<i>Potamogeton crispus</i>	1	1
<i>Fontinalis antipyretica</i>	1	1	<i>Potamogeton filiformis</i>		
<i>Sphagnum</i> sp.			<i>Potamogeton gramineus</i>	1	1
Vascular Plants			<i>Potamogeton lucens</i>	1	1
<i>Alisma plantago-aquatica</i>		1	<i>Potamogeton natans</i>	1	
<i>Apium inundatum</i>			<i>Potamogeton obtusifolius</i>	1	1
<i>Baldellia ranunculoides</i> subsp. <i>ranunculoides</i>	1		<i>Potamogeton pectinatus</i>		
<i>Baldellia ranunculoides</i> subsp. <i>repens</i>			<i>Potamogeton perfoliatus</i>		1
<i>Callitriche brutia</i> subsp. <i>hamulata</i>			<i>Potamogeton polygonifolius</i>		
<i>Callitriche hermaphroditica</i>		1	<i>Potamogeton praelongus</i>		
<i>Carex rostrata</i>	1		<i>Potamogeton pusillus</i>		1
<i>Ceratophyllum demersum</i>			<i>Potamogeton × angustifolius</i>		1
<i>Cladium mariscus</i>			<i>Potamogeton × nitens</i>		
<i>Elatine hexandra</i>	1	1	<i>Ranunculus</i> sp.		
<i>Eleocharis acicularis</i>			<i>Schoenoplectus lacustris</i>	1	1
<i>Eleocharis multicaulis</i>			<i>Spartanium angustifolium</i>		1
<i>Eleocharis palustris</i>			<i>Spartanium emersum</i>	1	
<i>Eleogiton fluitans</i>			<i>Spartanium erectum</i>		
<i>Elodea canadensis</i>			<i>Spartanium natans</i>		
<i>Equisetum fluviatile</i>	1	1	<i>Subularia aquatica</i>		
<i>Eriocaulon aquaticum</i>			<i>Typha angustifolia</i>		
<i>Hydrilla verticillata</i>			<i>Utricularia</i> sp.	1	1
<i>Isoetes echinospora</i>			<i>Zannichellia palustris</i>		

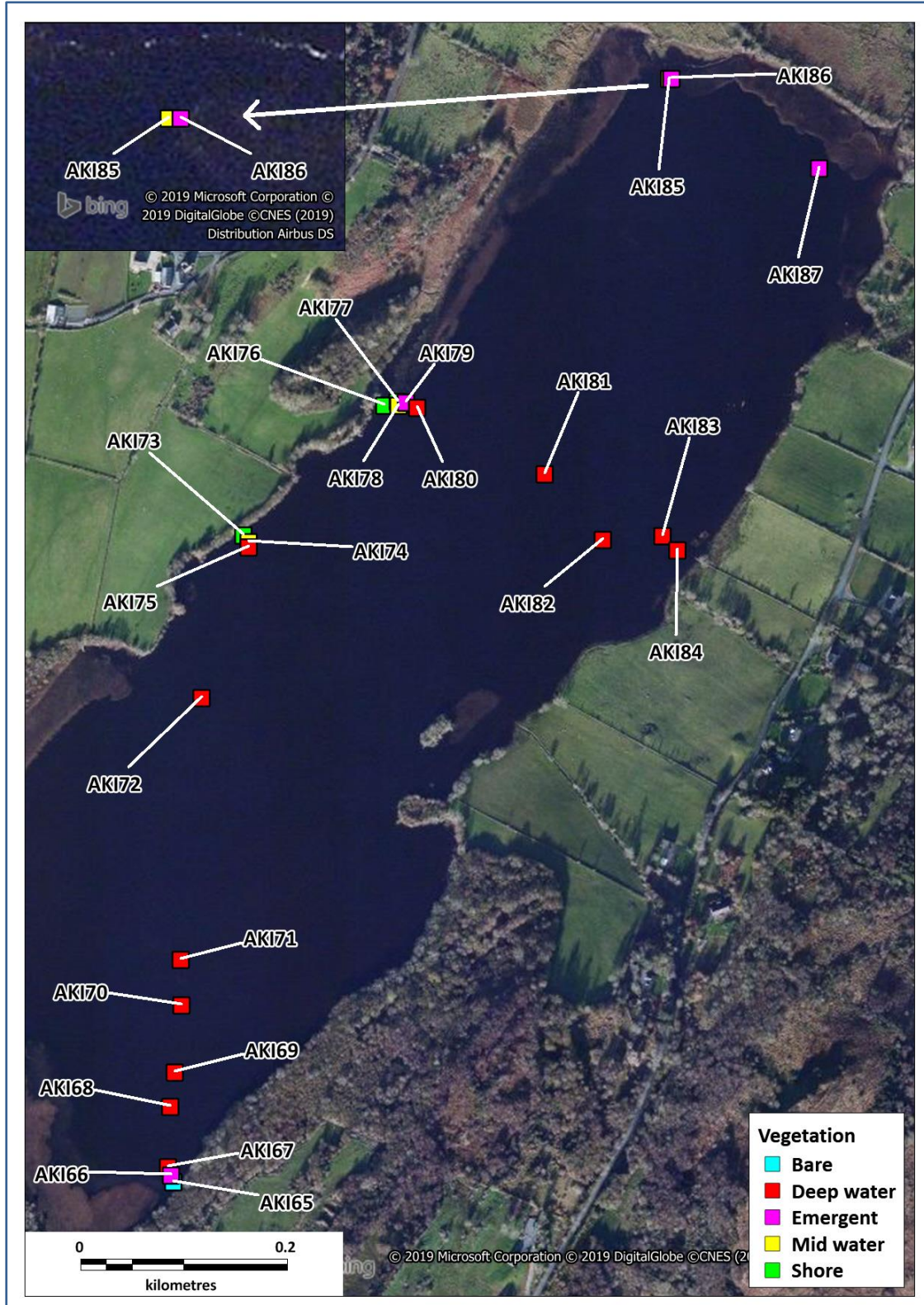
### *Najas flexilis*

The plant is very abundant in Lough Akibbon. This is largely due to the lake's shallow depth which provides a very extensive area for colonisation between 1.5 m and 3.0 m. Cover values of up to 20% were recorded and *Najas* occurs throughout the lake, covering an area of 20-25 ha. The associated community is species-rich with *Nitella confervoacea*, *Nitella flexilis*, *Callitriche hermaphroditica* and *Potamogeton* spp.



## Vegetation

Lough Akibbon is a very shallow lake with a maximum depth of 3 m and vegetation consequently covers nearly the entire lake bed. Sheltered shores support dense beds of *Schoenoplectus lacustris* and *Equisetum fluviatile*, while more exposed shores support *Littorella uniflora*, with *Isoetes lacustris* occurring below 1 m. Small patches of *Nymphaea* and *Nuphar* occur close to the *Schoenoplectus lacustris* beds. Very large beds of *Chara virgata* occur in the south-west at a depth of 1 m, which in turn give way to very extensive areas of a *Najas*—*Nitella*—*Callitriche* community. A number of *Potamogeton* species occur but in small quantity.





## Water chemistry data

Water quality data for the period 2009 to 2015 were made available by the EPA, for many samples from multiple depths. Values presented and used in assessment are averages of all data. For comparison, An Foras Forbartha data for the lake in August 1973 (Flanagan & Toner, 1975) and NPWS data from 22 September 1977 (Heuff, 1984) are presented.

Parameter	Unit	Lough Akibbon EPA 2009-2015	Lough Akibbon Heuff 1977	Lough Akibbon An Foras Forbartha 1973
Alkalinity	mg/l	37.8	40	45
Calcium	mg/l	12.98		
Chloride	mg/l	25.4		25
Chlorophyll	µg/l	3.6		2.1
Colour	Hazen units	56		25
Conductivity	µS/cm	135	170	175
Magnesium	mg/l	2.7		
pH		7.3		7.7-8.1
Potassium	mg/l	1.3	0.14	0.3
Sulphate	mg/l	4.3		4
Total oxidised nitrogen	mg/l	0.09		0.09
Total phosphorus	mg/l	0.012		

## Pressures and threats

Lough Akibbon was assessed as in WFD good ecological status in the 2015 EPA sampling round, however previous rounds had rated it only Moderate. While the *Schoenoplectus* beds at the south-western end are extremely dense and extensive they do not appear to be spreading (based on a comparison of 2000 and 2013 aerial photos). In 1973 it was not thought to be in danger of eutrophication (Flanagan & Toner, 1975). The fluctuating EPA ratings and the very vigorous growth in the south-western sector do suggest possible nutrient enrichment but there is no other evidence for this pressure impacting at present.

## Conservation condition

The lake has good scores except for lake colour. Taken together with the possible eutrophication in the south-western corner Lough Akibbon is borderline Good/Poor.

Parameter	Target for Good	Lough Akibbon 2018	Condition
Area of habitat	Stable or increasing	Stable or increasing	Good
Deep-water community	Full development	Full development	Good
Number of species	Stable or increase	Stable (27)	Good
Typical species	≥9 indicator species	10	Good
<i>Najas flexilis</i> population	Stable population	Stable	Good
Introduced species	Not present/not impacting on <i>Najas flexilis</i> / deep-water community	Not present	Good
Euphotic depth (m)	≥3	3.0	Good
Colour (Hazen units)	<40	56	Poor
Total phosphorus (TP) (mg/l)	<0.015	0.012	Good
Hydrological regime	<50% <i>Lobelia</i> – <i>Littorella</i> zone exposed in summer	-	Good
<b>Overall assessment</b>			<b>Good/Poor</b>

Loch an Chaolaigh, 2016, 2017, 2018				
Name	an Chaolaigh		Code	ACH
Alternative name(s)	Caolaidh, Lough Killa			
Grid reference	L8035630770	Max. depth (m)	>5.0	
County	Galway	EPA code	31_982	
Area (ha)	2.3	OSi 1:50,000 sheet	44	
Maximum length (km)	0.36	Nutrient data	This survey 18/01/2019	
Altitude (m)	20	SAC	002111, Kilkieran Bay And Islands SAC	
Geology	Galway Granite			
Previous survey	Roden (2004)			
Previous <i>Najas flexilis</i> records	J.B. Ryan 28/08/1996, C. Roden 02/08/2004			
Other noteworthy species	<i>Isoetes echinospora</i> , <i>Subularia aquatica</i>			
Snorkel survey date(s)	14/07/2016, 21/09/17, 13/09/18	Number of species	21	
Surveyors	PM, CR	Alkalinity (mg/l CaCO <sub>3</sub> )	15.3	
Number of transects	3	Total phosphorus (mg/l TP)	0.008	
Number of relevés	21	Colour (Hazen units)	96	
Euphotic depth (m)	3.6	Secchi depth (m)	2.5	
<i>Najas flexilis</i>	Najas flexilis present in 2017, absent in 2016 and 2018			
Deep-water vegetation	Marginal to absent			
Noteworthy species	<i>Isoetes echinospora</i> , <i>Subularia aquatica</i>			
Introduced species	None noted			
Substrates	Fine mud, sand, cobbles, rock			
Summary	A small coastal lake on granite with a known <i>Najas flexilis</i> population since 1996. For undetermined reasons the lake has declined in quality and the <i>Najas flexilis</i> population is smaller and not present in some years			
Lake score	135	Lake rank	4	
CONSERVATION CONDITION	<b>POOR</b>			

### Previous accounts

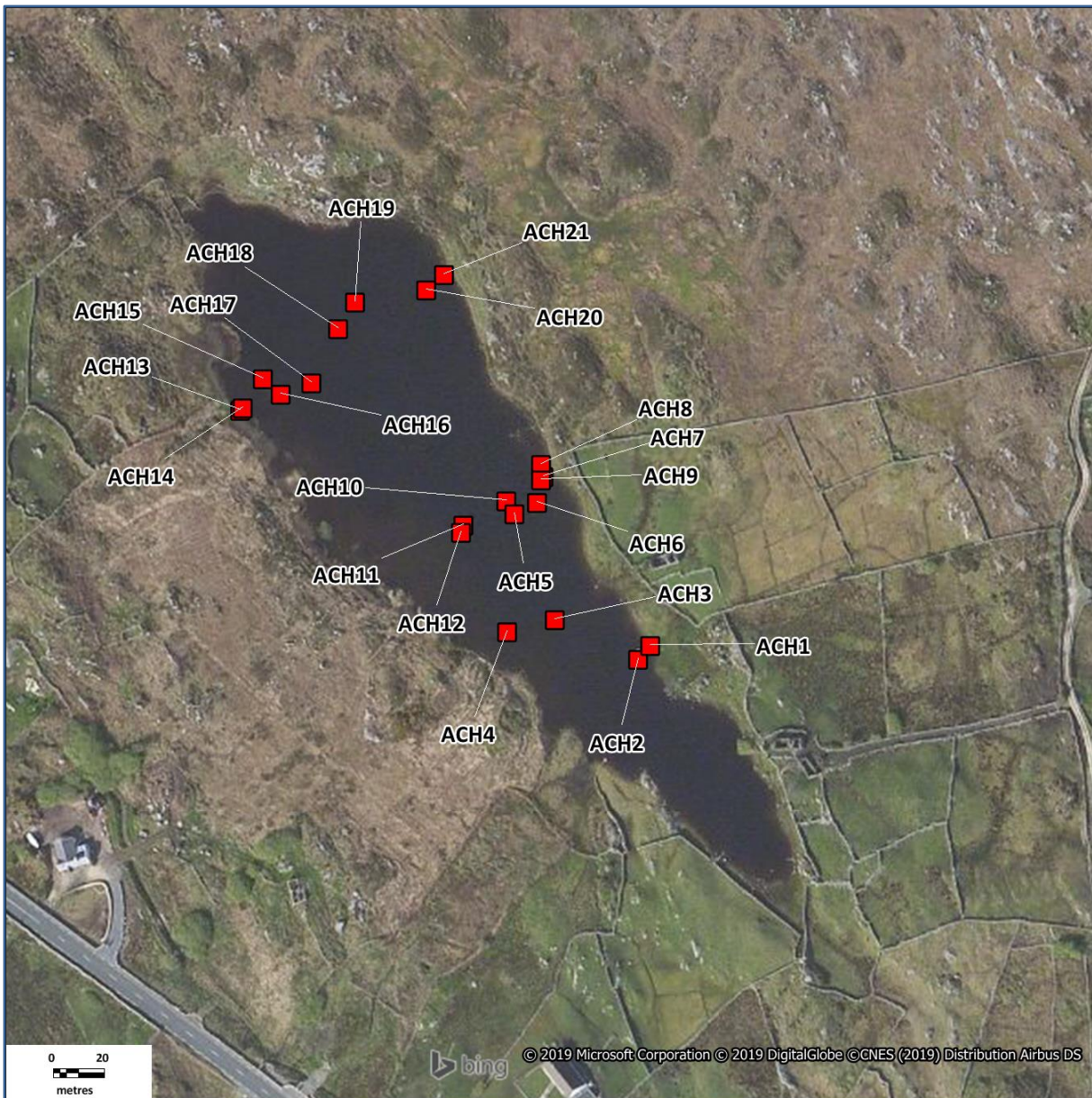
1. Loch an Chaolaigh was explored by J. Ryan in 1996 (NPWS database). He recorded *Najas flexilis* and *Subularia aquatica*.
2. The lake was then examined by C. Roden on 02/08/2004 (Roden, 2004). He noted 13 species in a limited area at the south-western side of the lake. He did not, however, re-find *Subularia aquatica*. He distinguished a shallow *Eriocaulon/Littorella/Lobelia* zone followed by an open vegetation of *Potamogeton* species and *Najas flexilis* descending to 4-5 m (these were estimates not accurate measurements). He noted very clear water.

See also NPWS (2014a, b).

### Species recorded

A total of 21 species was recorded from Loch an Chaolaigh during the 2016, 2017 and 2018 surveys. While a number of species were added to the lake species' list in the more extensive 2016 survey, four species were not re-found: *Najas flexilis*, *Potamogeton berchtoldii*, *Elatine hexandra* and *Chara virgata*. In addition, *Potamogeton obtusifolius* was only seen at one location in 2016, but was more common in 2017. *Subularia aquatica* was re-found and the presence of *Isoetes echinospora* confirmed. In 2017, *Najas flexilis* was noted as was *Potamogeton berchtoldii*. In 2018, *Najas flexilis* was not seen but *Potamogeton obtusifolius* was occasional, both *Chara virgata* and *Elatine hexandra* reappeared.

Taxon - an Chaolaigh	Before this survey	In this survey (2016-18)	Taxon - an Chaolaigh	Before this survey	In this survey (2016-18)
Charophytes			<i>Isoetes lacustris</i>	1	1
<i>Chara aspera</i>			<i>Juncus bulbosus</i>		
<i>Chara curta</i>			<i>Lemna minor</i>		
<i>Chara globularis</i>			<i>Lemna trisulca</i>		
<i>Chara rudis</i>			<i>Littorella uniflora</i>	1	1
<i>Chara virgata</i>	1	1	<i>Lobelia dortmanna</i>	1	1
<i>Nitella confervacea</i>			<i>Myriophyllum alterniflorum</i>		
<i>Nitella flexilis</i>			<i>Myriophyllum spicatum</i>		
<i>Nitella gracilis</i>			<i>Najas flexilis</i>	1	1
<i>Nitella opaca</i>			<i>Nuphar lutea</i>		
<i>Nitella translucens</i>	1	1	<i>Nymphaea alba</i>		1
<i>Tolypella glomerata</i>			<i>Oenanthe fluviatilis</i>		
<i>Chara cf. muscosa</i>			<i>Phragmites australis</i>		
Other algae			<i>Pilularia globulifera</i>		
<i>Ophrydium versatile</i>		1	<i>Potamogeton alpinus</i>		
Bryophytes			<i>Potamogeton berchtoldii</i>	1	1
<i>Fissidens fontanus</i>			<i>Potamogeton crispus</i>		
<i>Fontinalis antipyretica</i>			<i>Potamogeton filiformis</i>		
<i>Sphagnum</i> sp.			<i>Potamogeton gramineus</i>		
Vascular Plants			<i>Potamogeton lucens</i>		
<i>Alisma plantago-aquatica</i>			<i>Potamogeton natans</i>		1
<i>Apium inundatum</i>		1	<i>Potamogeton obtusifolius</i>	1	1
<i>Baldellia ranunculoides</i> subsp. <i>ranunculoides</i>		1	<i>Potamogeton pectinatus</i>		
<i>Baldellia ranunculoides</i> subsp. <i>repens</i>			<i>Potamogeton perfoliatus</i>	1	1
<i>Callitriche brutia</i> subsp. <i>hamulata</i>			<i>Potamogeton polygonifolius</i>		
<i>Callitriche hermaphrodita</i>			<i>Potamogeton praelongus</i>		
<i>Carex rostrata</i>			<i>Potamogeton pusillus</i>		
<i>Ceratophyllum demersum</i>			<i>Potamogeton × angustifolius</i>		
<i>Cladium mariscus</i>		1	<i>Potamogeton × nitens</i>		
<i>Elatine hexandra</i>	1	1	<i>Ranunculus</i> sp.		
<i>Eleocharis acicularis</i>			<i>Schoenoplectus lacustris</i>		1
<i>Eleocharis multicaulis</i>		1	<i>Sparganium angustifolium</i>		
<i>Eleocharis palustris</i>			<i>Sparganium emersum</i>		
<i>Eleogiton fluitans</i>			<i>Sparganium erectum</i>		
<i>Elodea canadensis</i>			<i>Sparganium natans</i>		
<i>Equisetum fluviatile</i>			<i>Subularia aquatica</i>	1	1
<i>Eriocaulon aquaticum</i>	1	1	<i>Typha angustifolia</i>		
<i>Hydrilla verticillata</i>			<i>Utricularia</i> sp.		
<i>Isoetes echinospora</i>	1	1	<i>Zannichellia palustris</i>		



### *Najas flexilis*

As detailed above, *Najas flexilis* was recorded in 2017, but not in 2016 or 2018. While it is an annual and populations may vary from year to year, the disappearance of three other deep-water species in 2016 points to an ecological change since 2004. In 2017, the species was present in the north-western part of the lake at low cover values. It was not seen in 2018. Compared to 2004, the deep-water vegetation was not as species-rich or abundant in 2016-18. Clearly the *Najas flexilis* population and associated habitat conditions vary and may be in overall decline.

### Vegetation

The following vegetation communities were recorded

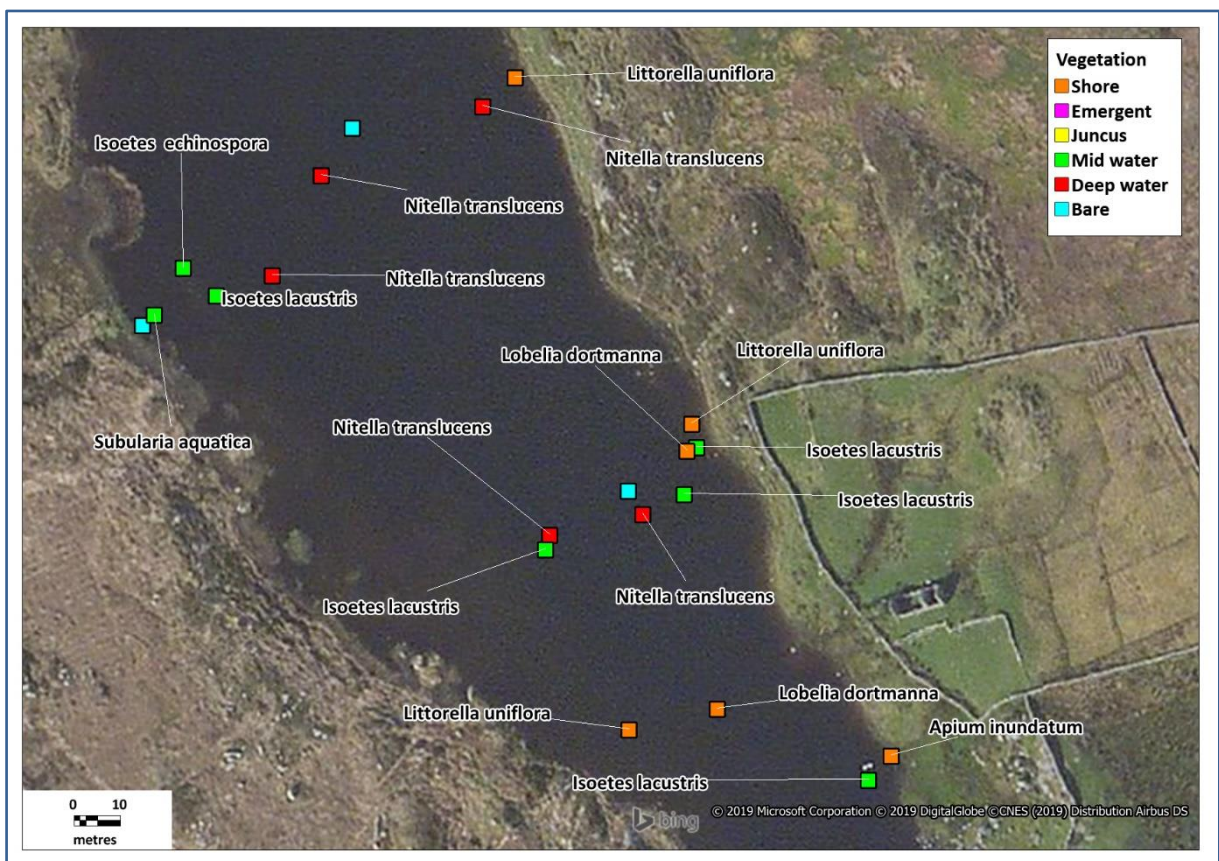
1. An *Eriocaulon*—*Lobelia* unit growing on soft sediment in shallow water
2. A variant dominated by *Littorella* growing on gravel
3. A *Subularia*—*Isoetes echinospora* zone on mud in the northern part of the lake
4. A deeper zone with *Nitella translucens* and rare *Potamogeton* species

### 5. Emergent vegetation of *Eleocharis palustris*

In 2016, the decline of *Najas flexilis*, *Potamogeton berchtoldii*, *Chara virgata* and, to a lesser extent, *Elatine* suggested the lake has become more oligotrophic since 2004. Rarer species of oligotrophic lakes, such as *Subularia aquatica* and *Isoetes echinospora*, remain in the lake. The euphotic depth had not changed greatly (3.6 m vs estimated 4-5 m in 2004) but species diversity at depth had declined as a comparison of relevés shows (see table below). In 2017 a slightly richer deep-water vegetation was found, but in 2018 it had diminished again.

Survey	2004	2016	2017	2018
Depth	3.5 m	2.8 m	3.0 m	2.5 m
<i>Najas flexilis</i>	2		+	
<i>Potamogeton berchtoldii</i>	1			
<i>Potamogeton obtusifolius</i>	2	+	1	1
<i>Elatine hexandra</i>	1			
<i>Nitella translucens</i>	1	2		+
<i>Isoetes</i> sp.	+			

No obvious explanation can be advanced for this change, but occasional dense algal blooms or increased silt discharge from dumping might be a factor (see Pressures and threats below). In 2018, a dense green algal blanket was noted on the sediment surface, possibly a decaying algal bloom.



## Water chemistry data

Water samples were taken on a single occasion on the 18 January 2019 as part of this survey.

Parameter	Unit	Lochan Chaolaigh This survey
Alkalinity	mg/l	15.3
Calcium	mg/l	5
Chloride	mg/l	48.9
Chlorophyll	µg/l	2.14
Colour	Hazen units	95.5
Conductivity	µS/cm	196
pH		6.9
Total phosphorus	mg/l	0.008

## Pressures and threats

A comparison of aerial photos taken in 2000 and 2013 shows minimal change close to the lake. While the number of houses nearby has increased from five to seven, an older cottage on the shore at the southern end of the lake has been abandoned during this period. Some evidence of small-scale rubbish dumping was noted. At first inspection however, it is difficult to notice large changes in the lake's immediate surroundings, either in house number or land use changes.

## Conservation condition

Despite the retreat or absence of the deep-water community, an Chaolaigh remains of some interest with two unusual species, *Subularia aquatica* and *Isoetes echinospora*. Nevertheless, the comparison of 2004 data with that of the recent surveys demonstrates a decline. It is possible that this decline is cyclical but only further survey can establish this point. The colour value is a winter measurement and seems high compared to growing season conditions.

Parameter	Target for Good	Lochan Chaolaigh 2016, 2017, 2018	Condition
Area of habitat	Stable or increasing	Stable or increasing	Good
Deep-water community	Full development	Marginal to absent	Poor/Bad
Number of species	Stable or increase	Increase (21)	Good
Typical species	≥9 indicator species	11	Good
<i>Najas flexilis</i> population	Stable population	Declining and fluctuating	Bad
Introduced species	Not present/not impacting on <i>Najas flexilis</i> / deep-water community	No present	Good
Euphotic depth (m)	≥3	3.6	Good
Colour (Hazen units)	<40	96	Poor
Total phosphorus (TP) (mg/l)	<0.015	0.008	Good
Hydrological regime	<50% <i>Lobelia</i> – <i>Littorella</i> zone exposed in summer	-	Good
<b>Overall assessment</b>			<b>Poor</b>

Lough Anscaul, 2017			
Name	Anscaul	Code	ASL
Alternative name(s)	Lochan Scail		
Grid reference	Q5851205140	Max. depth (m)	>5
County	Kerry	EPA code	22_189
Area (ha)	26	OSi 1:50,000 sheet	70
Maximum length (km)	0.8	Nutrient data	This survey 24/01/2019
Altitude (m)	78	SAC	000375, Mount Brandon SAC
Geology	Dingle group (Silurian Devonian) Sandstone		
Previous survey	Roden (2004)		
Previous <i>Najas flexilis</i> records	There are no records for the species in Lough Anscaul		
Other noteworthy species	<i>Potamogeton crispus</i>		
Snorkel survey date(s)	12/07/2017	Number of species	13
Surveyors	PM, CR	Alkalinity (mg/l CaCO <sub>3</sub> )	9
Number of transects	4	Total phosphorus (mg/l TP)	0.012
Number of relevés	21	Colour (Hazen units)	50
Euphotic depth (m)	2.7	Secchi depth (m)	-
<i>Najas flexilis</i>	Does not occur		
Deep-water vegetation	Marginal		
Noteworthy species	<i>Potamogeton crispus</i> , <i>Potamogeton</i> × <i>variifolius</i> (requires verification)		
Introduced species	None noted		
Substrates	Rock, cobble, gravel, sand, silt		
Summary	An oligotrophic lake with both <i>Isoetes</i> and <i>Potamogeton perfoliatus</i> but lacking <i>Najas flexilis</i> . Unusually, <i>Potamogeton crispus</i> is common. No obvious threats		
Lake score	94	Lake rank	5
CONSERVATION CONDITION	<b>GOOD</b>		

### Previous accounts

Roden (2004) appears to have been the first botanist to survey the lake. It is a typical upland lake in a glacial valley. The underlying rock is a sandstone of the Dingle Beds which differs slightly from the widespread Old Red Sandstone. At the northern end, an outwash deposit of coarse sand occurs, the remainder of the lake has steep rocky shores followed by silt. In 2004, the north-western corner was examined by snorkelling and the species found are listed in the table. *Isoetes lacustris*, *Potamogeton perfoliatus* and *Potamogeton crispus* were recorded, a combination frequently found in lakes with *Najas flexilis* but the species itself was not recorded. Two taxa, *Chara* and *Utricularia*, were noted in 2004 (as rare) but not seen in 2017. It is likely that both persist in small numbers.

### Species recorded

A total of only 13 species was recorded from Anscaul Lough in 2017. All are widespread in soft-water lakes with the exception of *Potamogeton crispus* and a hybrid *Potamogeton* (determined as *P.* × *variifolius* but requires verification). Combining the lists in the table below, a total of 16 species has been recorded in the lake. The low species diversity would suggest that the lake is not a typical 'Najas' lake but this is contradicted by the presence of *Isoetes* and *Potamogeton perfoliatus*.

- *Potamogeton crispus* is a common species in base rich or eutrophic lakes but an unexpected species in an upland lake on sandstone. It is quite common in Lough Anscaul, occurring on two transects with cover values up to 50%. It grows between 1.5 m and 2.5 m.
- A plant identified as possibly *Potamogeton* × *variifolius* was collected. This taxon is currently known only from one site in Co. Mayo and expert verification of the specimen is required. As a result, it has not been included in the table below. It is noteworthy that a similar plant was also collected in Glanmore Lough in west Cork (Beara Peninsula).

Taxon - Anscaul	Before this survey	In this survey (2017)	Taxon - Anscaul	Before this survey	In this survey (2017)
Charophytes			<i>Isoetes lacustris</i>	1	1
<i>Chara aspera</i>			<i>Juncus bulbosus</i>		
<i>Chara curta</i>			<i>Lemna minor</i>		
<i>Chara globularis</i>			<i>Lemna trisulca</i>		
<i>Chara rudis</i>			<i>Littorella uniflora</i>		1
<i>Chara virgata</i>	1		<i>Lobelia dortmanna</i>		1
<i>Nitella confervacea</i>			<i>Myriophyllum alterniflorum</i>	1	1
<i>Nitella flexilis</i>	1		<i>Myriophyllum spicatum</i>		
<i>Nitella gracilis</i>			<i>Najas flexilis</i>		
<i>Nitella opaca</i>			<i>Nuphar lutea</i>		
<i>Nitella translucens</i>	1	1	<i>Nymphaea alba</i>		
<i>Tolypella glomerata</i>			<i>Oenanthe fluviatilis</i>		
<i>Chara cf. muscosa</i>			<i>Phragmites australis</i>		
Other algae			<i>Pilularia globulifera</i>		
<i>Ophrydium versatile</i>			<i>Potamogeton alpinus</i>		
Bryophytes			<i>Potamogeton berchtoldii</i>	1	1
<i>Fissidens fontanus</i>			<i>Potamogeton crispus</i>	1	1
<i>Fontinalis antipyretica</i>		1	<i>Potamogeton filiformis</i>		
<i>Sphagnum</i> sp.			<i>Potamogeton gramineus</i>		
Vascular Plants			<i>Potamogeton lucens</i>		
<i>Alisma plantago-aquatica</i>			<i>Potamogeton natans</i>	1	1
<i>Apium inundatum</i>			<i>Potamogeton obtusifolius</i>		
<i>Baldellia ranunculoides</i> subsp. <i>ranunculoides</i>			<i>Potamogeton pectinatus</i>		
<i>Baldellia ranunculoides</i> subsp. <i>repens</i>			<i>Potamogeton perfoliatus</i>	1	1
<i>Callitriche brutia</i> subsp. <i>hamulata</i>	1	1	<i>Potamogeton polygonifolius</i>		
<i>Callitriche hermaphroditica</i>			<i>Potamogeton praelongus</i>		
<i>Carex rostrata</i>			<i>Potamogeton pusillus</i>		
<i>Ceratophyllum demersum</i>			<i>Potamogeton × angustifolius</i>		
<i>Cladium mariscus</i>			<i>Potamogeton × nitens</i>		
<i>Elatine hexandra</i>	1	1	<i>Ranunculus</i> sp.		
<i>Eleocharis acicularis</i>			<i>Schoenoplectus lacustris</i>		
<i>Eleocharis multicaulis</i>			<i>Sparganium angustifolium</i>		
<i>Eleocharis palustris</i>			<i>Sparganium emersum</i>		
<i>Eleogiton fluitans</i>			<i>Sparganium erectum</i>		
<i>Elodea canadensis</i>			<i>Sparganium natans</i>		
<i>Equisetum fluviatile</i>		1	<i>Subularia aquatica</i>		
<i>Eriocaulon aquaticum</i>			<i>Typha angustifolia</i>		
<i>Hydrilla verticillata</i>			<i>Utricularia</i> sp.	1	
<i>Isoetes echinospora</i>			<i>Zannichellia palustris</i>		

### *Najas flexilis*

*Najas flexilis* does not occur.

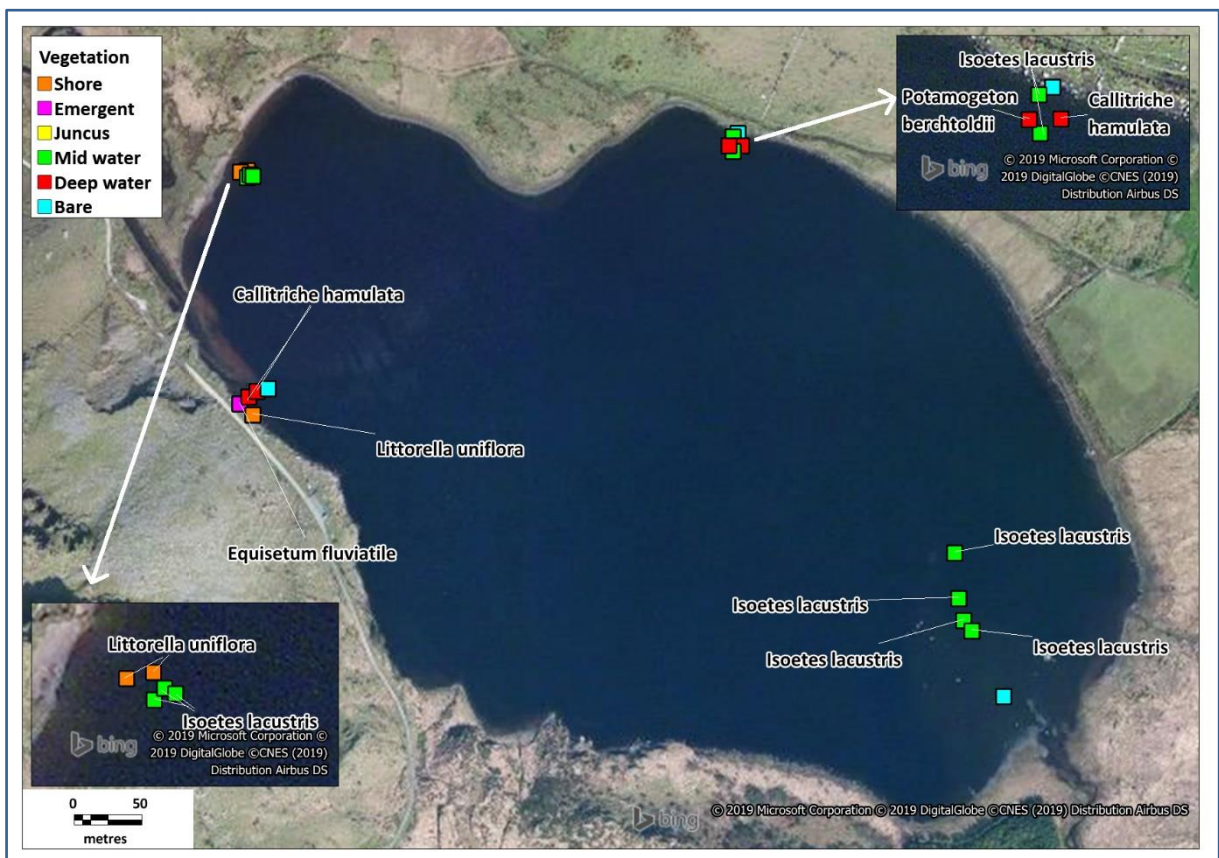
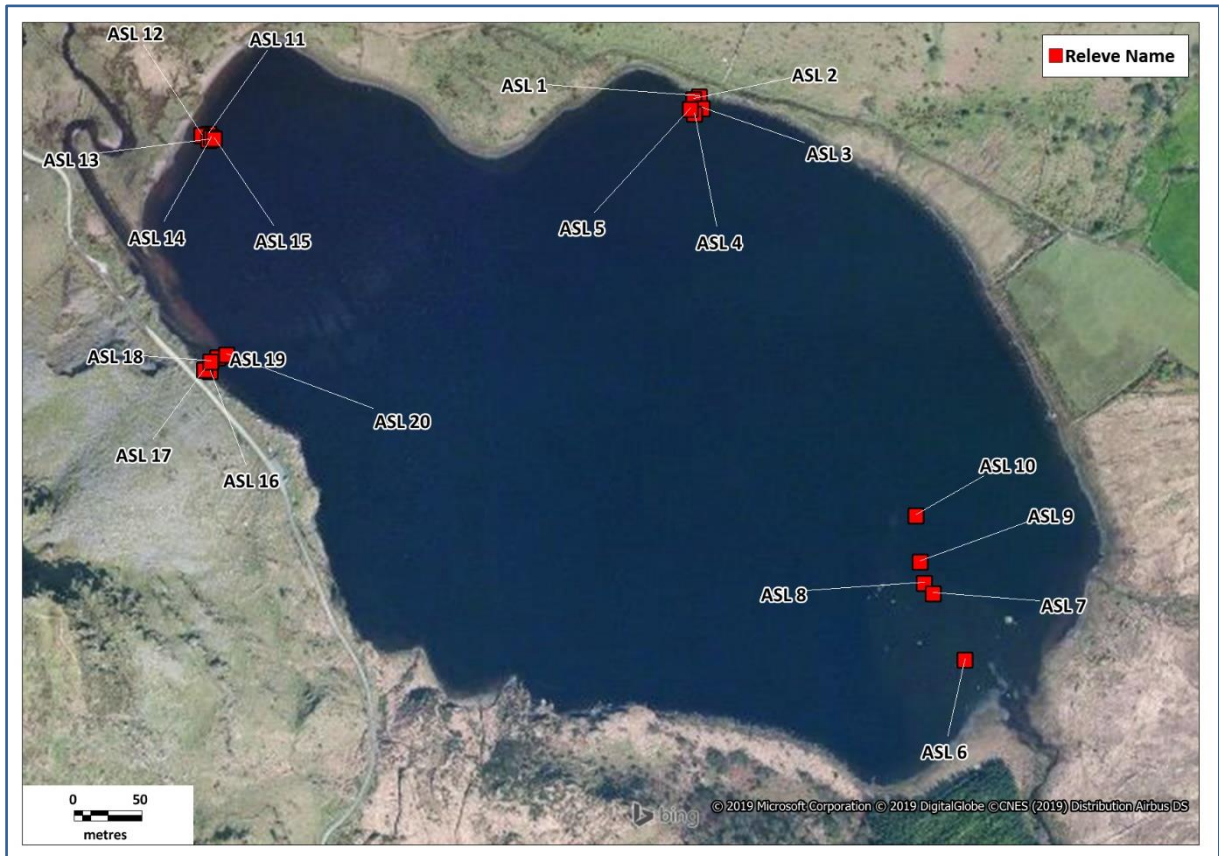
### Vegetation

As noted above, the lake is surrounded by rock and cobble shores except on the northern side where a large barely vegetated outwash fan of coarse sand occurs. At depth silt occurs. Water transparency was good when surveyed.

An Isoetid vegetation occurs on the cobble shores with *Isoetes lacustris*, *Lobelia dortmanna*, *Littorella uniflora* and *Elatine hexandra*. Below 1 m in more silty areas, *Callitriche brutia* subsp. *hamulata* is abundant,



in places with cover values >80%. Towards the euphotic depth (2.7 m), *Potamogeton berchtoldii*, *P. perfoliatus* and *P. crispus* are common, with little vegetation on the sediment surface other than some *Nitella translucens*.



## Water chemistry data

Water samples were taken on a single occasion on the 24 January 2019 as part of this survey.

Parameter	Unit	Lough Anscaul This survey
Alkalinity	mg/l	9
Calcium	mg/l	3.5
Chloride	mg/l	13.7
Chlorophyll	µg/l	2.14
Colour	Hazen units	49.6
Conductivity	µS/cm	52.2
pH		6.7
Total phosphorus	mg/l	0.012

## Pressures and threats

There are no current threats to Anscaul Lough and no obvious changes in flora or surrounding landscape (Geohive website) in the last 15 years.

## Conservation condition

Anscaul is a marginal *Najas flexilis*-type lake, included only as both *Isoetes lacustris* and *Potamogeton perfoliatus* occur. Other species recorded, however, suggest a dystrophic or oligotrophic lake. The presence of a population of *Potamogeton crispus* is very anomalous as this is a species of meso-eutrophic or eutrophic water (Preston, 1995). The colour value is based on one winter measurement, so there is no serious evidence of degradation. Anscaul is anomalous, so the targets for *Najas flexilis*-type lakes do not work. It is, however, an unusual lake with an interesting combination of typical oligotrophic, soft-water species and pondweed species, and its vegetation has not changed over time. Overall, it is considered to be in *Good* conservation condition.

Parameter	Target for Good	Anscaul 2017	Condition
Area of habitat	Stable or increasing	Stable or increasing	Good
Deep-water community	Full development	marginal	n/a
Number of species	Stable or increase	Stable (13)	n/a
Typical species	≥9 indicator species	7	n/a
<i>Najas flexilis</i> population	Stable population	Does not occur	n/a
Introduced species	Not present/not impacting on <i>Najas flexilis</i> / deep-water community	Not present	Good
Euphotic depth (m)	≥3	2.7	n/a
Colour (Hazen units)	<40	49	n/a
Total phosphorus (TP) (mg/l)	<0.015	0.012	n/a
Hydrological regime	<50% <i>Lobelia</i> – <i>Littorella</i> zone exposed in summer	-	Good
<b>Overall assessment</b>			<b>Good</b>

Lough Anure, 2017, 2018			
Name	Anure	Code	ANU
Alternative name(s)	Loughanure		
Grid reference	B8199616107	Max. depth (m)	8
County	Donegal	EPA code	38_83
Area (ha)	133	OSi 1:50,000 sheet	1
Maximum length (km)	3.1	Nutrient data	EPA 2009-2015, AFF 1973
Altitude (m)	36	SAC	-
Geology	Granite with rafts of Dalradian rock		
Previous survey	EPA in 2009, 2012, 2015		
Previous <i>Najas flexilis</i> records	EPA 12/08/2009		
Other noteworthy species	-		
Snorkel survey date(s)	25/07/17, 18/07/2018	Number of species	23
Surveyors	PM, JR, CR	Alkalinity (mg/l CaCO <sub>3</sub> )	13.3
Number of transects	4	Total phosphorus (mg/l TP)	0.008
Number of relevés	21	Colour (Hazen units)	73
Euphotic depth (m)	2.6	Secchi depth (m)	1.9
<i>Najas flexilis</i>	Substantial population in the south-eastern corner		
Deep-water vegetation	Only in part of lake		
Noteworthy species	<i>Najas flexilis</i> , <i>Nitella confervacea</i> , <i>Potamogeton</i> × <i>griffithsii</i> (requires verification)		
Introduced species	None noted		
Substrates	Rock, cobble, gravel, sand, silt, iron precipitate		
Summary	A medium sized lake on granite with a generally poor flora, except in the south-east where a large <i>Najas flexilis</i> population is found. The high colour and shallow euphotic depth indicate some environmental degradation		
Lake score	184	Lake rank	3
CONSERVATION CONDITION	<b>POOR</b>		

### Previous accounts

1. *Potamogeton praelongus* was recorded by Hart (1898).
2. The EPA examined the lake in 2009, 2012 and 2015. Their combined species list is included in the 'Before this survey' list. The *Potamogeton* flora in the lake is complex as a rare hybrid *P.* × *griffithsii* appears to be present. We suspect that this taxon was listed both as *P. polygonifolius* and *P. alpinus* by EPA surveyors. No plants were recorded by the EPA below 3.0 m. Between 2 m and 3 m, *Chara* sp., *Elatine*, *Fontinalis*, *Isoetes lacustris*, *Myriophyllum* sp., *Nitella* sp., *Najas flexilis*, *Potamogeton berchtoldii*, *Potamogeton praelongus* and *Utricularia* were recorded. At shallower depths, Isoetids were common and *Schoenoplectus* beds occurred in some places. No obvious changes can be discerned between the 2009 and 2015 surveys. *Najas* was recorded only in 2009 in the south-eastern corner but was described as frequent.

### Species recorded

The survey in 2017 was abandoned due to engine problems but the lake was fully surveyed in 2018.

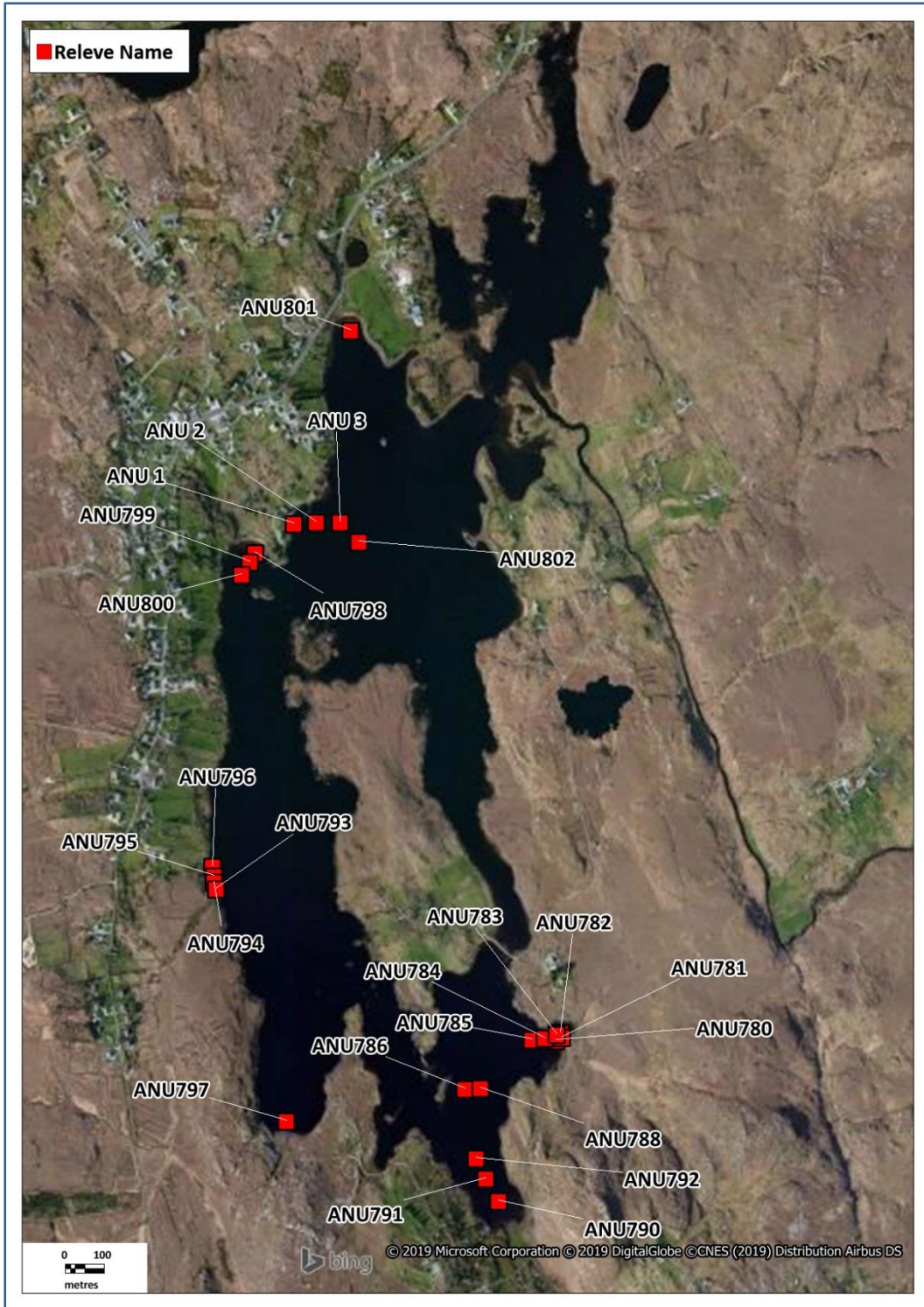
A total of 23 species was recorded from Lough Anure in 2017 and 2018. Unusual species include *Najas flexilis*, *Nitella confervacea* and *Potamogeton* × *griffithsii* (requires verification). The remaining species are widespread in soft-water lakes.

- *Potamogeton* × *griffithsii* (*P. praelongus* × *P. alpinus*) is a very rare hybrid in Ireland being only known from a lake in Fanad. Similar material was also gathered during the survey at Mullaghderg. These new localities have yet to be confirmed, but have been included in the

tables and species counts as the taxon is known to occur in Donegal. *Potamogeton* × *griffithsii* occurs at several locations in the Lough Anure with cover values of 10%.

- *Nitella confervacea* is known at present from c. 25 hectads. This record is additional to four recent records from Donegal. The plant is occasional at 2-3m in the south-eastern corner of the lake with cover values of up to 25%. It was first recorded by JR and PM in 2018.

The pre-2017 species list is very similar to the list from the present survey. As noted above, the *Potamogeton* flora is complex. *P. obtusifolius*, recorded by the EPA, was not re-found during this survey, however it is very different from *Potamogeton* × *griffithsii*, so it may remain in the lake. It is probable that *Sparganium emersum* recorded by the EPA, was identified as *Sparganium angustifolium* in the present survey.

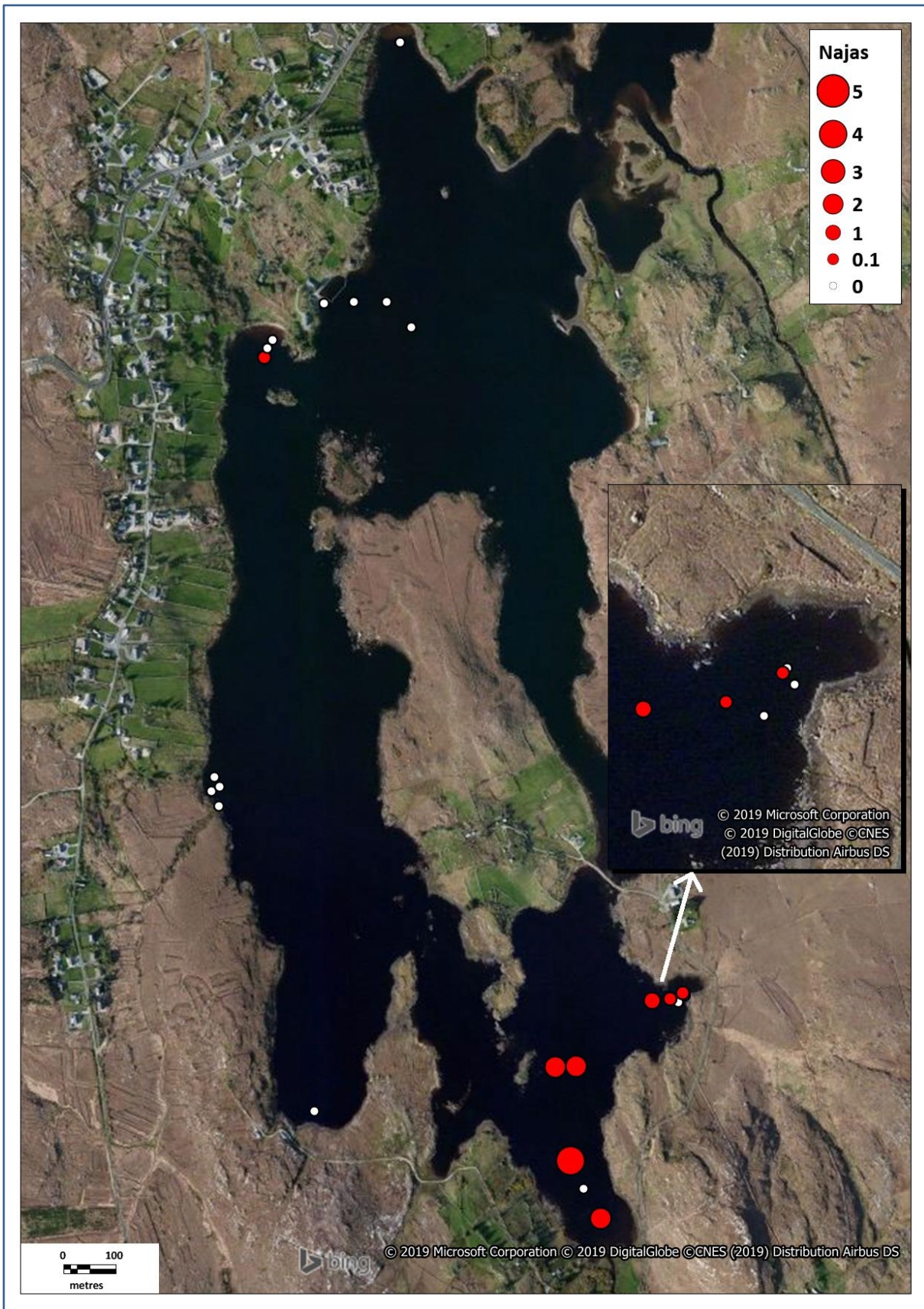


Taxon - Anure	Before this survey	In this survey (2017/8)	Taxon - Anure	Before this survey	In this survey (2017/8)
Charophytes			<i>Juncus bulbosus</i>	1	1
<i>Chara aspera</i>			<i>Lemna minor</i>		
<i>Chara curta</i>			<i>Lemna trisulca</i>		
<i>Chara globularis</i>			<i>Littorella uniflora</i>	1	1
<i>Chara rudis</i>			<i>Lobelia dortmanna</i>	1	1
<i>Chara virgata</i>	1	1	<i>Myriophyllum alterniflorum</i>	1	1
<i>Nitella confervacea</i>		1	<i>Myriophyllum spicatum</i>	1	1
<i>Nitella flexilis</i>			<i>Najas flexilis</i>	1	1
<i>Nitella gracilis</i>			<i>Nuphar lutea</i>		
<i>Nitella opaca</i>			<i>Nymphaea alba</i>		
<i>Nitella translucens</i>		1	<i>Oenanthe fluviatilis</i>		
<i>Tolypella glomerata</i>			<i>Phragmites australis</i>		1
<i>Chara cf. muscosa</i>			<i>Pilularia globulifera</i>		
Other algae			<i>Potamogeton alpinus</i>		
<i>Ophrydium versatile</i>			<i>Potamogeton berchtoldii</i>	1	1
Bryophytes			<i>Potamogeton crispus</i>		
<i>Fissidens fontanus</i>			<i>Potamogeton filiformis</i>		
<i>Fontinalis antipyretica</i>	1	1	<i>Potamogeton gramineus</i>		
<i>Sphagnum</i> sp.	1		<i>Potamogeton lucens</i>		
Vascular Plants			<i>Potamogeton natans</i>		
<i>Alisma plantago-aquatica</i>			<i>Potamogeton obtusifolius</i>	1	
<i>Apium inundatum</i>			<i>Potamogeton pectinatus</i>		
<i>Baldellia ranunculoides</i> subsp. <i>ranunculoides</i>			<i>Potamogeton perfoliatus</i>		1
<i>Baldellia ranunculoides</i> subsp. <i>repens</i>			<i>Potamogeton polygonifolius</i>	1	
<i>Callitriche brutia</i> subsp. <i>hamulata</i>			<i>Potamogeton praelongus</i>	1	1
<i>Callitriche hermaphroditica</i>			<i>Potamogeton pusillus</i>		
<i>Carex rostrata</i>			<i>Potamogeton × angustifolius</i>		1
<i>Ceratophyllum demersum</i>			<i>Potamogeton × griffithsii</i>		1*
<i>Cladium mariscus</i>			<i>Potamogeton × nitens</i>		
<i>Elatine hexandra</i>	1	1	<i>Ranunculus</i> sp.		
<i>Eleocharis acicularis</i>			<i>Schoenoplectus lacustris</i>	1	1
<i>Eleocharis multicaulis</i>	1		<i>Sparganium angustifolium</i>		1
<i>Eleocharis palustris</i>		1	<i>Sparganium emersum</i>	1	
<i>Eleogiton fluitans</i>	1	1	<i>Sparganium erectum</i>		
<i>Elodea canadensis</i>			<i>Sparganium natans</i>		
<i>Equisetum fluviatile</i>			<i>Subularia aquatica</i>		
<i>Eriocaulon aquaticum</i>			<i>Typha angustifolia</i>		
<i>Hydrilla verticillata</i>			<i>Utricularia</i> sp.	1	1
<i>Isoetes echinospora</i>			<i>Zannichellia palustris</i>		
<i>Isoetes lacustris</i>	1	1			

\* requires verification

### *Najas flexilis*

*Najas flexilis* was first recorded from the lake in 2009 by the EPA. They recorded it as frequent at two points on their Transect 3 in the south-east of the lake. They did not record it in 2012 or 2015. In this survey, it was found in eight relevés, mainly in the south and south-east of the lake but a fragment was also found in the north of the lake. Cover was up to 80% in one relevé. The substrate was silty-sand at depths between 1.5 m and 2.5 m. The area of the shallow southern basin is about 10 ha and most of it is shallow enough to support macrophytes including *Najas flexilis*, which is common there. As the record in the north of the lake was only a fragment, at present the total habitat area for *Najas flexilis* is estimated at 10 ha, but may be larger.

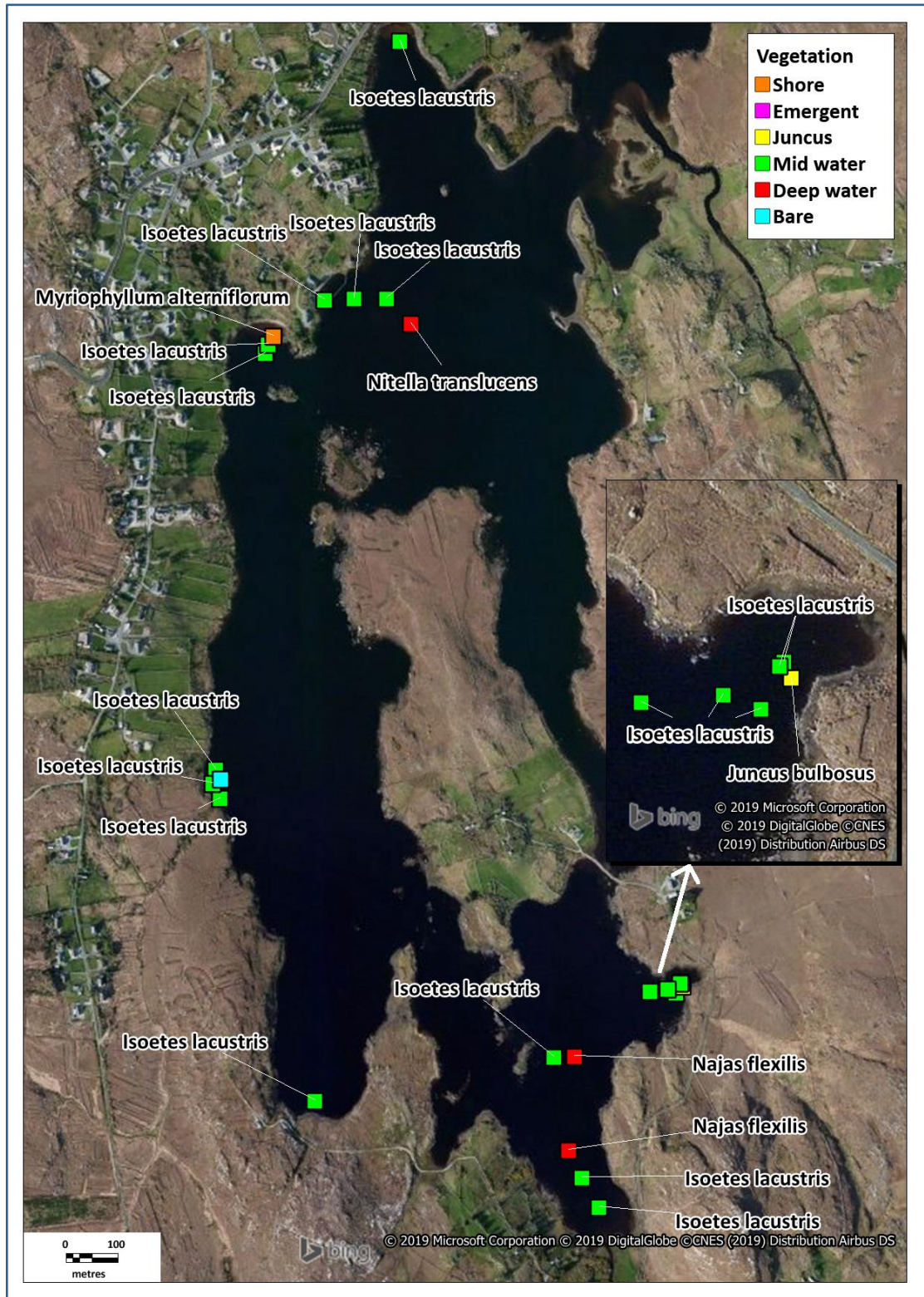


## Vegetation

Lough Anure is largely surrounded by rocky shores with some sand and gravel and more silt below 1 m. Some *Schoenoplectus lacustris* beds occur in the south of the lake but are not very extensive. As the

euphotic zone is shallow (2.6 m), large parts of the lake have no benthic vegetation and bare areas occur even above this depth, possibly due to coarse substrate and exposure.

As can be inferred from the EPA surveys, the lake has well-developed Isoetid communities around the rocky shores with *Littorella uniflora*, *Lobelia dortmanna* and *Isoetes lacustris*, and with *Myriophyllum alterniflorum* and *Elatine hexandra* in slightly deeper water. Below 1 m, *Isoetes* stands are accompanied by *Nitella translucens*, *Juncus bulbosus* and *Potamogeton* species. Near the base of the euphotic zone (2.6 m), a *Najas flexilis*—*Nitella confervacea*—*P. perfoliatus*—*P. berchtoldii* community occurs, but is only well-developed in the south of the lake. In much of the western section of the lake, vegetation is very sparse but it is somewhat more developed in the northern sector.



## Water chemistry data

Water quality data for the period 2009 to 2015 were made available by the EPA, for many samples from multiple depths. Values presented and used in assessment are averages of all data. An Foras Forbartha data for the lake in August 1973 are given for comparison (Flanagan & Toner, 1975).

Parameter	Unit	Lough Anure EPA 2009-2015	Lough Anure An Foras Forbartha 1973
Alkalinity	mg/l	13.3	14-18
Calcium	mg/l	4.4	
Chloride	mg/l	23.0	25
Chlorophyll	µg/l	4.6	2.8-3.7
Colour	Hazen units	72.5	40-80
Conductivity	µS/cm	101.8	95-130
Magnesium	mg/l	1.8	
pH		7.1	6.9-7.7
Potassium	mg/l	0.7	0.5-0.7
Secchi	m	1.9	1-2.5
Sulphate	mg/l	4.1	6
Total oxidised nitrogen	mg/l	0.11	0.03-0.1
Total phosphorus	mg/l	0.008	

## Pressures and threats

Flanagan & Toner (1975) noted that colour decreased and conductivity increased from north to south in the lake. This suggests that the inflowing Owenator, which enters and exits (as the Crolly) at the northern end brings peat-stained water to the lake, but the enclosed southern basin is sheltered from much of this flow. The southern basin is the location of the large *Najas flexilis* population, which appears to prefer clearer water. Consequently, the *Najas flexilis* population and more-developed benthic vegetation may be protected from inputs to the rest of the lake. A comparison of An Foras Forbartha data (Flanagan & Toner, 1975) with those of the EPA suggests little change in the last 40 years. However, a substantial village occurs along the lake and the danger of eutrophication must be considered. The EPA rated Loughanure as high ecological status in 2009 and good ecological status in 2012 and 2015.

## Conservation condition

While the south-eastern basin of Lough Anure contains a substantial population of *Najas flexilis*, much of the lake has both coloured water and little deep-water vegetation. It is rated poor for these reasons.

Parameter	Target for Good	Anure 2018	Condition
Area of habitat	Stable or increasing	Stable or increasing	Good
Deep-water community	Full development	Only in part of lake	Poor
Number of species	Stable or increase	Increase (23)	Good
Typical species	≥9 indicator species	10	Good
<i>Najas flexilis</i> population	Stable population	Appears stable in south-eastern basin	Good
Introduced species	Not present/not impacting on <i>Najas flexilis</i> / deep-water community	Not present	Good
Euphotic depth (m)	≥3	2.6	Poor
Colour (Hazen units)	<40	73	Poor
Total phosphorus (TP) (mg/l)	<0.015	0.008	Good
Hydrological regime	<50% <i>Lobelia</i> – <i>Littorella</i> zone exposed in summer	-	Good
<b>Overall assessment</b>			<b>Poor</b>



Aughrusbeg Lough, 2017				
Name	Aughrusbeg Lough		Code	ABG
Alternative name(s)				
Grid reference	L5579258173	Max. depth (m)	>6	
County	Galway	EPA code	32_436	
Area (ha)	50	OSi 1:50,000 sheet	37	
Maximum length (km)	1.4	Nutrient data	EPA 2009-2015	
Altitude (m)	3	SAC	001228, Aughrusbeg Machair and Lake SAC	
Geology	Granite & blown sand			
Previous survey	Webb & Scannell (1983), Roden (1999), EPA in 2007, 2010, 2013			
Previous <i>Najas flexilis</i> records	There are no records for the species in Aughrusbeg			
Other noteworthy species	<i>Chara muscosa</i> , <i>Nitella confervacea</i> , <i>Potamogeton filiformis</i> , <i>Tolypella glomerata</i>			
Snorkel survey date(s)	05/07/2017, 06/09/2017	Number of species	31	
Surveyors	PM, CR, JR	Alkalinity (mg/l CaCO <sub>3</sub> )	49.1	
Number of transects	5	Total phosphorus (mg/l TP)	0.015	
Number of relevés	21	Colour (Hazen units)	27	
Euphotic depth (m)	5.2	Secchi depth (m)	-	
<i>Najas flexilis</i>	<i>Najas flexilis</i> was not recorded			
Deep-water vegetation	Full development			
Noteworthy species	<i>Chara muscosa</i> , <i>Nitella confervacea</i> , <i>Potamogeton filiformis</i> , <i>Tolypella glomerata</i>			
Introduced species	<i>Elodea canadensis</i> present			
Substrates	Rock, sand			
Summary	A coastal lake with a diverse flora but lacking <i>Najas flexilis</i> . It is in good conservation condition			
Lake score	183	Lake rank	3	
CONSERVATION CONDITION	<b>GOOD</b>			

### Previous accounts

1. A few records from the lake were included in Webb & Scannell (1983).
2. Roden (1999) conducted a snorkel survey in 1999 (on 25/07/1999 and 18/08/1999) and he described the lake as follows

*Although this lake is on granite bedrock and separated from the sea by a small machair plain, it is very different from the neighbouring Fahy Lough. Much of the lake has sloping granite shores, only at the western end is there a well-developed sand shelf. This is a site for the possible Chara muscosa. The Chara aspera—Potamogeton filiformis community is also well-developed here. At the edge of the sand shelf the lake bed shelves steeply to 6 m. Here a Myriophyllum spicatum—Potamogeton pectinatus community is developed. The lake bottom has an unusually well-developed vegetation with large stands of Nitella translucens, interspersed by Nitella batrachosperma, Chara virgata var. virgata and Potamogeton berchtoldii. Cladophora aegagropilia balls are found in the deeper parts of the lake bed. The rocky shores support a Littorella—Chara virgata var. annulata community which is followed by a band of Isoetes lacustris. This is the only lake in which Tolypella glomerata is frequent, growing in shallower water on sand and gravel.*

3. Species recorded by the EPA in 2010 and 2013 are included in the species table. A greater number of species were recorded however, by C. Roden in 1999 than in the EPA surveys reflecting the different efficiencies of the methodologies used.

## Species recorded

A total of 31 species was recorded from Aughrusbeg in 2017. Combining this species list with those from before the survey, a total of 32 species has been recorded in the lake (see table below).

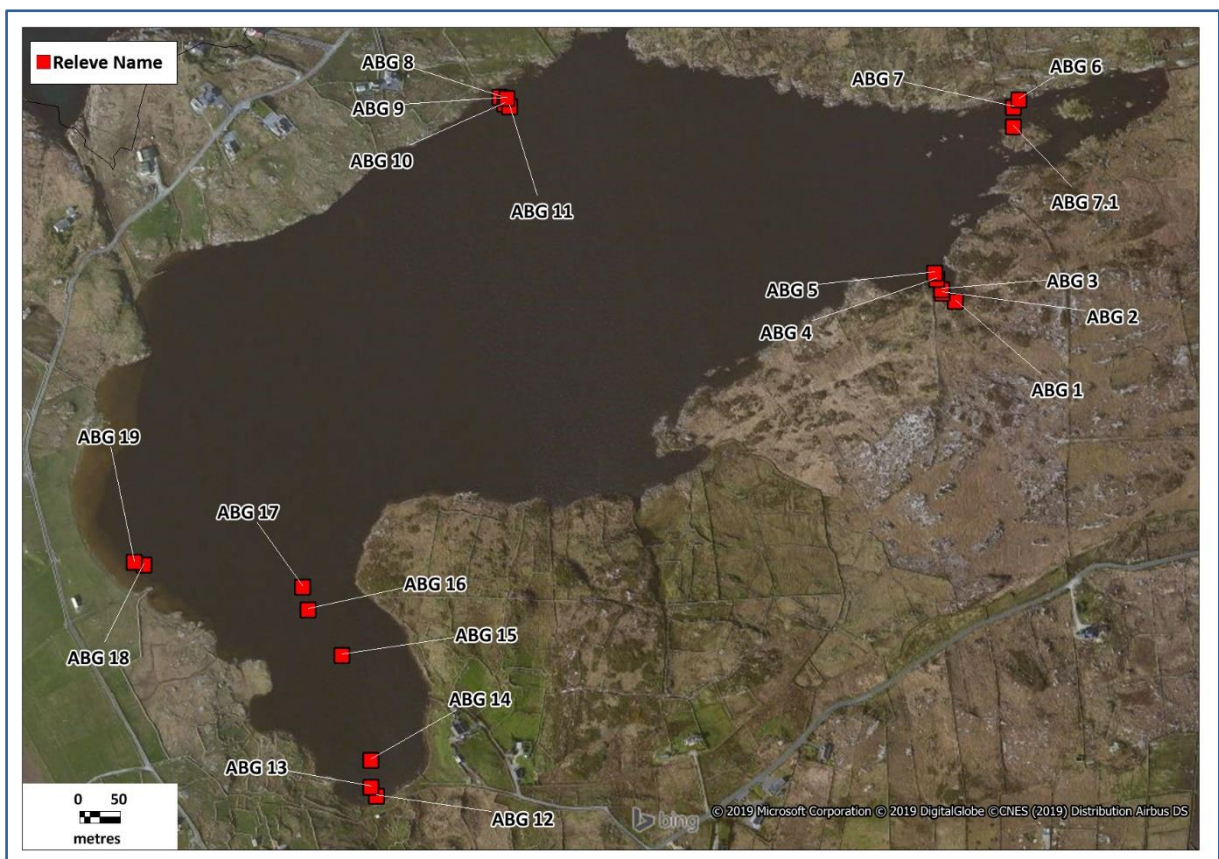
Taxon - Aughrusbeg	Before this survey	In this survey (2017)	Taxon - Aughrusbeg	Before this survey	In this survey (2017)
Charophytes			<i>Isoetes lacustris</i>	1	1
<i>Chara aspera</i>	1	1	<i>Juncus bulbosus</i>		1
<i>Chara curta</i>	1		<i>Lemna minor</i>		1
<i>Chara globularis</i>		1	<i>Lemna trisulca</i>		
<i>Chara rudis</i>			<i>Littorella uniflora</i>	1	1
<i>Chara virgata</i>	1	1	<i>Lobelia dortmanna</i>		
<i>Nitella confervacea</i>	1	1	<i>Myriophyllum alterniflorum</i>	1	1
<i>Nitella flexilis</i>	1	1	<i>Myriophyllum spicatum</i>	1	1
<i>Nitella gracilis</i>			<i>Najas flexilis</i>		
<i>Nitella opaca</i>			<i>Nuphar lutea</i>		
<i>Nitella translucens</i>	1	1	<i>Nymphaea alba</i>		
<i>Tolypella glomerata</i>	1	1	<i>Oenanthe fluviatilis</i>		
<i>Chara cf. muscosa</i>	1	1	<i>Phragmites australis</i>		1
Other algae			<i>Pilularia globulifera</i>		
<i>Ophrydium versatile</i>			<i>Potamogeton alpinus</i>		
Bryophytes			<i>Potamogeton berchtoldii</i>	1	1
<i>Fissidens fontanus</i>			<i>Potamogeton crispus</i>	1	1
<i>Fontinalis antipyretica</i>	1	1	<i>Potamogeton filiformis</i>	1	1
<i>Sphagnum</i> sp.			<i>Potamogeton gramineus</i>	1	1
Vascular Plants			<i>Potamogeton lucens</i>		
<i>Alisma plantago-aquatica</i>			<i>Potamogeton natans</i>		1
<i>Apium inundatum</i>			<i>Potamogeton obtusifolius</i>		
<i>Baldellia ranunculoides</i> subsp. <i>ranunculoides</i>		1	<i>Potamogeton pectinatus</i>	1	1
<i>Baldellia ranunculoides</i> subsp. <i>repens</i>			<i>Potamogeton perfoliatus</i>	1	1
<i>Callitriche brutia</i> subsp. <i>hamulata</i>			<i>Potamogeton polygonifolius</i>		
<i>Callitriche hermaphroditica</i>			<i>Potamogeton praelongus</i>		
<i>Carex rostrata</i>			<i>Potamogeton pusillus</i>		
<i>Ceratophyllum demersum</i>			<i>Potamogeton × angustifolius</i>		
<i>Cladium mariscus</i>			<i>Potamogeton × nitens</i>		1
<i>Elatine hexandra</i>	1	1	<i>Ranunculus</i> sp.	1	1
<i>Eleocharis acicularis</i>			<i>Schoenoplectus lacustris</i>		
<i>Eleocharis multicaulis</i>		1	<i>Sparanium angustifolium</i>		
<i>Eleocharis palustris</i>			<i>Sparanium emersum</i>		
<i>Eleogiton fluitans</i>		1	<i>Sparanium erectum</i>		
<i>Elodea canadensis</i>	1	1	<i>Sparanium natans</i>		
<i>Equisetum fluviatile</i>			<i>Subularia aquatica</i>		
<i>Eriocaulon aquaticum</i>			<i>Typha angustifolia</i>		
<i>Hydrilla verticillata</i>			<i>Utricularia</i> sp.		1
<i>Isoetes echinospora</i>			<i>Zannichellia palustris</i>		

The flora of Aughrusbeg is diverse with many *Potamogeton* species and also contains several very interesting charophyceae.

- *Chara muscosa* is a taxon that is not well known as it is only recorded from a few sites throughout the world. It was originally described from material collected at Lough Mullaghderg in 1917 and was seen at that site on several occasions since. However, by 1992 it could no longer be found there (Stewart & Church, 1992). It has also been collected in coastal lakes in the Outer Hebrides, Scotland and more recently at a site in western France (Krause, 1997). In this survey and in 1999, a form that matches the original description closely was found at Aughrusbeg

Lough, growing on the sand shelf along with *Chara aspera* at a depth of 0.5-1.0 m. It is less common than *Chara aspera*. This is the same habitat as that described by Bullock-Webster (1918) for Lough Mullaghderg. Both Aughrusbeg Lough and Mullaghderg are low-calcium coastal lakes with broadly similar vegetation, so it is not surprising that the species should be found at Aughrusbeg. *Chara muscosa* is thought to be closely related to *Chara contraria*. The existence of dwarf forms of *Chara contraria* in more calcareous loughs occupying the same habitat - the sand shelf accompanied by *Chara aspera* - suggests that *Chara muscosa* may be a related form which grows in less calcium-rich water. Whether it is a true species is not yet established.

- *Tolypella glomerata* was only recorded from Aughrusbeg during the 2016-18 survey. It grows in small quantity along with *Chara muscosa* and *Chara aspera* on the sand-shelf at the western end of the lake.
- *Nitella confervacea* is known from ten hectads in Connemara, but is scarce nationally. It occurs between 1 and 3 m depth both at the eastern and western ends of the lake. Perhaps surprisingly, its frequent companion *Najas flexilis* has never been recorded from Aughrusbeg.
- *Potamogeton filiformis* is a scarce species in Connemara, it grows on the sand shelf at the west of the lake.



### *Najas flexilis*

The plant does not occur in the lake.

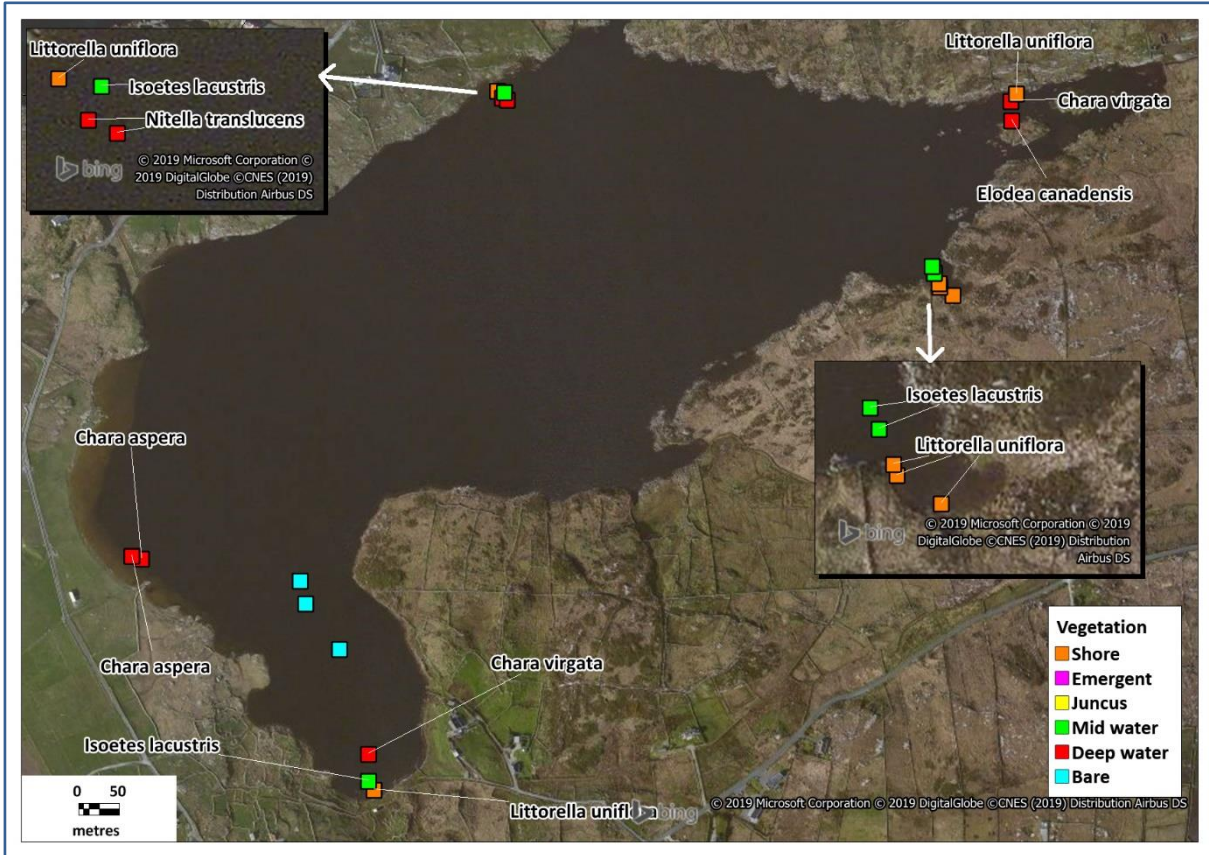
### Vegetation

The results of the 2017 survey are summarised in the vegetation map.

The vegetation of the lake is diverse, reflecting a complex morphology. The lake occupies an east-west basin of at least 6 m depth. At the western end, a large deposit of wind-blown sea-sand forms a shallow

shelf bordered by an abrupt drop of 4-6 m. The remaining shores are of bed rock or cobbles and boulders.

The sand shelf has a distinctive dwarf vegetation of charophyte species and *Potamogeton filiformis* while the adjacent shelf has a flora of *Potamogeton* species and *Myriophyllum spicatum*. On rocky shores, *Littorella* is dominant followed by *Isoetes lacustris* at 1-2.5 m along with *Chara aspera*. The lake has exceptional water clarity with a euphotic depth of 5.2 m allowing extensive vegetation at depth. The dominant species are *Nitella translucens* and *Fontinalis antipyretica*, along with *Nitella confervacea* and *Potamogeton* species.



### Water chemistry data

Water quality data for the period 2009 to 2015 were made available by the EPA, for many samples from multiple depths. Values presented and used in assessment are averages of all data.

Parameter	Unit	Aughrusbeg Lough EPA 2009-2015
Alkalinity	mg/l	49.1
Calcium	mg/l	20.8
Chlorophyll	µg/l	6.6
Colour	Hazen units	26.6
Conductivity	µS/cm	383
pH		7.8
Potassium	mg/l	2.2
Secchi	m	2.5
Total oxidised nitrogen	mg/l	0.16
Total phosphorus	mg/l	0.015

## Pressures and threats

Based both on macrophyte species composition and euphotic depth, the lake would appear to be in good ecological condition. However the EPA classified the lake as bad ecological status under the WFD based on surveys in 2007, 2010 and 2013. It is not immediately clear how this discrepancy arises but it is possibly due to large algal blooms caused by maritime influence.

## Conservation condition

Aughrusbeg appears to be an excellent example of a *Najas flexilis*-type lake except it lacks *Najas flexilis*. It is possibly borderline between *Najas flexilis*-type and the 'naturally eutrophic' habitat, 3150. Its coastal position may allow for some enrichment due to sea spray. The presence of *Chara muscosa* increases its conservation value.

Parameter	Target for Good	Aughrusbeg 2017	Condition
Area of habitat	Stable or increasing	Stable or increasing	Good
Deep-water community	Full development	Full development	Good
Number of species	Stable or increase	Increase (31)	Good
Typical species	≥9 indicator species	9	Good
<i>Najas flexilis</i> population	Stable population	Does not occur	n/a
Introduced species	Not present/not impacting on <i>Najas flexilis</i> / deep-water community	not impacting on deep-water community	Good
Euphotic depth (m)	≥3	5.2	Good
Colour (Hazen units)	<40	27	Good
Total phosphorus (TP) (mg/l)	<0.015	0.015	Good/Poor
Hydrological regime	<50% <i>Lobelia</i> – <i>Littorella</i> zone exposed in summer	-	Good
<b>Overall assessment</b>			<b>Good</b>

Lough Ballynakill Connemara, 2016				
Name	Ballynakill Connemara		Code	BAC
Alternative name(s)	Ballinakill			
Grid reference	L6411158108	Max. depth (m)	>10 m (EPA data)	
County	Galway	EPA code	32_479	
Area (ha)	62	OSi 1:50,000 sheet	37	
Maximum length (km)	2.1	Nutrient data	EPA 2009-2015, C. Roden 2005	
Altitude (m)	10	SAC	-	
Geology	Lakes marble formation (Dalradian)			
Previous survey	Roden (2004, 2005, 2011); Roden & Browne (2010); C. Roden for NPWS in 2005, EPA in 2003, 2007, 2010, 2013			
Previous <i>Najas flexilis</i> records	C. Roden 09/08/2004, 10/08/2005, 10/06/2010, EPA 31/07/2003, 11/07/2007, 13/07/2010, 2013			
Other noteworthy species	<i>Hydrilla verticillata</i> , <i>Nitella confervacea</i> , <i>Pilularia globulifera</i> , <i>Subularia aquatica</i> , <i>Typha angustifolia</i>			
Snorkel survey date(s)	19/07/2016	Number of species	37	
Surveyors	PM, CR, JR	Alkalinity (mg/l CaCO <sub>3</sub> )	19.6	
Number of transects	6	Total phosphorus (mg/l TP)	0.012	
Number of relevés	45	Colour (Hazen units)	33	
Euphotic depth (m)	4.0	Secchi depth (m)	4.5	
<i>Najas flexilis</i>	Large population throughout the lake			
Deep-water vegetation	Full development			
Noteworthy species	<i>Hydrilla verticillata</i> , <i>Isoetes echinospora</i> , <i>Najas flexilis</i> , <i>Pilularia globulifera</i> , <i>Subularia aquatica</i> , <i>Typha angustifolia</i> , <i>Fissidens fontanus</i>			
Introduced species	None noted			
Substrates	Fine mud, sand, cobbles, rock			
Summary	Ballynakill Lough is a mesotrophic lake with a circum-neutral pH. It is largely less than 4 m in depth but a deep trench (>10 m) occurs in the south-east. The lake has a rich flora of at least 37 species with several unusual species including <i>Hydrilla verticillata</i> , which is only known from two other sites in western Europe. Unusually for an Isoetid lake, it contains a diverse <i>Potamogeton</i> flora. Large populations of <i>Najas flexilis</i> , <i>Hydrilla verticillata</i> , <i>Nitella confervacea</i> and other unusual species contribute to the formation of diverse vegetation communities not often encountered			
Lake score	287	Lake rank	1	
CONSERVATION CONDITION	<b>GOOD</b>			

### Previous accounts

1. The initial account of this lake was provided by Roden (2004). The site and vegetation were briefly described based on a short examination by snorkelling of north-eastern section (see copy of his report below). Much of these 2004 data were published by Roden (2005a) in a note on *Hydrilla verticillata*.
2. A further area in the north-west was examined in 2005 confirming that both *Najas flexilis* and *Hydrilla verticillata* occurred along the entire northern shore.
3. In 2003, 2007, 2010 and 2013, the EPA examined the vegetation of Ballynakill Lough using a grab sampler along five transects spaced around the lake. No written account is provided but the data allow both a species list and initial vegetation map to be prepared. This work added extra species to those noted by Roden, including *Subularia aquatica* and, surprisingly, *Luronium natans*. In addition, chemical data were also collected.

4. In 2010, as part of an upgrade to the water extraction plant at the eastern end of the lake, C. Roden gave a more-detailed description of the vegetation in this part of the lake (Roden & Browne, 2010) (see account below).
5. This report was extended in 2011 to cover the distribution of *Pilularia globulifera* which had been noted by Ruth Little of the EPA (Roden, 2011) (see account below).

Roden (2004) site description:

<b><i>Najas flexilis</i></b>	<b>Discovery series map:</b> 37	<b>Grid reference:</b> L648581
<b>Locality:</b> Ballynakill Lough	<b>Vice county:</b> H16	<b>SAC/NHA name &amp;no:</b>
<b>Date:</b> 09/08/2004	<b>Recorder:</b> Cilian Roden	<b>Altitude:</b> 10 m
<p><b>Site description:</b> A long narrow lough of about 50 ha on the lakes marble formation lying between Maumfin and Shinnanagh Hills. The lake is surrounded by pasture, heath and rough grazing. The shore consists of gravel and sand. Some boulders occur along the side of the lake which shelves gently to a depth of 3 m. The bottom consists of soft mud. Water transparency is moderate. Several streams including one from the nearby Lough Garraunban enter the lake.</p> <p><b>Population:</b> Only the north-east corner of the lake was examined. A large population of <i>Najas</i> occurs from 1 m down wards. A lower limit to macrophyte vegetation was not found so a very large area of <i>Najas</i> extends over the lake bottom. <i>Najas</i> occurs as part of a very species rich community described below.</p> <p><b>Vegetation:</b> An Isoetid community is followed by a stand of <i>Schoenoplectrus lacustris</i> at about 1 m depth. Beyond the <i>S. lacustris</i>, a very diverse community is found including <i>Hydrilla verticillata</i>, <i>Najas flexilis</i>, <i>Callitriche hermaphroditica</i>, <i>Nitella confervacea</i> and <i>Potamogeton</i> species. This vegetation extends far out into the centre of the lake.</p> <p><b>Management:</b></p> <p><b>Threats:</b> No obvious threats, no houses or intensive farming occurs near the lake.</p> <p><b>Access:</b> From the Cleggan-Moyard road over several fields.</p> <p><b>Conservation:</b> As the second and larger Irish station for <i>Hydrilla verticillata</i> the lake appears to be of considerable conservation value. It contains a diverse flora including <i>Callitriche hermaphroditica</i>, known from one other Connemara station but formerly recorded from Rusheenduff Lough. The <i>Najas flexilis</i> population is very large.</p> <p><b>Remarks:</b> Both the <i>Hydrilla</i> and <i>Najas</i> stations were first recorded during this survey.</p>		

C. Roden survey results from 2010:

*Flora of rocky shores down to 2 m*

*The flora is typical of many Connemara lakes with Eriocaulon aquaticum, Isoetes lacustris, Lobelia dortmanna and Littorella uniflora. Other species noted include Ranunculus aquatilis, Elatine hexandra, Chara virgata, Chara aspera, Nitella translucens, Myriophyllum alterniflorum, Fontinalis antipyretica, Apium inundatum and Sparganium sp. Most of these grow in small pockets of gravel or cracks in the bedrock.*

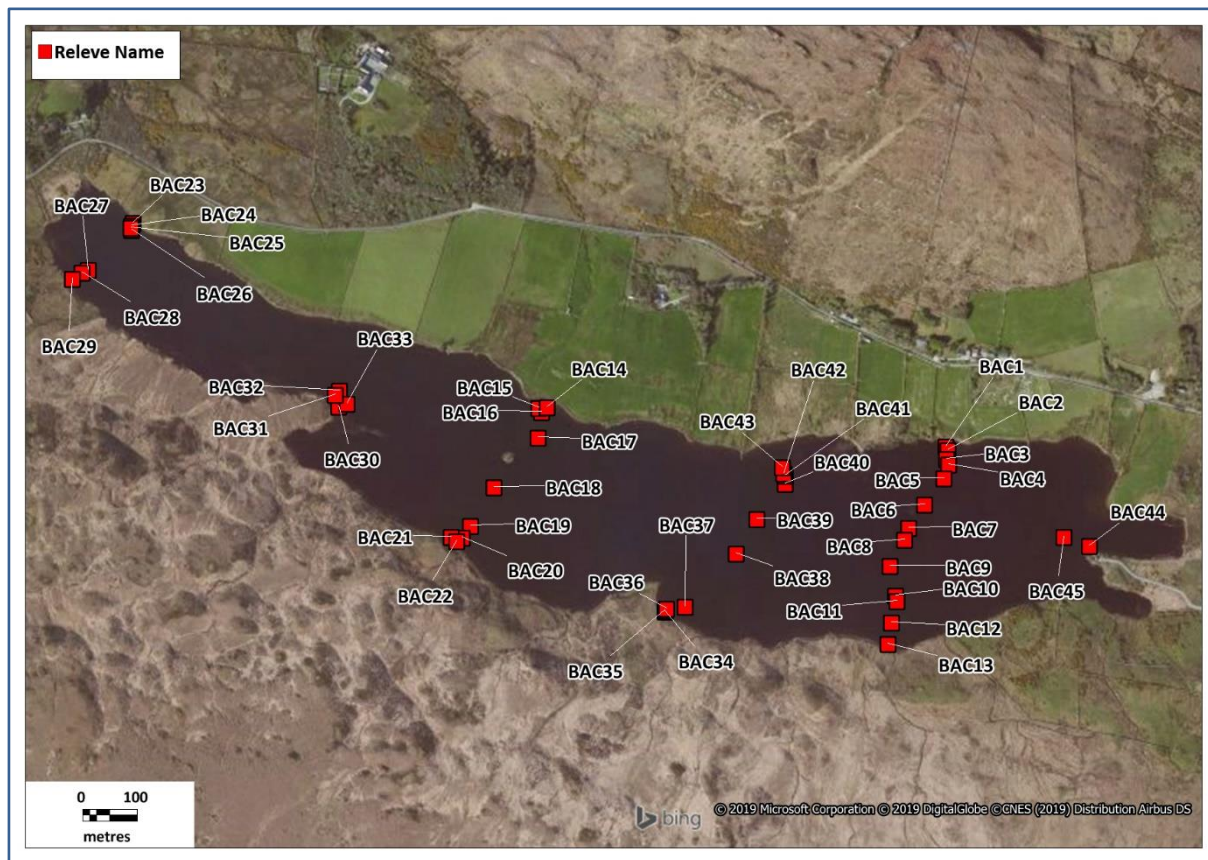
*Flora of silty areas below 2 m.*

*Silty areas support both Hydrilla verticillata and Najas flexilis in large numbers. At slightly deeper levels, the scarce charophyte Nitella confervacea forms very large dense patches. A second Nitella species which appears close to the little known taxon Nitella spanioclema also occurs. In addition, Potamogeton berchtoldii and filamentous algae were noted.*

### Flora of sheltered sediment shores to 2 m

Because of fine sediment or submerged peat these shores support an abundant emergent flora including *Schoenoplectus lacustris*, *Menyanthes trifoliata*, *Nuphar lutea*, *Nymphaea alba*, *Phragmites australis*, *Potamogeton natans*, *P. lucens*, *P. perfoliatus*, *Baldellia ranunculoides*, *Carex rostrata*, *Equisetum fluviatile* and *Juncus bulbosus*.

It was observed that the area around the intake pipe had a notably poorer vegetation, possibly due to a substrate of bare, steeply-dipping rock.



### C. Roden *Pilularia globulifera* survey results from 2011:

*Pilularia globulifera* was found at one place along the lake shore (L64065818) in water depth of 40 cm-1 m, growing in silt between cracks of coarse gravel. A sparse bed of *Schoenoplectus lacustris* offshore may offer some protection from wave action. The position is midway along the exposed northern shore. Accompanying species (with cover values) included *Littorella uniflora* (3), *Myriophyllum alterniflorum* (1), *Elatine hexandra* (1), *Nitella confervacea* (2), *Chara sp.* (1).

This site was close to the point where the EPA collected plants and presumably is part of the same population. The population extended for at least 30 m along the lake shore in shallow water, and extended up to 10 m into the lake. Frond density is high so the total population must number 1000s of plants in this area. In Ballynakill the plant was very small about 2-4 cm and no fertile material was found. A photograph taken by the EPA team (R. Little, pers. com.) shows a fertile plant.

### Species recorded

During the 2016 survey, 37 species were recorded in Ballynakill. Of the four new species added to the existing list in 2016, only two were of note, the moss *Fissidens fontanus* (*Octodicerus fontanum*) and *Isoetes echinospora*, showing the lake is now well surveyed. Two species noted in the EPA surveys but not found in 2016, *Myriophyllum spicatum* and *Luronium natans*, are rejected in this account and not included in the table; we suspect the first species was confused with *Hydrilla verticillata* (not recorded in EPA surveys),



while the second species seems extremely unlikely to occur in this lake (the only known Irish populations grow in far more oligotrophic conditions).

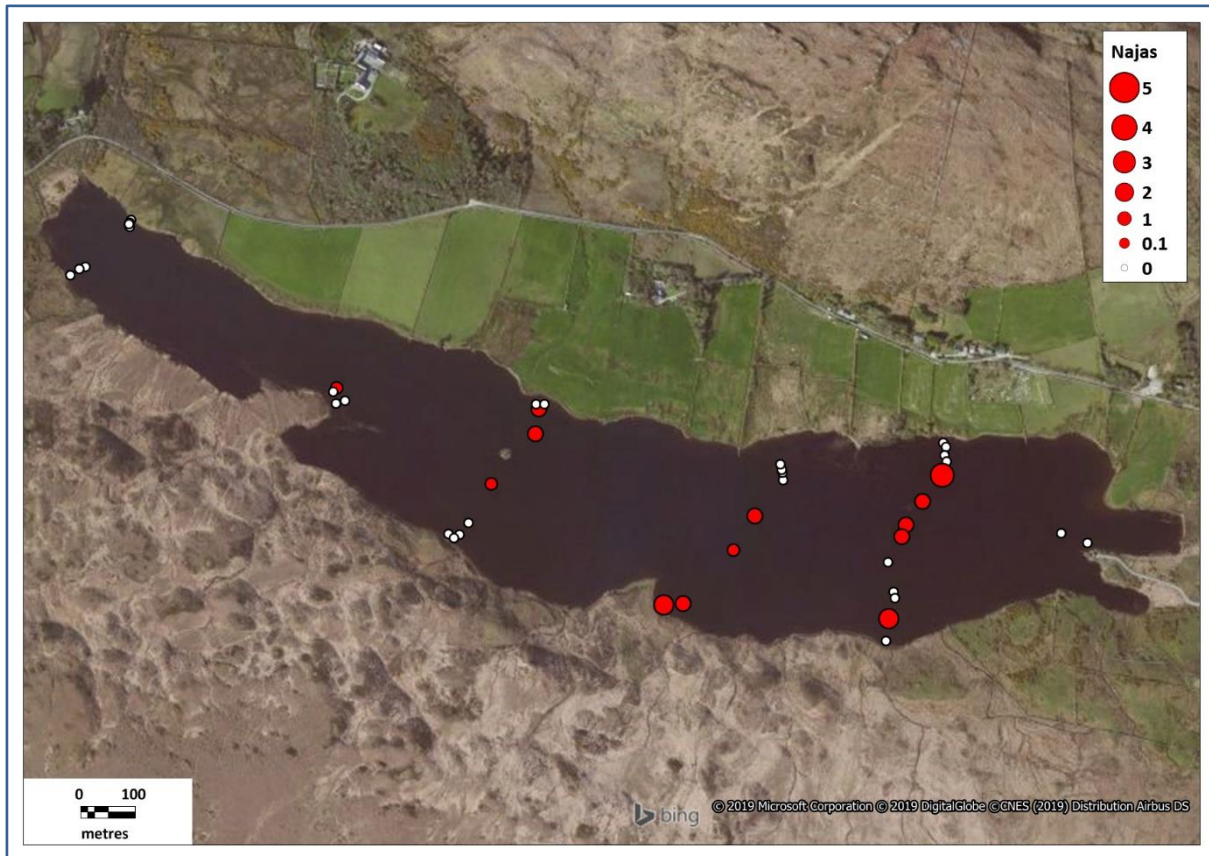
Taxon - Ballynakill Connemara	Before this survey	In this survey (2016)	Taxon - Ballynakill C	Before this survey	In this survey (2016)
Charophytes			<i>Isoetes lacustris</i>	1	1
<i>Chara aspera</i>	1	1	<i>Juncus bulbosus</i>	1	1
<i>Chara curta</i>			<i>Lemna minor</i>		
<i>Chara globularis</i>			<i>Lemna trisulca</i>		
<i>Chara rudis</i>			<i>Littorella uniflora</i>	1	1
<i>Chara virgata</i>	1	1	<i>Lobelia dortmanna</i>	1	1
<i>Nitella conferva cea</i>	1	1	<i>Myriophyllum alterniflorum</i>	1	1
<i>Nitella flexilis</i>	1	1	<i>Myriophyllum spicatum</i>		
<i>Nitella gracilis</i>			<i>Najas flexilis</i>	1	1
<i>Nitella opaca</i>			<i>Nuphar lutea</i>	1	1
<i>Nitella translucens</i>	1	1	<i>Nymphaea alba</i>	1	1
<i>Tolypella glomerata</i>			<i>Oenanthe fluviatilis</i>		
<i>Chara cf. muscosa</i>			<i>Phragmites australis</i>	1	1
Other algae			<i>Pilularia globulifera</i>	1	1
<i>Ophrydium versatile</i>			<i>Potamogeton alpinus</i>		
Bryophytes			<i>Potamogeton berchtoldii</i>	1	1
<i>Fissidens fontanus</i>		1	<i>Potamogeton crispus</i>		
<i>Fontinalis antipyretica</i>	1	1	<i>Potamogeton filiformis</i>		
<i>Sphagnum</i> sp.			<i>Potamogeton gramineus</i>	1	1
Vascular Plants			<i>Potamogeton lucens</i>	1	1
<i>Alisma plantago-aquatica</i>			<i>Potamogeton natans</i>	1	1
<i>Apium inundatum</i>	1	1	<i>Potamogeton obtusifolius</i>		
<i>Baldellia ranunculoides</i> subsp. <i>ranunculoides</i>	1	1	<i>Potamogeton pectinatus</i>		
<i>Baldellia ranunculoides</i> subsp. <i>repens</i>	1		<i>Potamogeton perfoliatus</i>	1	1
<i>Callitriche brutia</i> subsp. <i>hamulata</i>			<i>Potamogeton polygonifolius</i>		
<i>Callitriche hermaphroditica</i>	1	1	<i>Potamogeton praelongus</i>		
<i>Carex rostrata</i>	1		<i>Potamogeton pusillus</i>		
<i>Ceratophyllum demersum</i>			<i>Potamogeton × angustifolius</i>		1
<i>Cladium mariscus</i>			<i>Potamogeton × nitens</i>		
<i>Elatine hexandra</i>	1	1	<i>Ranunculus</i> sp.	1	1
<i>Eleocharis acicularis</i>			<i>Schoenoplectus lacustris</i>	1	1
<i>Eleocharis multicaulis</i>			<i>Sparganium angustifolium</i>		
<i>Eleocharis palustris</i>		1	<i>Sparganium emersum</i>		
<i>Eleogiton fluitans</i>			<i>Sparganium erectum</i>		
<i>Elodea canadensis</i>			<i>Sparganium natans</i>		
<i>Equisetum fluviatile</i>	1	1	<i>Subularia aquatica</i>	1	1
<i>Eriocaulon aquaticum</i>	1	1	<i>Typha angustifolia</i>	1	1
<i>Hydrilla verticillata</i>	1	1	<i>Utricularia</i> sp.	1	1
<i>Isoetes echinospora</i>		1	<i>Zannichellia palustris</i>		

This survey did confirm that very large populations of several rare macrophytes do occur

- *Hydrilla verticillata* occurs at 15 stations throughout the lake in water depths from 1 m to 4 m, growing on soft silt and mud.
- *Pilularia globulifera* occurs at five stations in water less than 1 m along the northern and southwestern shores, growing on gravel and silt.
- *Subularia aquatica* grows at three stations in similar conditions to *Pilularia*.
- *Fissidens fontanus* (*Octodicerus fontanum*) grows on stones in the south-east of the lake at 1-2 m depth.

## *Najas flexilis*

The plant is abundant in the lake and was recorded in 14 relevés with densities reaching cover values of up to 50%. The plant occurs from about 1.5 m to the euphotic depth of 4 m. It occurs throughout the lake with the exception of the extreme west. The substrate is always a reddish silt or mud. Companion species include *Hydrilla verticillata*, *Potamogeton berchtoldii* and *P. perfoliatus*. Many plants produce seeds and flowers and appear in good condition (large, much branched unfouled with epiphytes).

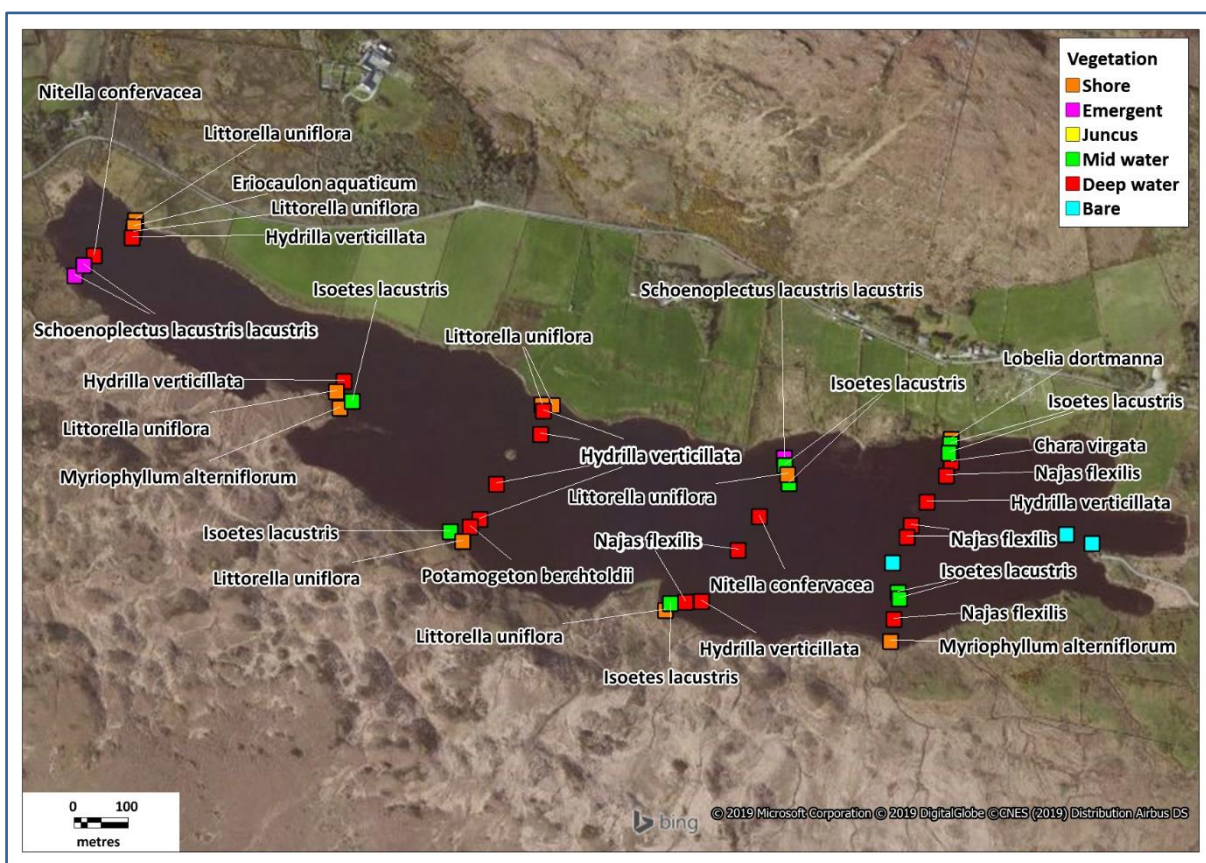


## Vegetation

The vegetation consists of

- Shore to mid-depth Isoetid communities
- A very extensive deep-water community
- An *Eriocaulon*—*Lobelia* unit growing on soft sediment in shallow water
- A variant dominated by *Littorella* growing on gravel
- An *Isoetes*—*Chara virgata* unit growing from 1-3 m
- An *Hydrilla*—*Najas* unit growing from about 2 m to the euphotic limit of 4 m
- Emergent vegetation of *Schoenoplectus*, *Phragmites* and *Typha*

Ballynakill is an unusual lake in that clear water (Secchi 4.5 m) allows almost the entire lake bed to support macrophyte growth with the exception of a narrow trench exceeding 10 m depth in the south-east.



### Water chemistry data

Water quality data for the period 2009 to 2015 were made available by the EPA, for many samples from multiple depths. Values presented and used in assessment are averages of all data. Data are also available from samples taken by C. Roden on 22 September 2005.

Parameter	Unit	Ballynakill Connemara EPA 2009-2015	Ballynakill Connemara C. Roden 2005
Alkalinity	mg/l	19.6	30
Ammonia	mg/l	-	0.023
Calcium	mg/l	7.7	3.6
Chloride	mg/l	32.8	48
Chlorophyll	µg/l	6.9	3.46
Colour	Hazen units	33.2	18
Conductivity	µS/cm	151	148.3
Magnesium	mg/l	2.6	1.7
Nitrate	mg/l	-	0.01
Nitrite	mg/l	-	0.02
Phosphate	mg/l	-	<0.003
pH		7.16	7.66
Total oxidised nitrogen	mg/l	0.018	-
Total phosphorus	mg/l	0.012	0.012

### Pressures and threats

Excess water abstraction from the treatment plant at the eastern end could damage littoral communities. Some managed pasture occurs along the northern shore of the lake, so the possibility of fertiliser run-off exists. As the lake is a water source for the locality, there is some local support for controlling excessive fertiliser use. An administrative problem is that the lake has no nature conservation designation as an NHA or SAC, though several plants are protected by the Flora Protection Order

(*Hydrilla verticillata*, *Najas flexilis* and *Pilularia globulifera*) and *Najas flexilis* is a Habitats Directive Annex II species.

### Conservation condition

The lake appears in very good condition with extremely rare (relict?) species present. It is probably the best example of a *Najas flexilis*-type lake in Ireland.

Parameter	Target for Good	Ballynakill Connemara 2016	Condition
Area of habitat	Stable or increasing	Stable or increasing	Good
Deep-water community	Full development	Full development	Good
Number of species	Stable or increase	Stable/increase (37)	Good
Typical species	≥9 indicator species	17	Good
<i>Najas flexilis</i> population	Stable population	Stable	Good
Introduced species	Not present/not impacting on <i>Najas flexilis</i> / deep-water community	Not present	Good
Euphotic depth (m)	≥3	4.0	Good
Colour (Hazen units)	<40	33	Good
Total phosphorus (TP) (mg/l)	<0.015	0.012	Good
Hydrological regime	<50% <i>Lobelia – Littorella</i> zone exposed in summer	-	Good
<b>Overall assessment</b>			<b>Good</b>

Lough Ballynakill Gort, 2016			
Name	Ballynakill Gort	Code	BAG
Alternative name(s)	Ballinakill		
Grid reference	R4639195651	Max. depth (m)	>10 m
County	Galway	EPA code	29_174
Area (ha)	31	OSi 1:50,000 sheet	52
Maximum length (km)	1.4	Nutrient data	This survey 06/02/2019
Altitude (m)	32	SAC	-
Geology	Shale and some limestone		
Previous survey	C. Roden in 2004, 2005		
Previous <i>Najas flexilis</i> records	There are no records for the species in Ballynakill Gort		
Other noteworthy species	<i>Callitriche hermaphroditica</i> , <i>Eleocharis acicularis</i> , <i>Isoetes lacustris</i> , <i>Lobelia dortmanna</i>		
Snorkel survey date(s)	11/07/2016	Number of species	21
Surveyors	PM, CR, JR	Alkalinity (mg/l CaCO <sub>3</sub> )	54.5
Number of transects	5	Total phosphorus (mg/l TP)	0.044
Number of relevés	24	Colour (Hazen units)	117
Euphotic depth (m)	2.7	Secchi depth (m)	2.5
<i>Najas flexilis</i>	Does not occur		
Deep-water vegetation	Absent		
Noteworthy species	<i>Eleocharis acicularis</i> , <i>Isoetes lacustris</i> , <i>Lobelia dortmanna</i>		
Introduced species	<i>Elodea canadensis</i> present		
Substrates	Fine mud, sand, cobbles, rock		
Summary	An unusual lake for reasons of geography: most <i>Isoetes</i> lakes occur further west, making the presence of this type of lake near Gort notable. The flora contains some locally rare species but there is some evidence of eutrophication		
Lake score	113	Lake rank	4
CONSERVATION CONDITION	<b>POOR</b>		

### Previous accounts

There appear to be no accounts of this lake before a brief visit by C. Roden in 2004. He made a short exploration of the north-eastern section and noted *Lobelia* and *Isoetes*, as well as *Callitriche hermaphroditica*. He examined the south-western end of the lake in 2005. The principal interest in the lake was its soft-water flora including *Isoetes* and *Lobelia*, even though it is situated partly on limestone and in the Gort lowlands, where such a flora has not been noted previously. A similar flora was noted in 2005 by C. Roden in the nearby Doon Lough (R439904). Like many *Najas*-containing lakes, both *Isoetes lacustris* and *Potamogeton perfoliatus* occur. However, abundant *Lemma trisulca* indicated a more eutrophic lake than most *Najas* sites.

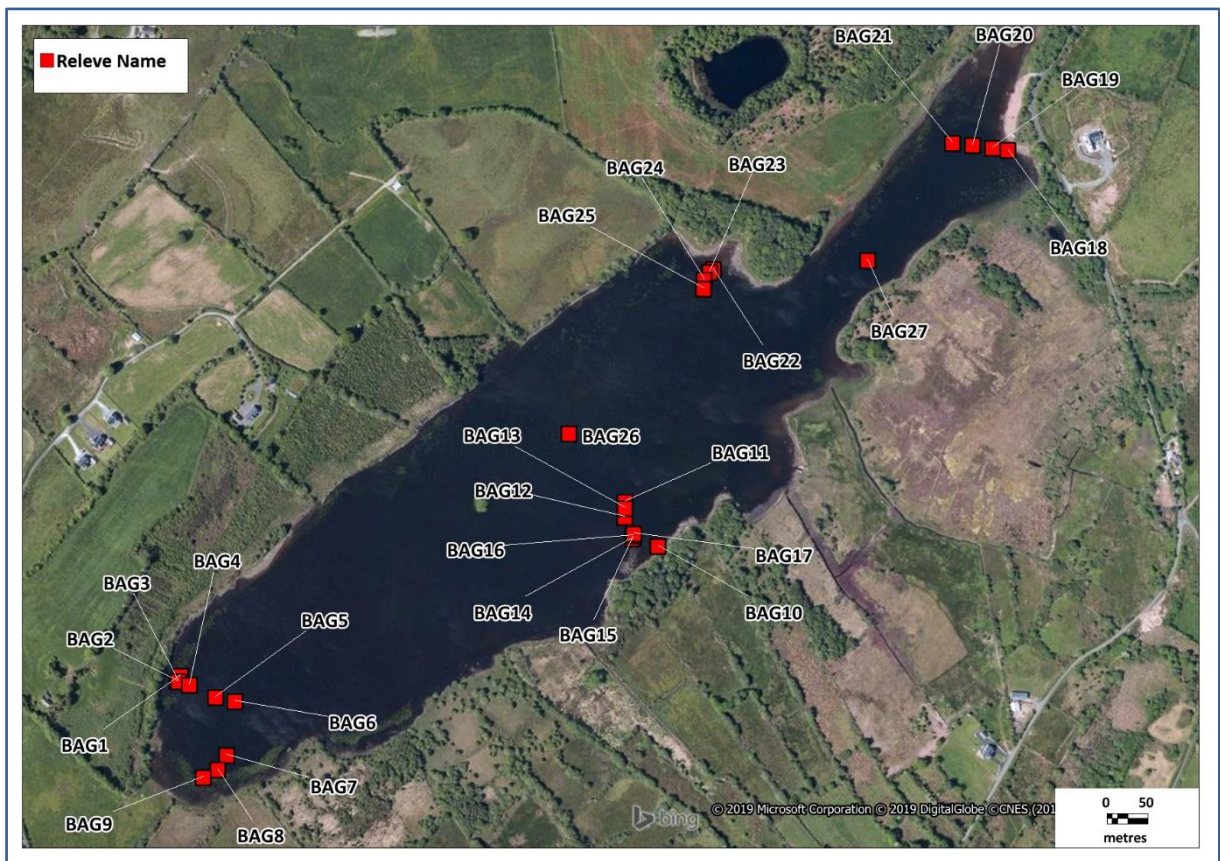
### Species recorded

Twenty-one species were recorded during the 2016 survey at Ballynakill Gort. An unusual species is *Oenanthe fluviatile* which is common north-east of the crannog in the lake centre. It also occurs as a submerged form on the eastern shore.

- *Eleocharis acicularis* occurs on coarse sand in the north of the lake.
- *Isoetes lacustris* is common in many parts of the lake, as is *Lobelia dortmanna* along the north-eastern shore. While common along the west coast, this lowland more easterly station for these species is unusual.

- *Callitriche hermaphroditica* was noted in 2004 but not seen in 2016. However it is possible that it persists. Like the two previous species, this is an almost unrecorded plant in south-east Galway, but often a companion species to *Najas flexilis* elsewhere.

Taxon - Ballynakill Gort	Before this survey	In this survey (2016)	Taxon - Ballynakill Gort	Before this survey	In this survey (2016)
Charophytes			<i>Isoetes lacustris</i>	1	1
<i>Chara aspera</i>			<i>Juncus bulbosus</i>		
<i>Chara curta</i>			<i>Lemna minor</i>	1	1
<i>Chara globularis</i>			<i>Lemna trisulca</i>		
<i>Chara rudis</i>			<i>Littorella uniflora</i>		1
<i>Chara virgata</i>	1	1	<i>Lobelia dortmanna</i>	1	1
<i>Nitella confervacea</i>			<i>Myriophyllum alterniflorum</i>		
<i>Nitella flexilis</i>	1	1	<i>Myriophyllum spicatum</i>		
<i>Nitella gracilis</i>			<i>Najas flexilis</i>		
<i>Nitella opaca</i>			<i>Nuphar lutea</i>		1
<i>Nitella translucens</i>			<i>Nymphaea alba</i>		
<i>Tolypella glomerata</i>			<i>Oenanthe fluviatilis</i>		1
<i>Chara cf. muscosa</i>			<i>Phragmites australis</i>		1
Other algae			<i>Pilularia globulifera</i>		
<i>Ophrydium versatile</i>			<i>Potamogeton alpinus</i>		
Bryophytes			<i>Potamogeton berchtoldii</i>	1	1
<i>Fissidens fontanus</i>			<i>Potamogeton crispus</i>		
<i>Fontinalis antipyretica</i>			<i>Potamogeton filiformis</i>		
<i>Sphagnum</i> sp.			<i>Potamogeton gramineus</i>		1
Vascular Plants			<i>Potamogeton lucens</i>	1	1
<i>Alisma plantago-aquatica</i>			<i>Potamogeton natans</i>		
<i>Apium inundatum</i>		1	<i>Potamogeton obtusifolius</i>		
<i>Baldellia ranunculoides</i> subsp. <i>ranunculoides</i>		1	<i>Potamogeton pectinatus</i>		
<i>Baldellia ranunculoides</i> subsp. <i>repens</i>			<i>Potamogeton perfoliatus</i>	1	1
<i>Callitriche brutia</i> subsp. <i>hamulata</i>			<i>Potamogeton polygonifolius</i>		
<i>Callitriche hermaphroditica</i>	1		<i>Potamogeton praelongus</i>		
<i>Carex rostrata</i>			<i>Potamogeton pusillus</i>		
<i>Ceratophyllum demersum</i>			<i>Potamogeton × angustifolius</i>		1
<i>Cladium mariscus</i>			<i>Potamogeton × nitens</i>		
<i>Elatine hexandra</i>			<i>Ranunculus</i> sp.		
<i>Eleocharis acicularis</i>	1	1	<i>Schoenoplectus lacustris</i>	1	1
<i>Eleocharis multicaulis</i>		1	<i>Spartanium angustifolium</i>		
<i>Eleocharis palustris</i>			<i>Spartanium emersum</i>		
<i>Eleogiton fluitans</i>			<i>Spartanium erectum</i>		
<i>Elodea canadensis</i>	1	1	<i>Spartanium natans</i>		
<i>Equisetum fluviatile</i>		1	<i>Subularia aquatica</i>		
<i>Eriocaulon aquaticum</i>			<i>Typha angustifolia</i>		
<i>Hydrilla verticillata</i>			<i>Utricularia</i> sp.		
<i>Isoetes echinospora</i>			<i>Zannichellia palustris</i>		



### *Najas flexilis*

*Najas flexilis* does not occur

### Vegetation

Vegetation of rocky shores down to 1 m:

- *Littorella* and *Lobelia* occur in shallow water giving way to a scattered lawn of *Isoetes lacustris* with *Chara virgata*.

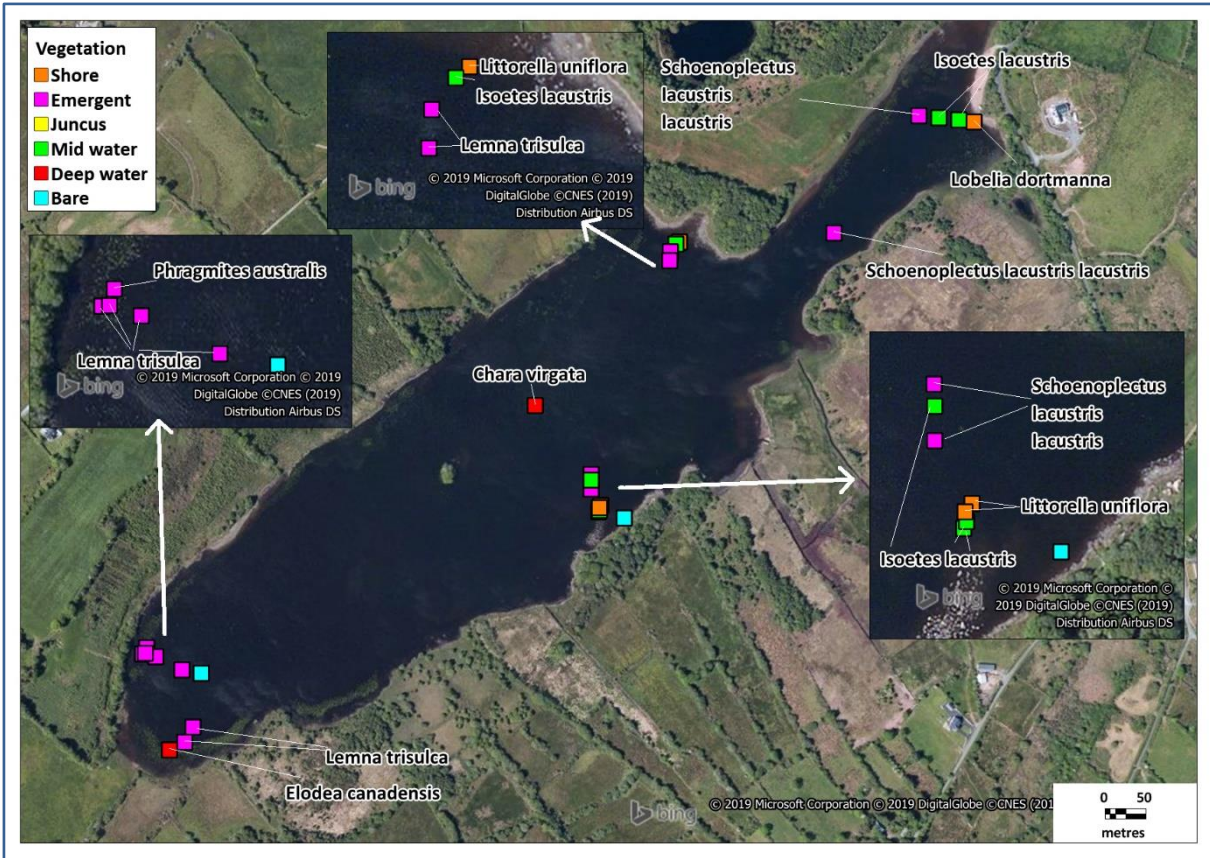
Vegetation of silty areas below 1 m:

- Silty areas have an abundant cover of *Lemna trisulca*, *Potamogeton* species, *Elodea* and *Isoetes* and *Nitella flexilis*. This vegetation fades into a sparse monoculture of *Lemna* at about 2 m.

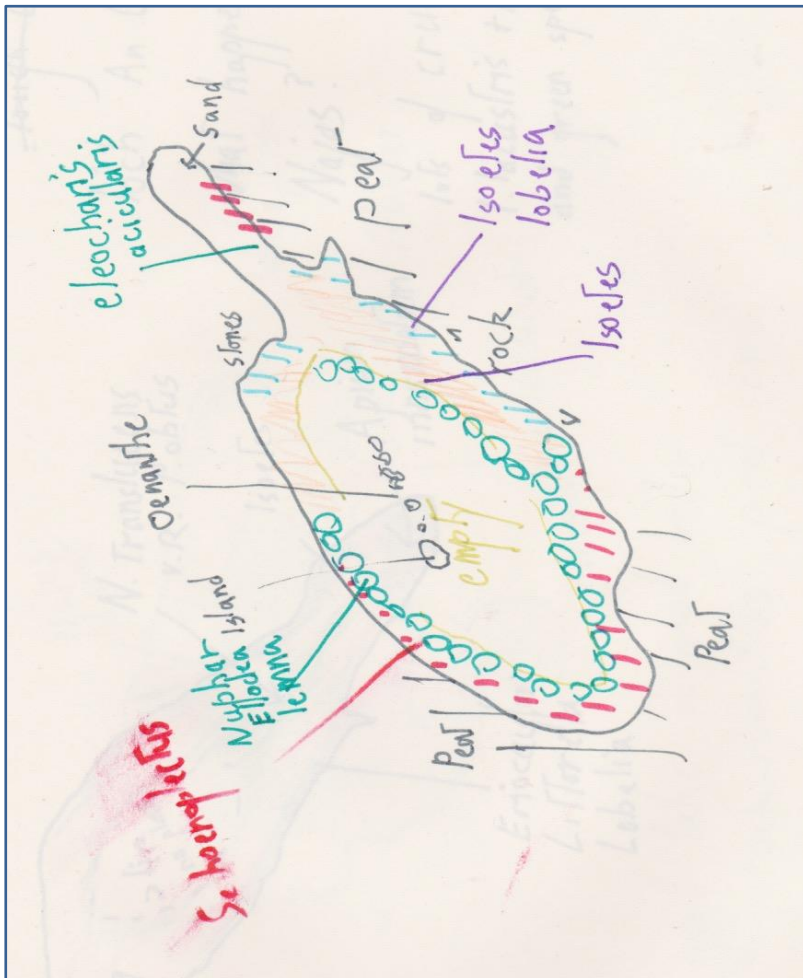
Vegetation of sheltered sediment or peaty shores

- Here a reduced flora of *Schoenoplectus lacustris*, *Nuphar lutea* and *Lemna trisulca* occur from the ill-defined peaty shoreline to the euphotic depth of about 2.5 m. As *Lemna trisulca* is often carried below the euphotic depth (it does not root), it is difficult to mark the exact euphotic depth (2.7 m was used).

At the north-eastern end an extensive deposit of coarse sand occurs in water less than 1 m. Here *Eleocharis acicularis* occurs along with species such as *Chara virgata*, *Elodea canadensis*, *Littorella* and *Schoenoplectus*.



Sketch map





## Water chemistry data

Water samples were taken on a single occasion on the 6 February 2019 as part of this survey.

Parameter	Unit	Ballynakill Gort This survey
Alkalinity	mg/l	54.5
Calcium	mg/l	22
Chloride	mg/l	18.9
Chlorophyll	µg/l	1
Colour	Hazen units	117
Conductivity	µS/cm	181
pH		7.6
Total phosphorus	mg/l	0.044

## Pressures and threats

The lake is used and presumably preserved by a local angling club. There are no obvious threats. 90% of the lake shore is surrounded by scrub, cutaway bog or forestry. The forestry in the south-western quadrant was planted in 2005 and was kept 20 m from the lake shore. A house was built about 100 m from the lake (behind the forestry) around 2005. There is no evidence of large change in species composition since 2005. No other changes can be seen between 2013 and 2005/2000 Aerial photographs.

## Conservation condition

Alkalinity and the presence of both *Isoetes lacustris* and *Potamogeton perfoliatus* show this lowland lake on carboniferous shale is a *Najas flexilis*-type lake, albeit not in good conservation condition. High colour and TP are based on single winter figures but euphotic depth is low and no deep-water vegetation was noted.

Parameter	Target for Good	Ballynakill Gort 2016	Condition
Area of habitat	Stable or increasing	Stable or increasing	Good
Deep-water community	Full development	absent	Bad
Number of species	Stable or increase	Increase (21)	Good
Typical species	≥9 indicator species	6	Poor
<i>Najas flexilis</i> population	Stable population	Does not occur	n/a
Introduced species	Not present/not impacting on <i>Najas flexilis</i> / deep-water community	Abundant <i>Elodea canadensis</i> may be impacting deep-water flora	Poor
Euphotic depth (m)	≥3	2.7	Poor
Colour (Hazen units)	<40	117	Bad
Total phosphorus (TP) (mg/l)	<0.015	0.047	Poor
Hydrological regime	<50% <i>Lobelia – Littorella</i> zone exposed in summer	-	Good
<b>Overall assessment</b>			<b>Poor</b>

Lough Bofin, 2018				
Name	Bofin		Code	BOF
Alternative name(s)				
Grid reference	M0339744013	Max. depth (m)	14	
County	Galway	EPA code	30_335	
Area (ha)	92	OSi 1:50,000 sheet	45	
Maximum length (km)	2.5	Nutrient data	EPA 2009-2015	
Altitude (m)	40	SAC	002034, Connemara Bog Complex SAC	
Geology	Oughterard granite			
Previous survey	EPA in 2007, 2010, 2013			
Previous <i>Najas flexilis</i> records	EPA 31/07/2007, 17/08/2010			
Other noteworthy species	<i>Nitella confervacea</i>			
Snorkel survey date(s)	25/07/2018	Number of species	23	
Surveyors	PM, JR	Alkalinity (mg/l CaCO <sub>3</sub> )	42.4	
Number of transects	4	Total phosphorus (mg/l TP)	0.012	
Number of relevés	15	Colour (Hazen units)	64	
Euphotic depth (m)	1.9	Secchi depth (m)	2.1	
<i>Najas flexilis</i>	Small population present			
Deep-water vegetation	Poorly developed			
Noteworthy species	<i>Isoetes echinospora</i> , <i>Najas flexilis</i> , <i>Nitella confervacea</i>			
Introduced species	None noted			
Substrates	Rock, gravel, silt			
Summary	A lake with a very shallow euphotic depth and high colour which still retains a small <i>Najas flexilis</i> population, possibly damaged by peat run off. An additional interest is the presence of freshwater pearl mussels in the lake			
Lake score	124	Lake rank	4	
CONSERVATION CONDITION	<b>POOR</b>			

### Previous accounts

1. A few records, *Potamogeton perfoliatus*, *Sparganium emersum*, are included in Webb and Scannell (1983).
2. The EPA surveyed the lake on three occasions: 2007, 2010 and 2013. The plants found are included in the table ('Before this survey'), including first records for *Najas flexilis* and *Nitella confervacea*. While it is difficult to create a map of vegetation from the EPA data, the lake appears to have been dominated by Isoetids and a *Najas*–*Nitella* community below 2.0 m with a euphotic depth of 3.5 m and *Fontinalis* present.

See also NPWS (2015e, f).

### Species recorded

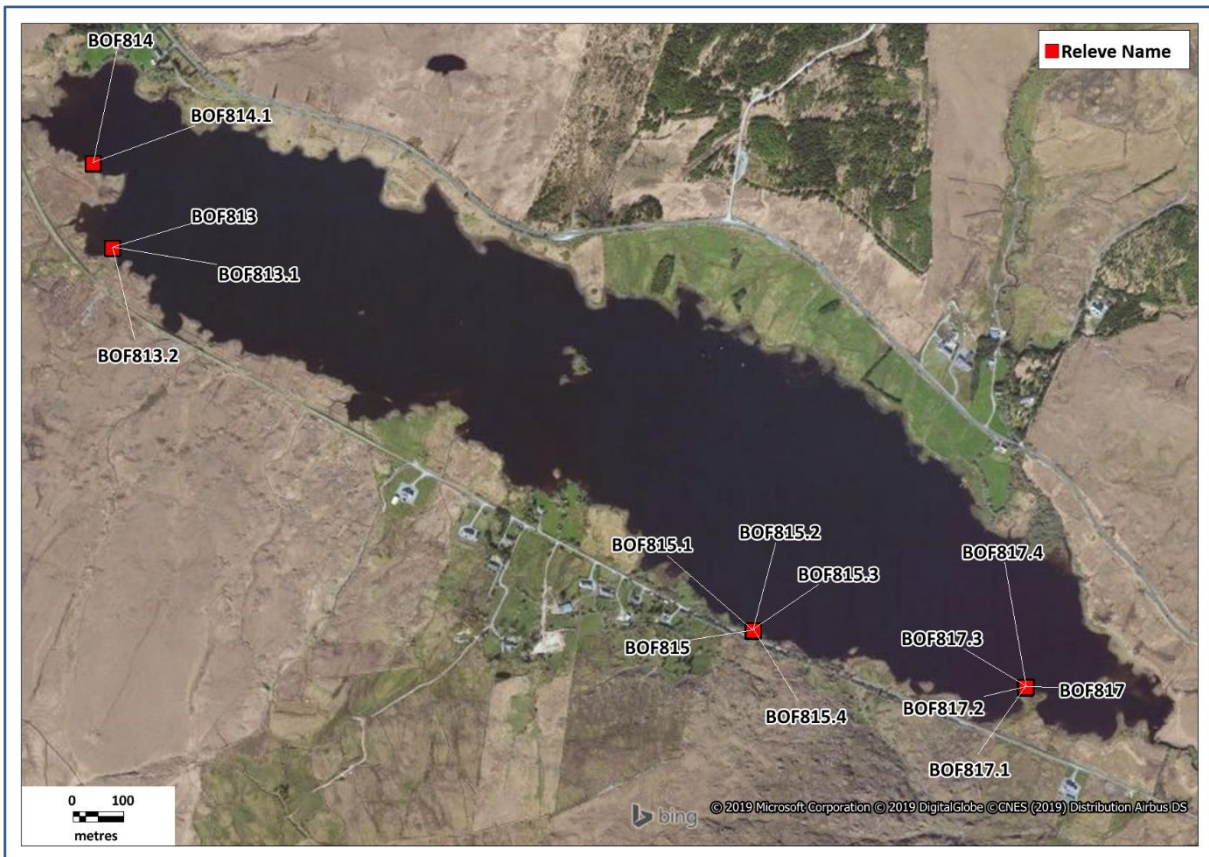
In 2018, 23 species were recorded from Lough Bofin and most are widespread in soft-water lakes. The lake is of interest as it is situated near the eastern border of Connemara and at some distance from the sea.

- *Isoetes echinospora*, probably an under-recorded species, was found at 1.2 m at the south eastern side of the lake (WP 815).
- *Nitella confervacea*, again an under-recorded taxon, was first noted by the EPA in 2013 between 1.7 and 2.6 m at the north-western end and the south-eastern shore. It was again found in the 2018 survey on the south eastern shore.
- *Najas flexilis* occurs (see below).

Taxon - Bofin	Before this survey	In this survey (2018)	Taxon - Bofin	Before this survey	In this survey (2018)
Charophytes			<i>Isoetes lacustris</i>	1	1
<i>Chara aspera</i>			<i>Juncus bulbosus</i>	1	1
<i>Chara curta</i>			<i>Lemna minor</i>		
<i>Chara globularis</i>			<i>Lemna trisulca</i>		
<i>Chara rudis</i>			<i>Littorella uniflora</i>	1	1
<i>Chara virgata</i>		1	<i>Lobelia dortmanna</i>	1	1
<i>Nitella confervacea</i>	1	1	<i>Myriophyllum alterniflorum</i>	1	1
<i>Nitella flexilis</i>	1	1	<i>Myriophyllum spicatum</i>	1	
<i>Nitella gracilis</i>			<i>Najas flexilis</i>	1	1
<i>Nitella opaca</i>			<i>Nuphar lutea</i>		
<i>Nitella translucens</i>		1	<i>Nymphaea alba</i>		
<i>Tolypella glomerata</i>			<i>Oenanthe fluviatilis</i>	1	
<i>Chara cf. muscosa</i>			<i>Phragmites australis</i>		
Other algae			<i>Pilularia globulifera</i>		
<i>Ophrydium versatile</i>			<i>Potamogeton alpinus</i>		
Bryophytes			<i>Potamogeton berchtoldii</i>	1	1
<i>Fissidens fontanus</i>			<i>Potamogeton crispus</i>		
<i>Fontinalis antipyretica</i>	1	1	<i>Potamogeton filiformis</i>		
<i>Sphagnum</i> sp.		1	<i>Potamogeton gramineus</i>		1
Vascular Plants			<i>Potamogeton lucens</i>		
<i>Alisma plantago-aquatica</i>			<i>Potamogeton natans</i>	1	1
<i>Apium inundatum</i>	1	1	<i>Potamogeton obtusifolius</i>		
<i>Baldellia ranunculoides</i> subsp. <i>ranunculoides</i>			<i>Potamogeton pectinatus</i>		
<i>Baldellia ranunculoides</i> subsp. <i>repens</i>			<i>Potamogeton perfoliatus</i>	1	1
<i>Callitriche brutia</i> subsp. <i>hamulata</i>			<i>Potamogeton polygonifolius</i>		
<i>Callitriche hermaphrodita</i>			<i>Potamogeton praelongus</i>		
<i>Carex rostrata</i>			<i>Potamogeton pusillus</i>		
<i>Ceratophyllum demersum</i>			<i>Potamogeton × angustifolius</i>		
<i>Cladium mariscus</i>			<i>Potamogeton × nitens</i>		
<i>Elatine hexandra</i>	1	1	<i>Ranunculus</i> sp.		
<i>Eleocharis acicularis</i>			<i>Schoenoplectus lacustris</i>		
<i>Eleocharis multicaulis</i>	1		<i>Sparganium angustifolium</i>		1
<i>Eleocharis palustris</i>			<i>Sparganium emersum</i>	1	
<i>Eleogiton fluitans</i>			<i>Sparganium erectum</i>		
<i>Elodea canadensis</i>			<i>Sparganium natans</i>		
<i>Equisetum fluviatile</i>		1	<i>Subularia aquatica</i>		
<i>Eriocaulon aquaticum</i>	1	1	<i>Typha angustifolia</i>		
<i>Hydrilla verticillata</i>			<i>Utricularia</i> sp.	1	1
<i>Isoetes echinospora</i>		1	<i>Zannichellia palustris</i>		

### *Najas flexilis*

The plant was first recorded by the EPA in 2007 at the north-western end of the lake growing at 1.7 m. It was again found at the north-western end in 2010 and along the south-eastern shore where it occurred at 2.6 m. It was not recorded in 2013. In 2018, the plant was again found at both these locations. While noted as frequent by the EPA, large populations were not seen in 2018 (cover values < 5%). The total area of *Najas* habitat is estimated at 2-4 ha, depending on the width of the area colonised along the southern shore.



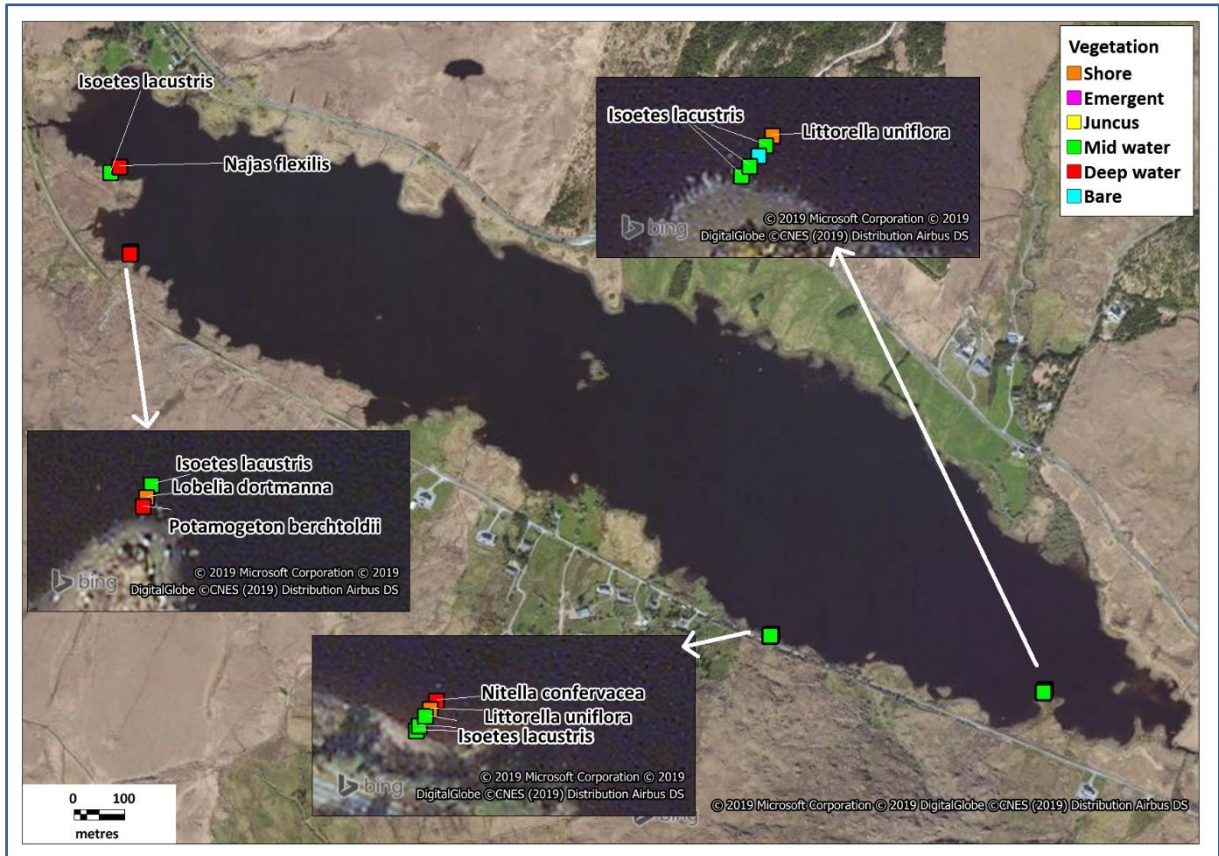
## Vegetation

The lake is a north-west to south-east trending basin about 2 km in length with a maximum depth of 14 m and shores of granite rock boulders and sand. At depth, sandy-silt occurs, with some mud. The

lake is surrounded by sloping shores with rock, rough grazing, heath and a little agricultural land. The vegetation is sparse due to outcrops of rock and coarse sand with maximum cover values of 60%.

In shallow water Isoetids including *Littorella*, *Eriocaulon* and *Lobelia* occur with *Isoetes* sp. occurring to the euphotic depth of about 2.0 m. A community with *Potamogeton berchtoldii*, *P. perfoliatus*, *Fontinalis* and some *Najas* occurs below about 1.0 m. The euphotic depth was measured at 1.9 m but given that water level in 2018 was low, this may be an under estimate. In 2013, the EPA recorded *Nitella* sp. and *Fontinalis* growing below 3.5 m.

The lake is unusual in having a population of the Freshwater Pearl Mussel *Margaritifera margaritifera*, which is found at both ends of the lake in the 2018 survey, between 1 m and 2 m on coarse sand and cobbles.



## Water chemistry data

Water quality data for the period 2009 to 2015 were made available by the EPA, for many samples from multiple depths. Values presented and used in assessment are averages of all data.

Parameter	Unit	Lough Bofin EPA 2009-2015
Alkalinity	mg/l	42.4
Calcium	mg/l	2.6
Chloride	mg/l	17.8
Chlorophyll	µg/l	4.2
Colour	Hazen units	63.9
Conductivity	µS/cm	137
Magnesium	mg/l	1.1
pH		7.3
Potassium	mg/l	0.4
Secchi	m	2.1
Sulphate	mg/l	2.5
Total oxidised nitrogen	mg/l	0.18
Total phosphorus	mg/l	0.012

## Pressures and threats

There appear to be no major threats to the lake. The reduced euphotic depth in 2018 compared to earlier estimates may reflect the dry and warm summer of 2018, which in other lakes resulted in the absence of *Najas flexilis*, e.g. Lough Leane and Loch an Chaolaigh.

## Conservation condition

The lake was sampled in 2018 when water levels were low, so euphotic depth may be underestimated. Colour is high and deep-water vegetation poorly developed so the lake is an indifferent example of a *Najas flexilis*-type lake. However the presence of the Freshwater Pearl Mussel and some unusual plants is interesting.

Parameter	Target for Good	Lough Bofin 2018	Condition
Area of habitat	Stable or increasing	Stable or increasing	Good
Deep-water community	Full development	Partial	Poor
Number of species	Stable or increase	Increase (23)	Good
Typical species	≥9 indicator species	12	Good
<i>Najas flexilis</i> population	Stable population	Increase in locations from 2007 EPA survey	Good
Introduced species	Not present/not impacting on <i>Najas flexilis</i> / deep-water community	Not present	Good
Euphotic depth (m)	≥3	1.9	Bad
Colour (Hazen units)	<40	64	Poor
Total phosphorus (TP) (mg/l)	<0.015	0.012	Good
Hydrological regime	<50% <i>Lobelia</i> – <i>Littorella</i> zone exposed in summer	-	Good
<b>Overall assessment</b>			<b>Poor</b>

Lough Caragh, 2017			
Name	Caragh	Code	CAR
Alternative name(s)			
Grid reference	V7227890806	Max. depth (m)	> 40 m (EPA data)
County	Kerry	EPA code	22_207
Area (ha)	493	OSi 1:50,000 sheet	78
Maximum length (km)	5.4	Nutrient data	EPA 2009-2015, AFF 1973/4
Altitude (m)	15	SAC	000365, Killarney National Park, Macgillycuddy's Reeks And Caragh River Catchment SAC
Geology	Devonian sandstone, some Carboniferous limestone		
Previous survey	Multiple surveys since mid-19 <sup>th</sup> Century, including Scully (1916), Heuff (1984), FitzGerald & Preston (1994), Wingfield <i>et al.</i> (2004), Roden (2004), EPA surveys in 2008, 2011, 2014 and others.		
Previous <i>Najas flexilis</i> records	A.G. More 1877 (More, 1877; Scully, 1916), R.W. Scully 1896-1906 (Scully, 1916), Hanbury 1906 (Scully, 1916), H. Heuff & J. Ryan 09/10/1977 (Heuff, 1984), R. FitzGerald, P. Foley & C.D. Preston 27/07/1994 (FitzGerald & Preston, 1994), R.A. Wingfield 17/08/2000 (Wingfield <i>et al.</i> , 2004), EPA 14/08/2002, 29/08/2011, Roden 31/08/2004 (Roden, 2004)		
Other noteworthy species	<i>Isoetes echinospora</i> , <i>Nitella confervacea</i> , <i>Subularia aquatica</i>		
Snorkel survey date(s)	03/08/17, 04/08/17	Number of species	27
Surveyors	PM, CR, JR	Alkalinity (mg/l CaCO <sub>3</sub> )	6.9
Number of transects	9	Total phosphorus (mg/l TP)	0.01
Number of relevés	39	Colour (Hazen units)	35
Euphotic depth (m)	3.7	Secchi depth (m)	3.2
<i>Najas flexilis</i>	Large population in south of lake		
Deep-water vegetation	Full development only at a few locations		
Noteworthy species	<i>Baldellia ranunculoides</i> subsp. <i>repens</i> , <i>Eleocharis acicularis</i> , <i>Isoetes echinospora</i> , <i>Najas flexilis</i>		
Introduced species	<i>Elodea canadensis</i> present		
Substrates	Fine mud, sand, cobbles, rock		
Summary	A large lake on Devonian sandstone and Carboniferous limestone. Well-studied, with <i>Najas flexilis</i> populations first recorded in 1877. Two other species have not been seen recently and there is evidence of a shallowing in the euphotic depth		
Lake score	194	Lake rank	3
CONSERVATION CONDITION	<b>POOR</b>		

### Previous accounts

Lough Caragh has been visited by naturalists for over 100 years.

1. Scully (1916) gives an account of early work and most species known from the lake were recorded by this date. Two species reported in Scully (1916), *Subularia aquatica* and *Nitella confervacea*, have not been seen recently. *Elodea canadensis* was not recorded from Caragh in Scully's time and was described as 'very rare' in Kerry (Scully, 1916).
2. Heuff and Ryan examined Caragh in 1977, recording *Najas flexilis* and *Subularia aquatica* (Heuff, 1984). They recorded a euphotic depth of 4 m, and vegetation similar to that described below.
3. FitzGerald & Preston (1994) recorded *Najas flexilis* in Lough Caragh in 1994.
4. Roden (2004) examined a small part of the south-western end of the lake in 2004, where he also recorded *Najas flexilis* in a relevé on sand with silt with the following species (cover abundance): *Najas flexilis* (4), *Potamogeton berchtoldii* (1), *Utricularia* sp. (+), *Schoenoplectus lacustris* (+). He also recorded *Isoetes echinospora*, *Elatine hexandra* and *Nitella translucens* in this habitat.

5. The EPA surveyed Caragh in 2008, 2011 and 2014. Their results resemble the 2016 survey except they recorded *Potamogeton pusillus*, which was not recorded in 2016. They noted *Najas flexilis* at two locations, both of which were confirmed in the 2016 survey. In general, their recorded euphotic depth was 2-3 m.

See also NPWS (2017d, e).

### Species recorded

Taxon - Caragh	Before this survey	In this survey (2017)	Taxon - Caragh	Before this survey	In this survey (2017)
Charophytes			<i>Isoetes lacustris</i>	1	1
<i>Chara aspera</i>			<i>Juncus bulbosus</i>	1	1
<i>Chara curta</i>			<i>Lemna minor</i>		
<i>Chara globularis</i>			<i>Lemna trisulca</i>		
<i>Chara rudis</i>			<i>Littorella uniflora</i>	1	1
<i>Chara virgata</i>		1	<i>Lobelia dortmanna</i>	1	1
<i>Nitella confervacea</i>	1*		<i>Myriophyllum alterniflorum</i>	1	1
<i>Nitella flexilis</i>	1	1	<i>Myriophyllum spicatum</i>		
<i>Nitella gracilis</i>			<i>Najas flexilis</i>	1	1
<i>Nitella opaca</i>			<i>Nuphar lutea</i>	1	1
<i>Nitella translucens</i>	1	1	<i>Nymphaea alba</i>	1	1
<i>Tolypella glomerata</i>			<i>Oenanthe fluviatilis</i>		
<i>Chara cf. muscosa</i>			<i>Phragmites australis</i>		1
Other algae			<i>Pilularia globulifera</i>		
<i>Ophrydium versatile</i>			<i>Potamogeton alpinus</i>		
Bryophytes			<i>Potamogeton berchtoldii</i>	1	1
<i>Fissidens fontanus</i>			<i>Potamogeton crispus</i>		
<i>Fontinalis antipyretica</i>	1	1	<i>Potamogeton filiformis</i>		
<i>Sphagnum</i> sp.			<i>Potamogeton gramineus</i>		
Vascular Plants			<i>Potamogeton lucens</i>		
<i>Alisma plantago-aquatica</i>			<i>Potamogeton natans</i>	1	1
<i>Apium inundatum</i>			<i>Potamogeton obtusifolius</i>	1	1
<i>Baldellia ranunculoides</i> subsp. <i>ranunculoides</i>	1		<i>Potamogeton pectinatus</i>		
<i>Baldellia ranunculoides</i> subsp. <i>repens</i>		1	<i>Potamogeton perfoliatus</i>	1	1
<i>Callitriche brutia</i> subsp. <i>hamulata</i>		1	<i>Potamogeton polygonifolius</i>		
<i>Callitriche hermaphroditica</i>			<i>Potamogeton praelongus</i>		
<i>Carex rostrata</i>			<i>Potamogeton pusillus</i>	1	
<i>Ceratophyllum demersum</i>			<i>Potamogeton × angustifolius</i>		
<i>Cladium mariscus</i>			<i>Potamogeton × nitens</i>		
<i>Elatine hexandra</i>	1	1	<i>Ranunculus</i> sp.		
<i>Eleocharis acicularis</i>		1	<i>Schoenoplectus lacustris</i>	1	1
<i>Eleocharis multicaulis</i>			<i>Sparganium angustifolium</i>		
<i>Eleocharis palustris</i>			<i>Sparganium emersum</i>		
<i>Eleogiton fluitans</i>			<i>Sparganium erectum</i>		
<i>Elodea canadensis</i>	1	1	<i>Sparganium natans</i>		
<i>Equisetum fluviatile</i>		1	<i>Subularia aquatica</i>	1*	
<i>Eriocaulon aquaticum</i>	1	1	<i>Typha angustifolia</i>		
<i>Hydrilla verticillata</i>			<i>Utricularia</i> sp.	1	1
<i>Isoetes echinospora</i>	1	1	<i>Zannichellia palustris</i>		

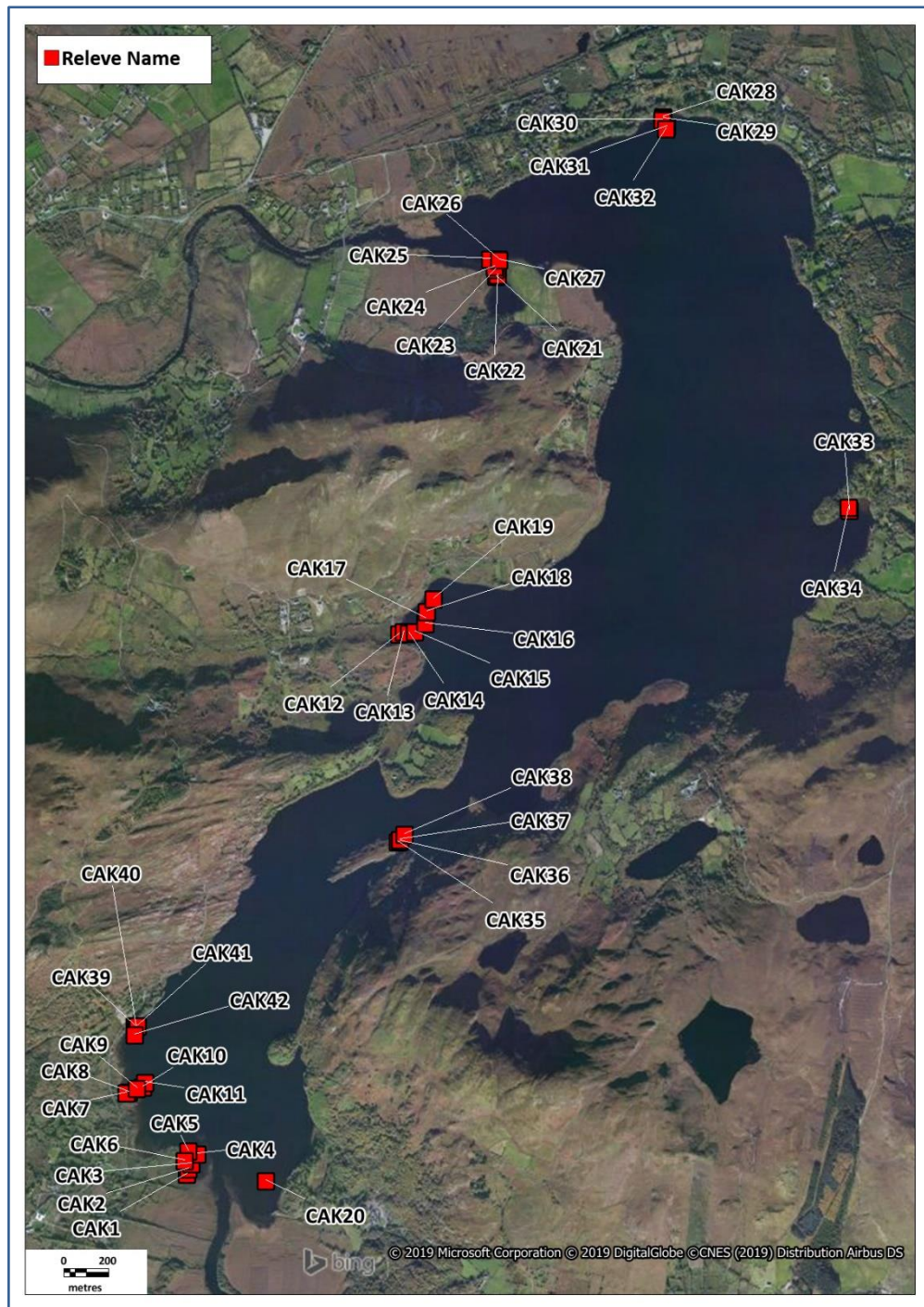
\* considered likely to be extinct in the lake

Lough Caragh is a large and frequently studied lake. Most of the rarer species that occur there were first recorded before WWI. The flora is not exceptionally diverse being typical of many soft-water lakes in



Ireland. In 2017, 27 species were recorded. A total of 31 species has been recorded in all surveys combined, two of which are considered likely to be extinct ('E' in table above). Notable species include.

- *Najas flexilis*, first recorded in 1877 in the southern part of the lake, still occurs in these locations. It was not located in the northern part.
- *Baldellia ranunculoides* subsp. *repens* is a very distinct stoloniferous taxon only known from Caragh, Leane, Muckcross and the Long Range. It has been confused with *Luronium natans* but on-growing of material to flowering shows it is undoubtedly *Baldellia ranunculoides* subsp. *repens*. Its Irish distribution has yet to be determined but it appears confined to *Najas flexilis*-type lakes on Old Red Sandstone. It forms large mats, similar to *Eriocaulon* on sand or silt.
- *Eleocharis acicularis* occurs on sand at the southern end of the lake.
- *Isoetes echinospora* occurs at several stations.



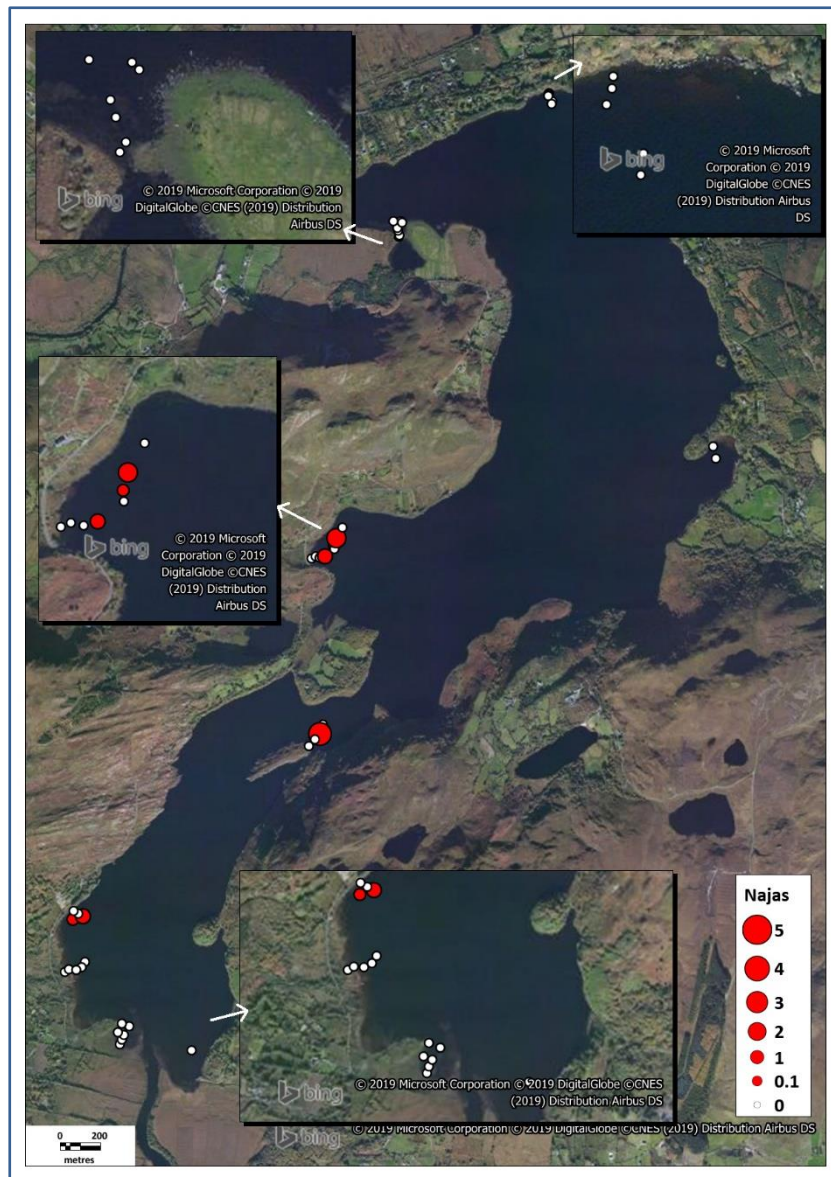
### *Najas flexilis*

The first record for *Najas flexilis* in Lough Caragh was by A.G. More in 1877 (More, 1877; Scully, 1916). It was seen in the lake on a number of occasions between 1896 and 1906 (Scully, 1916). It was also recorded in Lough Caragh by H. Heuff and J. Ryan in 1977 (Heuff, 1984) and by R. FitzGerald, P. Foley and C.D. Preston in 1994 (FitzGerald & Preston, 1994). EPA biologists have recorded it on a number of occasions since 2002.

In 2017, the plant was recorded at three locations in the southern half of the lake (see vegetation maps and sketch map):

1. The southern-most shore, near the inflow of the Caragh River. It was noted by many previous recorders at the southern end of the lake, apparently at depths of up to 6 m, far greater than the current maximum depths of c. 3.7 m.
2. The unnamed bay north-east of Lough Beg, where it was seen previously by Heuff and Ryan at 4 m depth.
3. On the eastern shore south of Lough Beg.

In these limited areas, large populations occur (2-3 cover value) but they only constitute a small fraction of the lake. Surprisingly there are no records of *Najas* in the northern part of the lake, even though large expanses of flat sandy-silt occur.



## Vegetation

Much of the lake shore is steeply shelving rock or boulders with few macrophytes. Some bays, especially the unnamed bay on the western shore north-east of Lough Beg, have a well-developed flora. The northern more open and sandy section surprisingly has a poor flora.

### Vegetation of rocky shores down to 2 m.

The flora is typical of many soft-water lakes with *Eriocaulon aquaticum*, *Isoetes lacustris*, *Lobelia dortmanna* and *Littorella uniflora*. Other species noted include *Elatine hexandra*, *Nitella translucens*, *Myriophyllum alterniflorum*, *Fontinalis antipyretica*. Most of these grow in small pockets of gravel or cracks in the bedrock. This vegetation corresponds to shore and mid water vegetation.

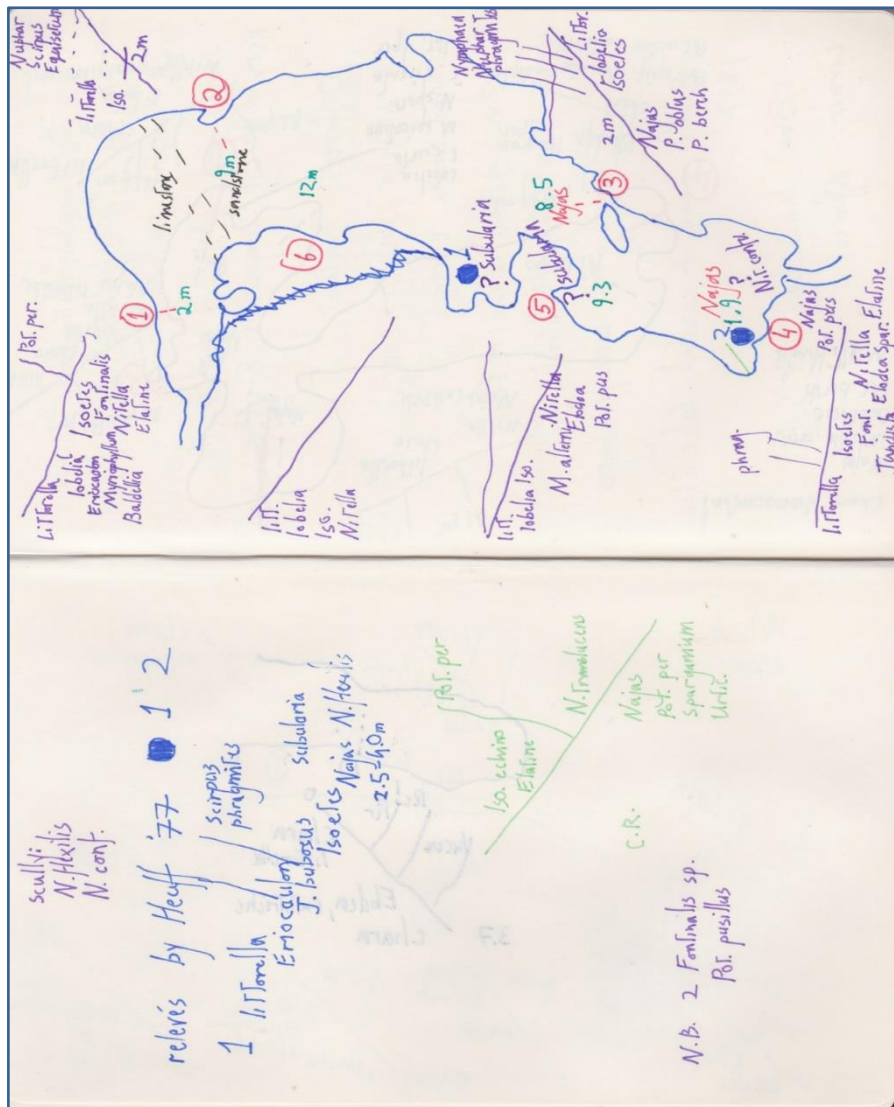
### Vegetation of silty areas below 2 m.

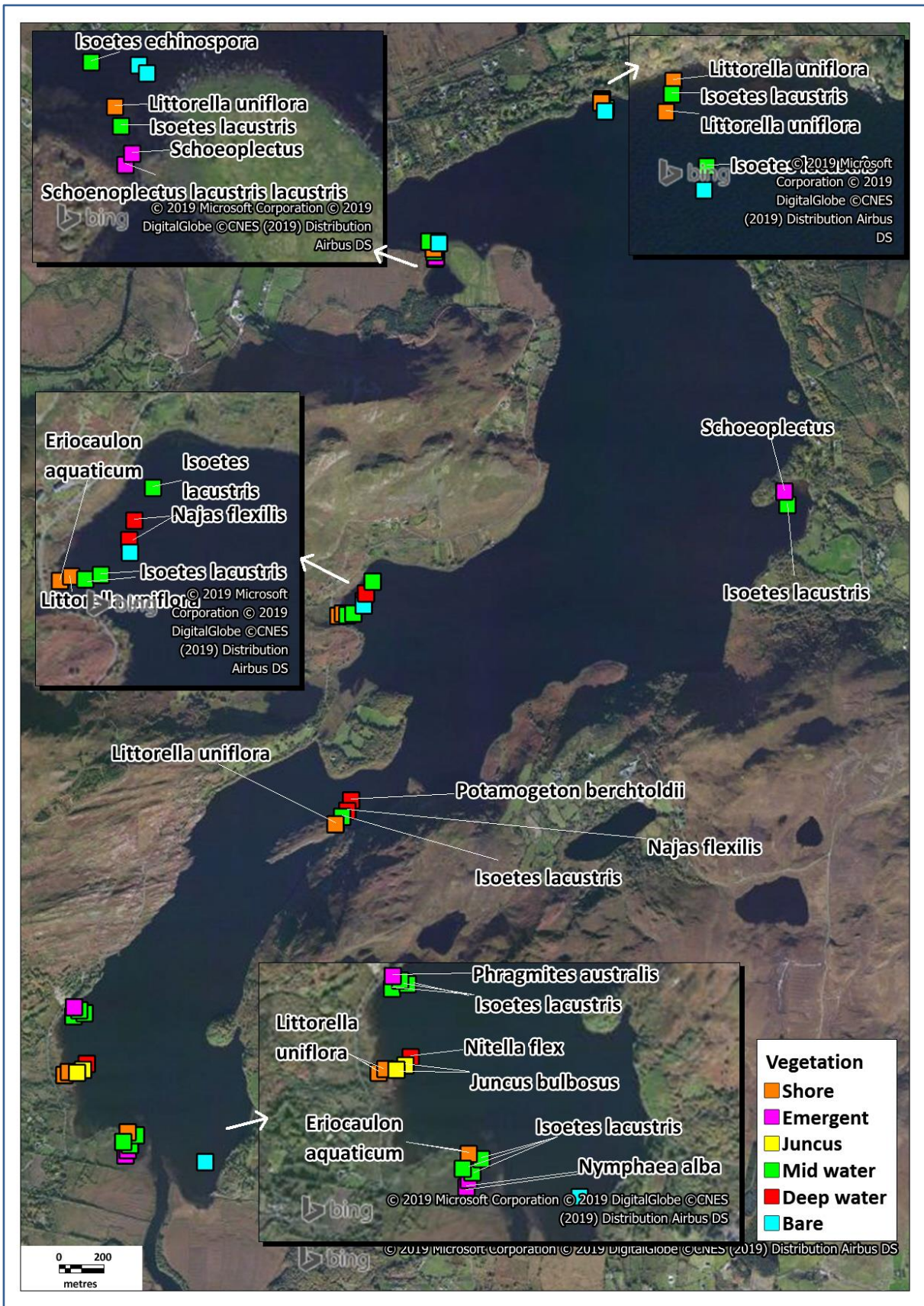
Because of the generally poor light climate, deeper vegetation is poorly developed in Lough Caragh. While *Najas flexilis* is common at several stations, macrophytes are often scarce or absent below 2.5 m. Commoner species include *Nitella flexilis*, *Potamogeton berchtoldii*, *Nitella translucens*.

### Vegetation of sheltered sediment shores to 2 m

At the southern end of the lake, large areas of *Schoenoplectus lacustris*, *Phragmites australis* and *Nymphaea alba* grow on sand or silt.

## Sketch Map





## Water chemistry data

Water quality data for the period 2009 to 2015 were made available by the EPA, for many samples from multiple depths. Values presented and used in assessment are averages of all data. An Foras Forbartha data for the lake in November 1973 and June 1974 are given for comparison (Flanagan & Toner, 1975).

Parameter	Unit	Lough Caragh EPA 2009-2015	Lough Caragh An Foras Forbartha 1973/4
Alkalinity	mg/l	6.9	6.8
Calcium	mg/l	2.2	
Chloride	mg/l	13.8	12
Chlorophyll	µg/l	2.97	2.2-3.7
Colour	Hazen units	35	33
Conductivity	µS/cm	60	65
Magnesium	mg/l	1.3	
pH		6.6	
Total oxidised nitrogen	mg/l	0.18	
Total phosphorus	mg/l	0.01	0.12-0.26

## Pressures and threats

There is some evidence that the euphotic depth of Lough Caragh has decreased in the 20<sup>th</sup> Century. Scully (1916) records *Najas flexilis* dredged from 6 m before WW1. Heuff and Ryan noted a euphotic depth of 4 m in 1977 (Heuff, 1984), but in 2016 euphotic depth was 3.7 m maximum and 3.1 m at Heuff and Ryan's station. In 2016 the water was noticeably dark and the euphotic zone was frequently less than 3.0 m. The cause of this decline is possibly eutrophication or peat run off. The declining euphotic depth is a probable threat to the vegetation present. Some forest felling has occurred recently up-stream of the lake (Geohive maps) which might increase nutrient and sediment load. The lake had only moderate WFD ecological status in 2012.

## Conservation condition

While most metrics for Caragh are good, the deep-water vegetation is only found in part of the lake and may be declining in area as euphotic depth decreases. Species number is low given the lake's size and some nationally scarce species (e.g. *Subularia aquatica* and *Nitella confervacea*) have not been seen recently. Consequently the lake is classified as poor.

Parameter	Target for Good	Caragh 2017	Condition
Area of habitat	Stable or increasing	Stable or increasing	Good
Deep-water community	Full development	Full development only at a few locations	Poor
Number of species	Stable or increase	Stable/increase (27)	Good
Typical species	≥9 indicator species	12	Good
<i>Najas flexilis</i> population	Stable population	Apparent decline in depth distribution	Poor
Introduced species	Not present/not impacting on <i>Najas flexilis</i> / deep-water community	Not impacting	Good
Euphotic depth (m)	≥3	3.7	Good
Colour (Hazen units)	<40	35	Good
Total phosphorus (TP) (mg/l)	<0.015	0.01	Good
Hydrological regime	<50% <i>Lobelia</i> – <i>Littorella</i> zone exposed in summer	-	Good
<b>Overall assessment</b>			<b>Poor</b>

Lough Carrigeencor, 2018			
Name	Carrigeencor		
Alternative name(s)			
Grid reference	G8312933762	Max. depth (m)	>3
County	Leitrim	EPA code	35_142
Area (ha)	44	OSi 1:50,000 sheet	16
Maximum length (km)	1.3	Nutrient data	This survey 05/05/2019
Altitude (m)	45	SAC	-
Geology	Precambrian paragneiss but close to calcareous Carboniferous rocks		
Previous survey	No information available		
Previous <i>Najas flexilis</i> records	There are no records for the species in Lough Carrigeencor		
Snorkel survey date(s)	13/07/2018	Number of species	18
Surveyors	PM, CR, JR	Alkalinity (mg/l CaCO <sub>3</sub> )	49
Number of transects	1	Total phosphorus (mg/l TP)	0.028
Number of relevés	5	Colour (Hazen units)	51
Euphotic depth (m)	3.0	Secchi depth (m)	-
<i>Najas flexilis</i>	<i>Najas flexilis</i> was not found		
Deep-water vegetation	Slight development		
Introduced species	<i>Elodea canadensis</i> present		
Substrates	Gravel, cobbles, sand, silt		

Carrigeencor is a lake of some interest. The water is clear with a euphotic depth of 3.0 m. The flora is diverse including *Alisma plantago aquatica*, *Baldellia ranunculoides*, *Chara virgata*, *Elodea canadensis*, *Fontinalis antipyretica*, *Isoetes lacustris*, *Juncus bulbosus*, *Lemma trisulca*, *Littorella uniflora*, *Lobelia dortmanna*, *Myriophyllum alterniflorum*, *Nitella translucens*, *Nymphaea alba*, *Phragmites australis*, *Potamogeton gramineus*, *P. natans*, *P. obtusifolius* and *P. perfoliatus*.

Data for a transect taken at IG 183385 334343 are given in the table below. These show the presence of a shore zone with *Littorella* and *Lobelia*, followed by an *Isoetes* zone and a slight development of a deep-water zone with *Potamogeton perfoliatus* and *Nitella translucens*.

Transect at northern end of Carrigeencor Lough

Depth (m)	0.4	0.7	1.7	2.3	3.0
Substrate	Rock, cobble	Sand, cobble	Sand, silt	Sand, silt	Silt
% cover	50	50	75	75	3
<i>Alisma plantago aquatica</i>	1				
<i>Chara virgata</i>	1	3	1	1	
<i>Elodea canadensis</i>		0.1	0.1	0.1	0.1
<i>Fontinalis antipyretica</i>			0.1	0.1	
<i>Isoetes lacustris</i>	0.1	1	4	4	
<i>Littorella uniflora</i>	3	2			
<i>Lobelia dortmanna</i>	2	1			
<i>Myriophyllum alterniflorum</i>	0.1				
<i>Nitella translucens</i>			2		
<i>Potamogeton perfoliatus</i>			0.1	0.1	0.1
<i>Eleocharis palustris</i>	1				

The lake has the *Isoetes* and *Potamogeton perfoliatus* flora, water clarity and euphotic depth to support *Najas flexilis*, it is possible, if unlikely, that a complete survey would locate the species. In the absence of a complete data set, including nutrient data, the lake is not treated as a *Najas flexilis*-type lake until further survey is done. This was not possible as the lake was first visited very late in the survey.

## Species recorded

Taxon - Carrigeencor
Charophytes
<i>Chara virgate</i>
<i>Nitella translucens</i>
Bryophytes
<i>Fontinalis antipyretica</i>
Vascular Plants
<i>Alisma plantago-aquatica</i>
<i>Baldellia ranunculoides</i>
<i>Elodea canadensis</i>
<i>Isoetes lacustris</i>
<i>Juncus bulbosus</i>
<i>Lemna trisulca</i>
<i>Littorella uniflora</i>
<i>Lobelia dortmanna</i>
<i>Myriophyllum alterniflorum</i>
<i>Nymphaea alba</i>
<i>Phragmites australis</i>
<i>Potamogeton gramineus</i>
<i>Potamogeton natans</i>
<i>Potamogeton obtusifolius</i>
<i>Potamogeton perfoliatus</i>

## Water chemistry data

Water samples were taken on a single occasion on the 05 February 2019 as part of this survey.

Parameter	Unit	Carrigeencor This survey
Alkalinity	mg/l	49
Calcium	mg/l	17
Chloride	mg/l	14.1
Chlorophyll	µg/l	1.07
Colour	Hazen units	50.6
Conductivity	µS/cm	138
pH		7.7
Total phosphorus	mg/l	0.028

Lough Chluain Toipin, 2016			
Name	Chluain Toipin	Code	CHT
Alternative name(s)	Chluain Toipín, Shannaghcloontippen		
Grid reference	L9095745756	Max. depth (m)	
County	Galway	EPA code	31_47
Area (ha)	17	OSi 1:50,000 sheet	37
Maximum length (km)	0.8	Nutrient data	This survey 18/01/2019
Altitude (m)	45	SAC	002034, Connemara Bog Complex SAC
Geology	Lakes marble formation (Dalradian)		
Snorkel survey date(s)	13/07/2016	Number of species	25
Previous survey	Roden (2013)		
Previous <i>Najas flexilis</i> records	C. Roden 14/08/2013		
Other noteworthy species	<i>Isoetes echinospora</i> , <i>Potamogeton obtusifolius</i>		
Surveyors	PM, CR	Alkalinity (mg/l CaCO <sub>3</sub> )	9
Number of transects	4	Total phosphorus (mg/l TP)	0.005
Number of relevés	24	Colour (Hazen units)	59
Euphotic depth (m)	2.8	Secchi depth (m)	2.0
<i>Najas flexilis</i>	Large population throughout the lake		
Deep-water vegetation	Fully developed		
Noteworthy species	<i>Isoetes echinospora</i> , <i>Najas flexilis</i> , <i>Nitella confervacea</i> , <i>Potamogeton alpinus</i> , <i>Subularia aquatica</i>		
Introduced species	None noted		
Substrates	Fine mud, sand, cobbles, rock		
Summary	A shallow lake surrounded by peat, it contains a diverse flora, a large population of <i>Najas flexilis</i> and has no signs of environmental damage		
Lake score	162	Lake rank	3
CONSERVATION CONDITION	<b>GOOD</b>		

### Previous accounts

The initial account of this lake was provided by Roden (2013). The site and vegetation were briefly described based on a short snorkel survey of the north-western section

#### *Loch Chluain Toipín (17 species) 002034*

*An interesting clear-water lake with a very large population of Slender Naiad *Najas flexilis*. The lake is shallow (2-2.5 m) where examined and has a soft sediment with extensive beds of macrophytes. A large number of species were encountered including the infrequently recorded Spring Quillwort *Isoetes echinospora* and the Pond Weed *Potamogeton obtusifolius* which, in Connemara, has only been recorded in coastal lakes hitherto fore.*

This account was supplemented by a species list which is reproduced in the table below. See also NPWS (2015e, f).

### Species recorded

A total of 25 species was recorded in 2016, an increase of eight compared to 2013 and bringing the total number of species recorded in Chluain Toipin to 29. Most species are typical of soft-water lakes but a number are less frequently encountered. These include

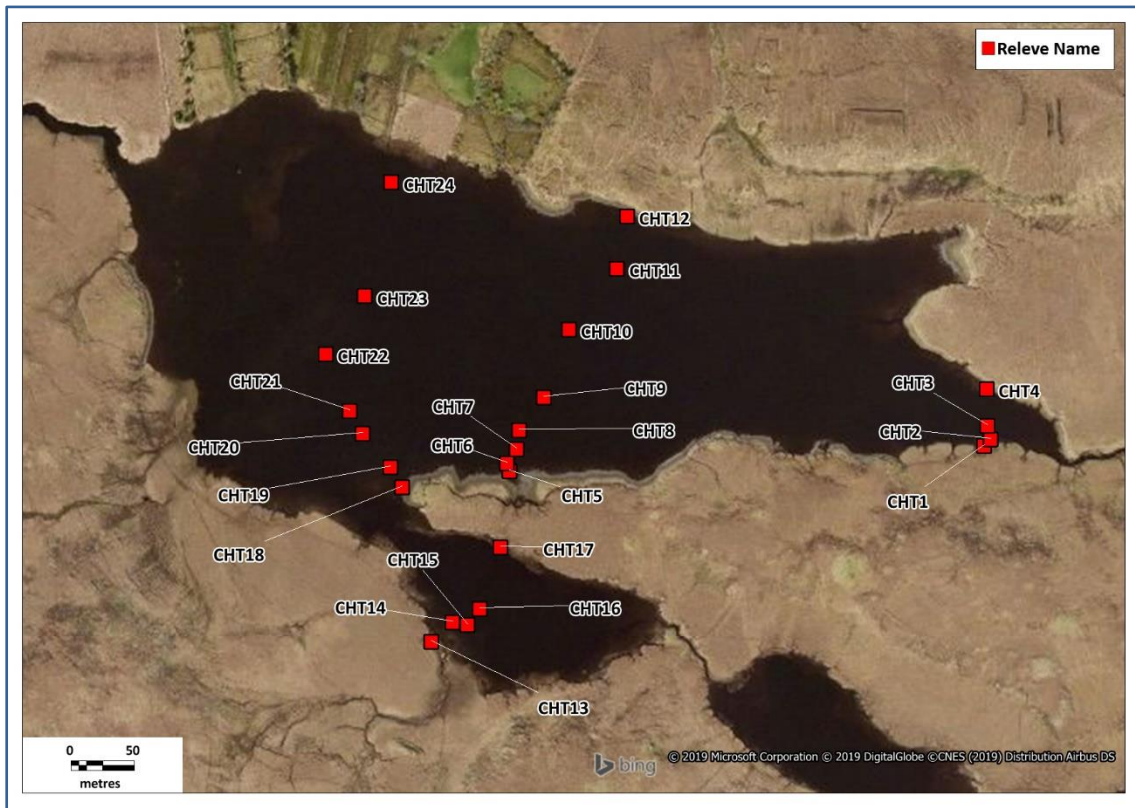
- *Isoetes echinospora*, frequent in the north-western segment
- *Najas flexilis*, very abundant in west-centre of lake
- *Nitella confervacea*, abundant below 2 m



- *Potamogeton alpinus*, only in outflowing stream and rarely recorded in Connemara
- *Subularia aquatica*, common in limited area near western shore.

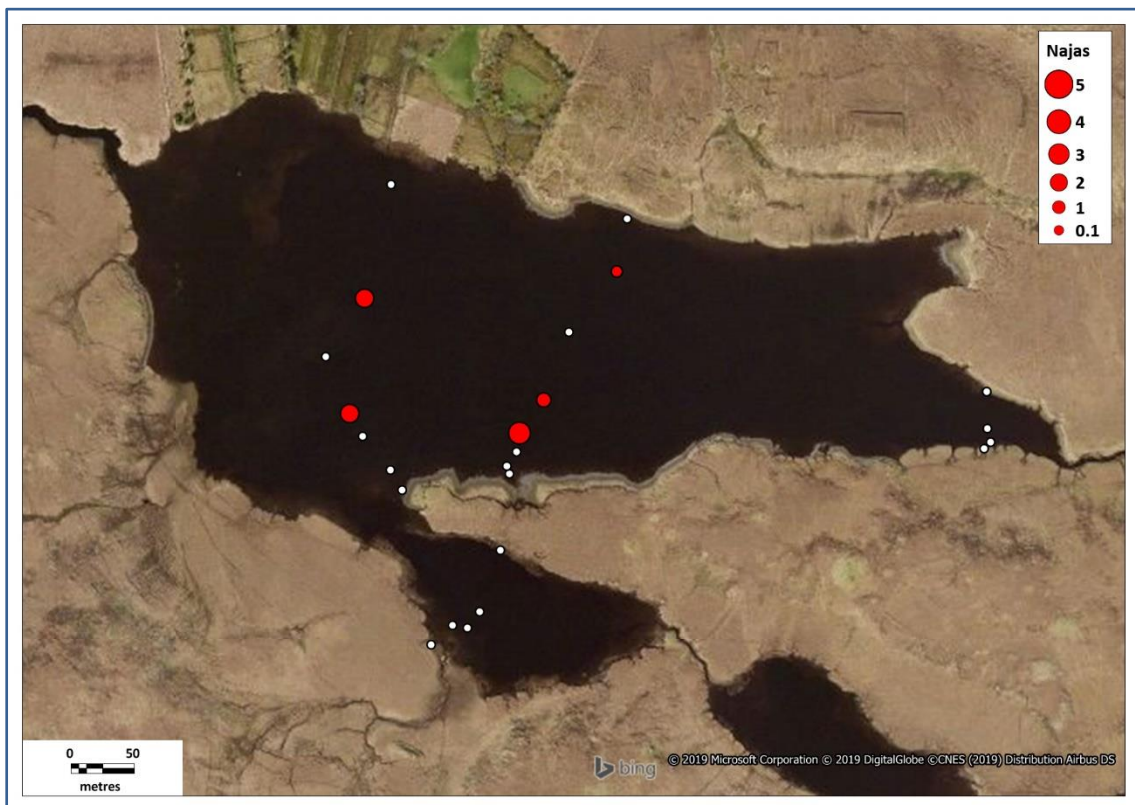
Three species recorded by Roden (2013) were not seen in 2016: *Chara virgata* and *Nymphaea alba* appear to be very localised and were not seen in 2016, but are almost certainly still present; *Sparganium angustifolium* is thought to be a mis-identification.

Taxon - Chluain Toipin	Before this survey	In this survey (2016)	Taxon - Chluain Toipin	Before this survey	In this survey (2016)
Charophytes			<i>Isoetes lacustris</i>		1
<i>Chara aspera</i>			<i>Juncus bulbosus</i>	1	1
<i>Chara curta</i>			<i>Lemna minor</i>		
<i>Chara globularis</i>			<i>Lemna trisulca</i>		
<i>Chara rudis</i>			<i>Littorella uniflora</i>		1
<i>Chara virgata</i>	1		<i>Lobelia dortmanna</i>		1
<i>Nitella confervacea</i>		1	<i>Myriophyllum alterniflorum</i>		1
<i>Nitella flexilis</i>		1	<i>Myriophyllum spicatum</i>		
<i>Nitella gracilis</i>			<i>Najas flexilis</i>	1	1
<i>Nitella opaca</i>			<i>Nuphar lutea</i>	1	1
<i>Nitella translucens</i>	1	1	<i>Nymphaea alba</i>	1	
<i>Tolypella glomerata</i>			<i>Oenanthe fluviatilis</i>		
<i>Chara cf. muscosa</i>			<i>Phragmites australis</i>	1	1
Other algae			<i>Pilularia globulifera</i>		
<i>Ophrydium versatile</i>			<i>Potamogeton alpinus</i>		1
Bryophytes			<i>Potamogeton berchtoldii</i>	1	1
<i>Fissidens fontanus</i>			<i>Potamogeton crispus</i>		
<i>Fontinalis antipyretica</i>			<i>Potamogeton filiformis</i>		
<i>Sphagnum</i> sp.			<i>Potamogeton gramineus</i>		
Vascular Plants			<i>Potamogeton lucens</i>		
<i>Alisma plantago-aquatica</i>			<i>Potamogeton natans</i>	1	1
<i>Apium inundatum</i>			<i>Potamogeton obtusifolius</i>	1	1
<i>Baldellia ranunculoides</i> subsp. <i>ranunculoides</i>			<i>Potamogeton pectinatus</i>		
<i>Baldellia ranunculoides</i> subsp. <i>repens</i>			<i>Potamogeton perfoliatus</i>	1	1
<i>Callitriche brutia</i> subsp. <i>hamulata</i>		1	<i>Potamogeton polygonifolius</i>		
<i>Callitriche hermaphrodita</i>			<i>Potamogeton praelongus</i>		
<i>Carex rostrata</i>		1	<i>Potamogeton pusillus</i>		
<i>Ceratophyllum demersum</i>			<i>Potamogeton × angustifolius</i>		
<i>Cladium mariscus</i>			<i>Potamogeton × nitens</i>		1
<i>Elatine hexandra</i>		1	<i>Ranunculus</i> sp.		
<i>Eleocharis acicularis</i>			<i>Schoenoplectus lacustris</i>	1	1
<i>Eleocharis multicaulis</i>			<i>Sparganium angustifolium</i>	1	
<i>Eleocharis palustris</i>			<i>Sparganium emersum</i>		
<i>Eleogiton fluitans</i>			<i>Sparganium erectum</i>		
<i>Elodea canadensis</i>			<i>Sparganium natans</i>		
<i>Equisetum fluviatile</i>	1		<i>Subularia aquatica</i>		1
<i>Eriocaulon aquaticum</i>	1	1	<i>Typha angustifolia</i>		
<i>Hydrilla verticillata</i>			<i>Utricularia</i> sp.	1	1
<i>Isoetes echinospora</i>	1	1	<i>Zannichellia palustris</i>		

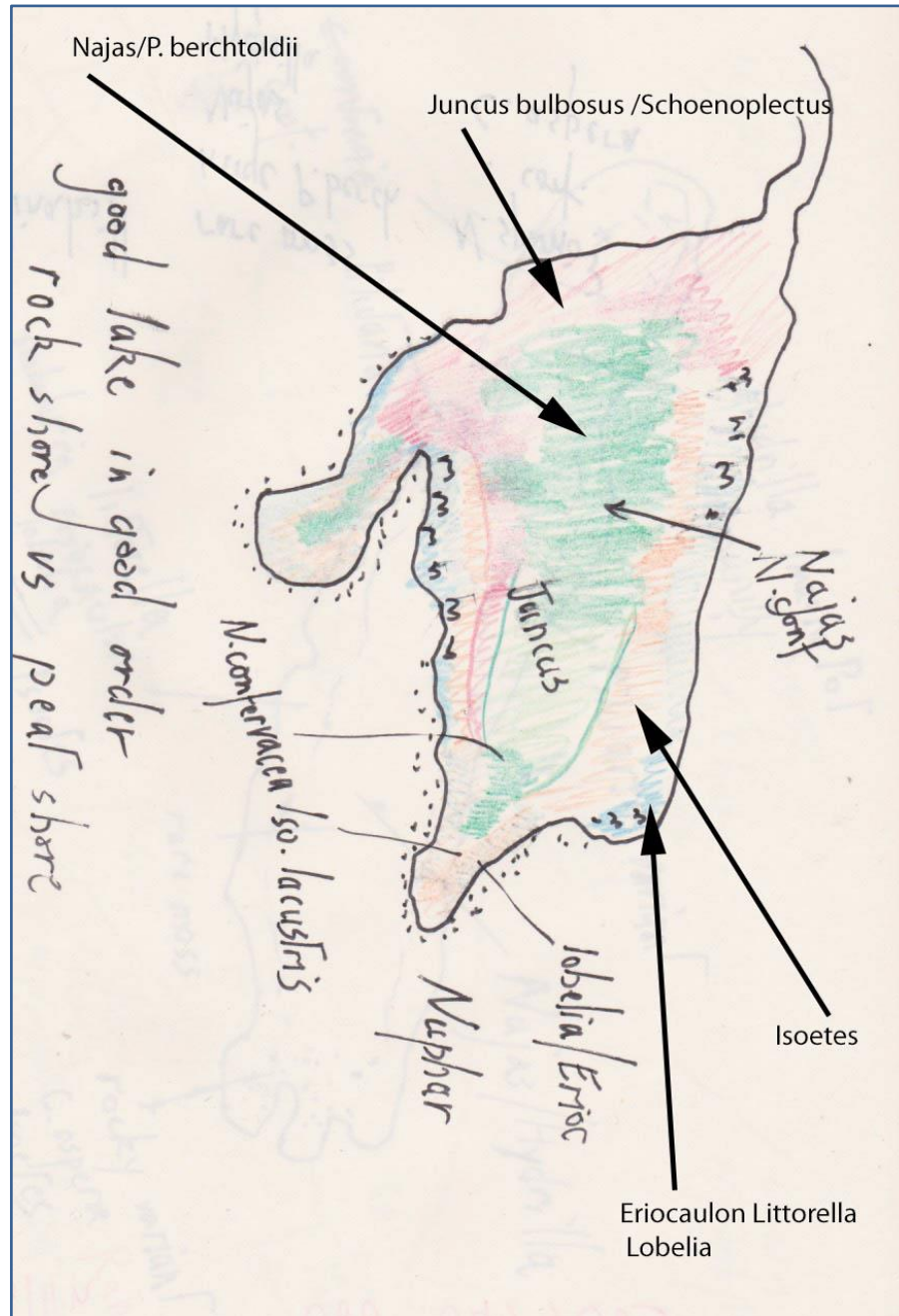


### *Najas flexilis*

The plant is abundant in the lake and was recorded in five relevés with densities reaching cover values exceeding 50%. *Najas flexilis* occurs from about 1.5 m to 2.1 m. It occurs mainly in the western sector of the lake. Substrate is always a reddish silt or mud. Companion species include *Nitella confervacea*, *Potamogeton berchtoldii* and *P. perfoliatus*. Many plants produce seeds and flowers and appear in good condition (large, much branched unfouled with epiphytes).



Sketch map (preliminary map based on field survey in 2013 and 2016)

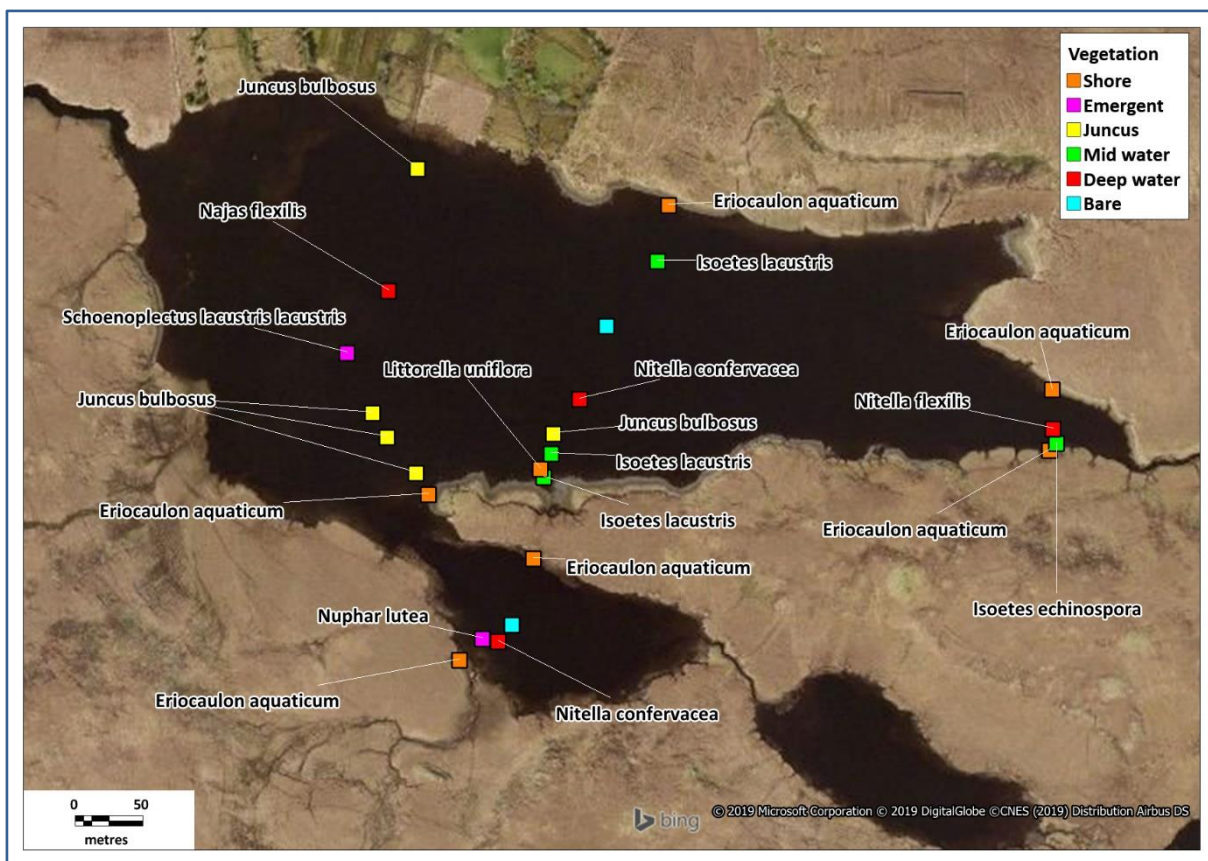


## Vegetation

Four units can be distinguished

1. An *Eriocaulon*—*Lobelia* unit growing on soft sediment in shallow water, with a variant dominated by *Littorella* growing on gravel.
2. An *Isoetes* unit which is not clearly defined growing in about 1-1.5 m.
3. A *Najas* unit growing below 1.5 m with *Nitella confervacea*.
4. Emergent vegetation of *Schoenoplectus*, *Phragmites* and *Nuphar* with large amounts of *Juncus bulbosus* as a lower layer.

While water clarity is not exceptional (Secchi depth is 2 m). Vegetation covers much of the shallow lake bottom resulting in large populations of *Najas flexilis* and *Nitella confervacea*.



### Water chemistry data

Water samples were taken on a single occasion on the 18 January 2019 as part of this survey.

Parameter	Unit	Chluain Toipin This survey
Alkalinity	mg/l	9
Calcium	mg/l	2.9
Chloride	mg/l	12
Chlorophyll	µg/l	1.07
Colour	Hazen units	58.7
Conductivity	µS/cm	55.2
pH		6.7
Total phosphorus	mg/l	0.005

### Pressures and threats

The lake appears not to be under any immediate environmental threat. It is largely surrounded by uncut blanket bog and is situated in the Connemara Bog Complex SAC.

### Conservation condition

A shallow lake where water deeper than the euphotic depth was only found in one transect. The euphotic depth is estimated at a minimum of 2.8 m. Water chemistry is based on a single winter reading and colour may be over-estimated. With very low alkalinity, the lake might be seen as a marginal *Najas flexilis*-type lake but the presence of a large *Najas flexilis* population and both *Isoetes lacustris* and *Potamogeton perfoliatus* indicates the contrary.

Parameter	Target for Good	Chluain Toipin	Condition
Area of habitat	Stable or increasing	Stable or increasing	Good
Deep-water community	Full development	Full development	Good
Number of species	Stable or increase	Increase (25)	Good
Typical species	≥9 indicator species	12	Good
<i>Najas flexilis</i> population	Stable population	Appears stable	Good
Introduced species	Not present/not impacting on <i>Najas flexilis</i> / deep-water community	Not present	Good
Euphotic depth (m)	≥3	At least 2.8	Good
Colour (Hazen units)	<40	59	Poor
Total phosphorus (TP) (mg/l)	<0.015	0.005	Good
Hydrological regime	<50% <i>Lobelia</i> – <i>Littorella</i> zone exposed in summer	-	Good
<b>Overall assessment</b>			<b>Good</b>

Cloonmackan Lough, 2018			
Name	Cloonmackan		
Alternative name(s)			
Grid reference	R1945880266	Max. depth (m)	2
County	Clare	EPA code	28_84
Area (ha)	23	OSi 1:50,000 sheet	57
Maximum length (km)	0.6	Nutrient data	None available
Altitude (m)	56	SAC	-
Geology	Clare shales		
Previous survey	No information available		
Previous <i>Najas flexilis</i> records	There are no records for the species in Cloonmackan Lough		
Snorkel survey date(s)	08/06/18	Number of species	11
Surveyors	PM, CR	Alkalinity (mg/l CaCO <sub>3</sub> )	-
Number of transects	0	Total phosphorus (mg/l TP)	-
Number of relevés	0	Colour (Hazen units)	-
Euphotic depth (m)	1.0	Secchi depth (m)	-
<i>Najas flexilis</i>	<i>Najas flexilis</i> was not found		
Deep-water vegetation	Absent		
Noteworthy species	<i>Carex pseudocyperus</i> , <i>Potamogeton obtusifolius</i>		
Introduced species	<i>Elodea canadensis</i> present		
Substrates	Soft peaty mud, shale, submerged pine stumps		

Cloonmackan is a surprisingly barren lough, despite a snorkel transect across the entire lough from north-east to south-west, few species were encountered. Euphotic depth was less than 1 m and the bottom consisted of loose peaty sediment. Species included *Elatine hexandra*, *Elodea canadensis*, *Isoetes lacustris*, *Littorella uniflora*, *Nitella translucens*, *Nuphar lutea*, *Nymphaea alba*, *Phragmites australis*, *Potamogeton obtusifolius*, *Schoenoplectus lacustris* and *Sparganium angustifolium*. No species occurred in great quantity. It was chosen for survey because of the unexpected importance of Knocka Lough which occurs on similar bedrock. It illustrates the difficulty of finding *Najas flexilis* sites in west Clare where many small lakes are found but there is no easy way to assess lake vegetation quality other than snorkelling.

### Species recorded

Taxon - Cloonmackan
Charophytes
<i>Nitella translucens</i>
Vascular Plants
<i>Elatine hexandra</i>
<i>Elodea canadensis</i>
<i>Isoetes lacustris</i>
<i>Littorella uniflora</i>
<i>Nuphar lutea</i>
<i>Nymphaea alba</i>
<i>Phragmites australis</i>
<i>Potamogeton obtusifolius</i>
<i>Schoenoplectus lacustris</i>
<i>Sparganium angustifolium</i>

Lough Courhoor, 2017			
Name	Courhoor		
Alternative name(s)			
Grid reference	L5954357138	Max. depth (m)	2
County	Galway	EPA code	32_499
Area (ha)	13	OSi 1:50,000 sheet	37
Maximum length (km)	0.7	Nutrient data	None available
Altitude (m)	20	SAC	-
Geology	Lakes Marble formation of the Dalradian		
Previous survey	No information available		
Previous <i>Najas flexilis</i> records	There are no records for the species in Courhoor Lough		
Snorkel survey date(s)	06/07/17	Number of species	13
Surveyors	PM, CR	Alkalinity (mg/l CaCO <sub>3</sub> )	-
Number of transects	0	Total phosphorus (mg/l TP)	-
Number of relevés	0	Colour (Hazen units)	-
Euphotic depth (m)	2.0	Secchi depth (m)	-
<i>Najas flexilis</i>	<i>Najas flexilis</i> was not found		
Deep-water vegetation	None noted		
Noteworthy species	None noted		
Introduced species	Absent		
Substrates	Rock, soft mud		

Courhoor has peat-stained or coloured water with a small flora. Rocky shores support *Eriocaulon aquaticum* and *Lobelia dortmanna*, with some *Phragmites australis*. Below this vegetation band, a layer of *Isoetes lacustris* occurs with a little *Juncus bulbosus*, but no deeper vegetation was noted other than patches of *Elatine hexandra*.

The lake is of interest as it lies on the same bedrock as Ballynakill but has a much poorer flora. Why this is so is not known, but the water is noticeably more peat stained. It is unlikely that *Najas flexilis* occurs.

### Species recorded

Taxon - Courhoor
Charophytes
<i>Nitella translucens</i>
Bryophytes
<i>Fontinalis antipyretica</i>
Vascular Plants
<i>Baldellia ranunculoides</i> subsp. <i>ranunculoides</i>
<i>Elatine hexandra</i>
<i>Eriocaulon aquaticum</i>
<i>Isoetes lacustris</i>
<i>Juncus bulbosus</i>
<i>Littorella uniflora</i>
<i>Lobelia dortmanna</i>
<i>Myriophyllum alterniflorum</i>
<i>Nuphar lutea</i>
<i>Phragmites australis</i>
<i>Schoenoplectus lacustris</i>

Lough Derg, 2017			
Name	Derg		
Alternative name(s)			
Grid reference	H0813674284	Max. depth (m)	28
County	Donegal	EPA code	01_115
Area (ha)	861	OSi 1:50,000 sheet	11
Maximum length (km)	4.6	Nutrient data	EPA 2009-2015
Altitude (m)	140	SAC	002301, River Finn SAC
Geology	Precambrian gneiss		
Previous survey	EPA in 2009, 2012, 2015		
Previous <i>Najas flexilis</i> records	An EPA record for 2012 cannot be verified (see account below)		
Snorkel survey date(s)	19/07/2017	Number of species	5
Surveyors	PM, CR, JR	Alkalinity (mg/l CaCO <sub>3</sub> )	7.3
Number of transects	2	Total phosphorus (mg/l TP)	0.012
Number of relevés	0	Colour (Hazen units)	66
Euphotic depth (m)	2.4	Secchi depth (m)	-
<i>Najas flexilis</i>	<i>Najas flexilis</i> was not found and is considered unlikely to occur		
Deep-water vegetation	Absent		
Noteworthy species	None noted		
Introduced species	None noted		
Substrates	Boulders, gravel, rock		
Summary	The lake appears both in vegetation and chemistry to be too oligotrophic to be rated as a <i>Najas flexilis</i> -type lake. The single record of <i>Najas</i> from 2010 was not confirmed		
CONSERVATION CONDITION	Not assessed		

### Previous accounts

Data from EPA surveys Lough Derg on three occasions were available. These showed a flora typical of an oligotrophic lake with an Isoetid flora with *P. natans* and *Sparganium* spp. in more sheltered areas. The flora is lacking any species such as *Potamogeton perfoliatus* indicating more nutrient rich conditions. *Najas flexilis* was recorded on one occasion in 2012 at 3.3 m in the northern part of the lake, but was not re-found in subsequent surveys.

### Species recorded

A total of only five species was recorded from Lough Derg in 2017, partly because only the northern bay was examined but largely because of the extremely oligotrophic condition of the lake. A two hour search by three snorkelers failed to find either *Najas flexilis* or any of its usual associated species.

### *Najas flexilis*

There is only a single record for *Najas flexilis* from Lough Derg and no herbarium specimen is available for confirmation. Despite two subsequent lake-wide surveys by the EPA and a detailed examination by snorkelling of the recorded locality in 2017, no further plants have been found. The lake, in comparison to the *Najas* lakes described in this survey, appears very oligotrophic and species-poor, so any *Najas* population would be an outlier in habitat terms. We are left with two possible explanations: firstly an error in identification or, secondly, ephemeral populations of *Najas flexilis* occur in less suitable environments. An example of the latter is the 1930s record of *Najas flexilis* from Finn Lough in Murrisk in Co. Mayo which has never been confirmed despite a thorough snorkel search in 2014.



Taxon - Derg	Before this survey	In this survey (2017)
Bryophytes		
<i>Fontinalis antipyretica</i>	1	
<i>Sphagnum</i> sp.	1	
Vascular Plants		
<i>Elatine hexandra</i>	1	1
<i>Isoetes lacustris</i>	1	1
<i>Juncus bulbosus</i>	1	
<i>Littorella uniflora</i>	1	1
<i>Lobelia dortmanna</i>	1	1
<i>Myriophyllum alterniflorum</i>	1	1
<i>Najas flexilis</i>	1*	
<i>Potamogeton natans</i>	1	
<i>Sparganium angustifolium</i>	1	
<i>Sparganium emersum</i>	1	

\* record not currently accepted as has not been verified

## Vegetation

The lake has a species-poor flora typical of oligotrophic lakes with an Isoetid community that descends to about 2.4 m. Substrate is largely sand cobbles and sandy-silt. Vegetation cover is low with few areas exceeding 20%.

## Water chemistry data

Water quality data for the period 2009 to 2015 were made available by the EPA, for many samples from multiple depths. Values presented and used in assessment are averages of all data.

Parameter	Unit	Lough Derg EPA 2009-2015
Alkalinity	mg/l	7.27
Calcium	mg/l	2.05
Chloride	mg/l	17.2
Chlorophyll	µg/l	4.69
Colour	Hazen units	65.6
Conductivity	µS/cm	53
Magnesium	mg/l	1.0
pH		6.59
Potassium	mg/l	0.5
Sulphate	mg/l	3.7
Total oxidised nitrogen	mg/l	0.06
Total phosphorus	mg/l	0.012

## Pressures and threats

Extensive afforestation may have led to water acidification, but there are no obvious impacts at present. The lake's WFD status is good in all three EPA surveys.

## Conservation condition

The conservation condition of the lake was not assessed as the targets for *Najas flexilis*-type lakes were not considered appropriate for such an oligotrophic, species-poor lake.

Lough Derryierin, 2018			
Name	Derryierin		
Alternative name(s)			
Grid reference	M1246377009	Max. depth (m)	2
County	Mayo	EPA code	30_327
Area (ha)	8	OSi 1:50,000 sheet	36
Maximum length (km)	0.8	Nutrient data	None available
Altitude (m)	33	SAC	-
Geology	Carboniferous sandstone		
Previous survey	No information available		
Previous <i>Najas flexilis</i> records	There are no records for the species in Derryierin Lough		
Snorkel survey date(s)	14/08/18	Number of species	7
Surveyors	CR	Alkalinity (mg/l CaCO <sub>3</sub> )	-
Number of transects	0	Total phosphorus (mg/l TP)	-
Number of relevés	0	Colour (Hazen units)	-
Euphotic depth (m)	1.0	Secchi depth (m)	-
<i>Najas flexilis</i>	<i>Najas flexilis</i> was not found		
Deep-water vegetation	None noted		
Noteworthy species	<i>Eriocaulon aquaticum</i>		
Introduced species	None noted		
Substrates	Soft mud		

A lake about 1 km south-east of Lough Nageltia on similar bedrock but with a much poorer flora. Like Lough Nageltia, it is bounded on the eastern shore by a drumlin or moraine, there are no rocky shores but submerged stumps of *Pinus sylvestris* occur. The lake is very shallow with a soft muddy bottom. The shore line supports large colonies of *Eriocaulon aquaticum* with some *Lobelia dortmanna*. The shallow lake bottom supports *Juncus bulbosus*, *Sparganium angustifolium* and *Eleogiton (Isolepis) fluitans*. Surprisingly large colonies of *Chara virgata* also occur in the lake. The flora indicates the lake is too oligotrophic to support *Najas flexilis*. The site is of interest as one of the most easterly stations for *Eriocaulon* in the Galway/Mayo area.

### Species recorded

Taxon - Derryierin
Charophytes
<i>Chara virgata</i>
Vascular Plants
<i>Eleogiton fluitans</i>
<i>Eriocaulon aquaticum</i>
<i>Juncus bulbosus</i>
<i>Lobelia dortmanna</i>
<i>Schoenoplectus lacustris</i>
<i>Sparganium angustifolium</i>

Lough Eske, 2017, 2018			
Name	Eske	Code	ESK
Alternative name(s)			
Grid reference	G9724383605	Max. depth (m)	32
County	Donegal	EPA code	37_188
Area (ha)	387	OSi 1:50,000 sheet	11
Maximum length (km)	3.8	Nutrient data	EPA 2009-2015
Altitude (m)	27	SAC	000163, Lough Eske and Ardnamona Wood SAC
Geology	Dalradian schist, quartzite, Carboniferous limestone		
Previous survey	C. Roden on 25/08/2005, EPA in 2009, 2012, 2015		
Previous <i>Najas flexilis</i> records	There are no records for the species in Lough Eske		
Other noteworthy species	-		
Snorkel survey date(s)	19/07/2017, 12/07/2018	Number of species	28
Surveyors	PM, CR, JR	Alkalinity (mg/l CaCO <sub>3</sub> )	17.1
Number of transects	3	Total phosphorus (mg/l TP)	0.009
Number of relevés	16	Colour (Hazen units)	42
Euphotic depth (m)	3.1	Secchi depth (m)	2.7
<i>Najas flexilis</i>	<i>Najas flexilis</i> was not recorded		
Deep-water vegetation	Absent		
Noteworthy species	<i>Typha angustifolia</i> , <i>Isoetes echinospora</i>		
Introduced species	<i>Elodea canadensis</i> present		
Substrates	Sand, cobbles, silt, rock		
Summary	Lough Eske has many of the characteristics of a <i>Najas flexilis</i> -type lake but lacks any developed deep-water vegetation including <i>Najas flexilis</i> itself. It may have suffered some environmental damage		
Lake score	141	Lake rank	4
CONSERVATION CONDITION	<b>POOR</b>		

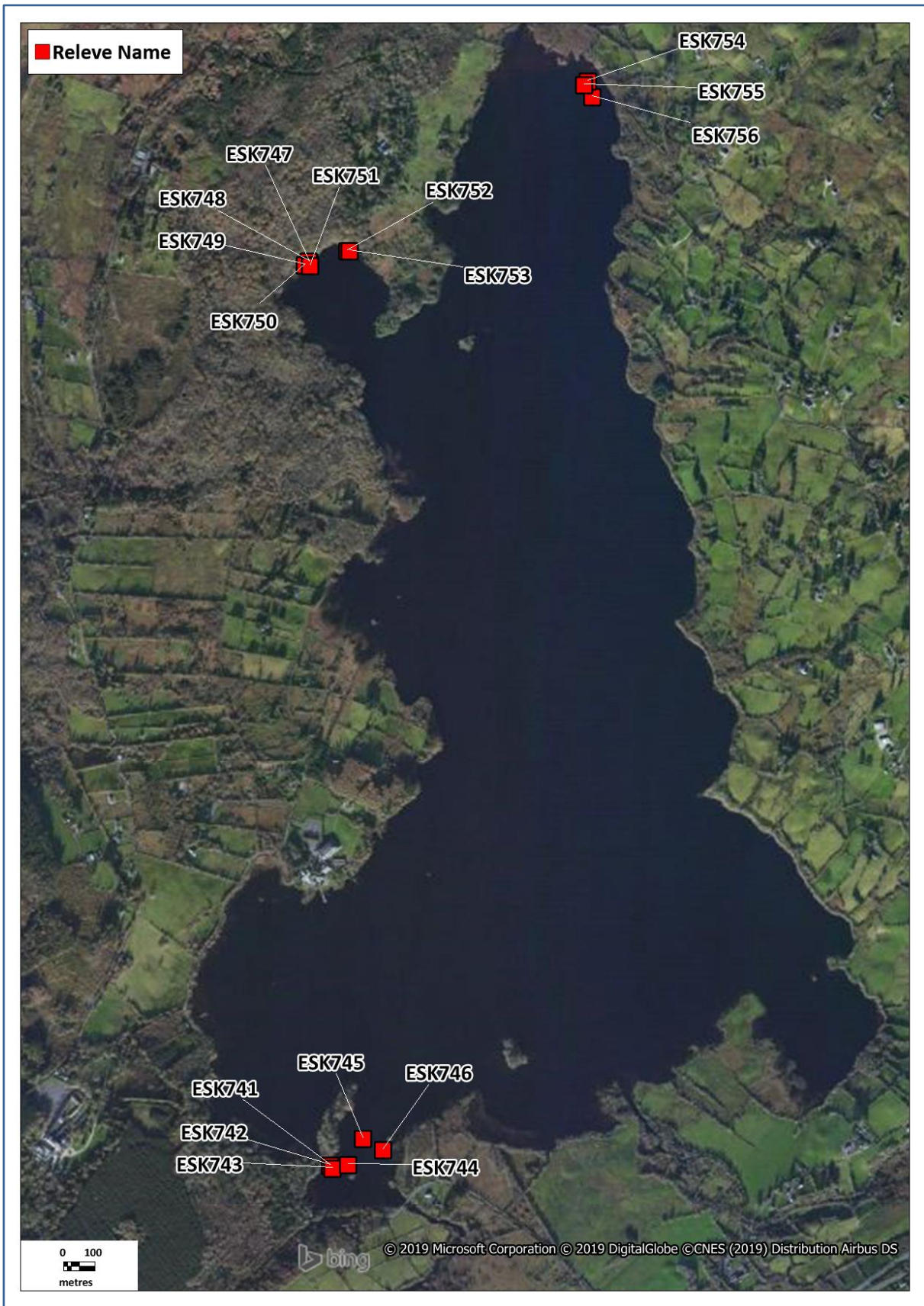
### Previous accounts

1. The Lake was visited by Hart (1998) who recorded *Elatine hexandra* (still present).
2. C. Roden briefly snorkelled in the lake in 2005 and noted *Isoetes lacustris*, *Lobelia*, *Elatine*, *Nitella translucens*, *Chara virgata*, *Elodea* and *Juncus bulbosus*.
3. The EPA surveyed the lake in July 2011, August 2012 and July 2015. Their species lists are included in the table ('Before this survey').

See also NPWS (2019c).

### 2017-2018 survey

The lake was first examined on 19/07/2017 when both *Potamogeton* species and *Isoetes* were noted. Given the exposure both of limestone and schist, it was thought to be a possible *Najas* lake. A full survey was conducted in 2018. The results of the 2018 survey are summarised in the vegetation map and the revised species list.



## Species recorded

In 2018, 28 species were recorded from the lake. Most are typical of soft-water lakes but *Potamogeton* species include *P. praelongus* and *P. perfoliatus*. The uncommon *Isoetes echinospora* occurs.

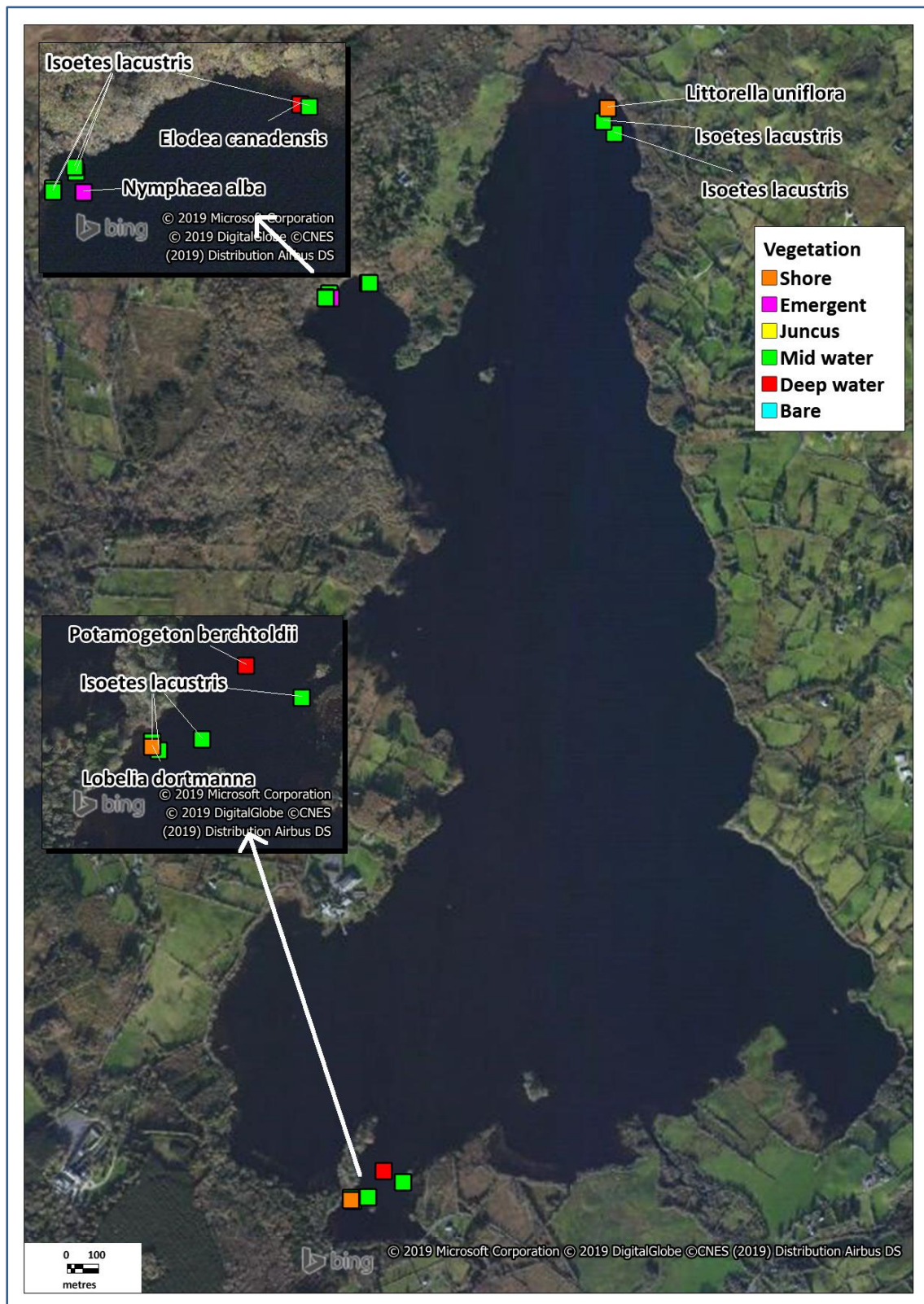
Taxon - Eske	Before this survey	In this survey (2018)	Taxon - Eske	Before this survey	In this survey (2018)
Charophytes			<i>Isoetes lacustris</i>	1	1
<i>Chara aspera</i>			<i>Juncus bulbosus</i>	1	1
<i>Chara curta</i>			<i>Lemna minor</i>		
<i>Chara globularis</i>			<i>Lemna trisulca</i>		
<i>Chara rudis</i>			<i>Littorella uniflora</i>	1	1
<i>Chara virgata</i>	1	1	<i>Lobelia dortmanna</i>	1	1
<i>Nitella confervacea</i>			<i>Myriophyllum alterniflorum</i>	1	1
<i>Nitella flexilis</i>		1	<i>Myriophyllum spicatum</i>		
<i>Nitella gracilis</i>			<i>Najas flexilis</i>		
<i>Nitella opaca</i>			<i>Nuphar lutea</i>	1	1
<i>Nitella translucens</i>	1	1	<i>Nymphaea alba</i>		1
<i>Tolypella glomerata</i>			<i>Oenanthe fluviatilis</i>		
<i>Chara cf. muscosa</i>			<i>Phragmites australis</i>	1	1
Other algae			<i>Pilularia globulifera</i>		
<i>Ophrydium versatile</i>			<i>Potamogeton alpinus</i>		1
Bryophytes			<i>Potamogeton berchtoldii</i>	1	1
<i>Fissidens fontanus</i>			<i>Potamogeton crispus</i>		
<i>Fontinalis antipyretica</i>	1	1	<i>Potamogeton filiformis</i>		
<i>Sphagnum</i> sp.			<i>Potamogeton gramineus</i>		
Vascular Plants			<i>Potamogeton lucens</i>		
<i>Alisma plantago-aquatica</i>	1		<i>Potamogeton natans</i>	1	1
<i>Apium inundatum</i>			<i>Potamogeton obtusifolius</i>		
<i>Baldellia ranunculoides</i> subsp. <i>ranunculoides</i>		1	<i>Potamogeton pectinatus</i>		
<i>Baldellia ranunculoides</i> subsp. <i>repens</i>			<i>Potamogeton perfoliatus</i>	1	1
<i>Callitriche brutia</i> subsp. <i>hamulata</i>			<i>Potamogeton polygonifolius</i>		
<i>Callitriche hermaphroditica</i>			<i>Potamogeton praelongus</i>		1
<i>Carex rostrata</i>		1	<i>Potamogeton pusillus</i>		
<i>Ceratophyllum demersum</i>			<i>Potamogeton × angustifolius</i>		1
<i>Cladium mariscus</i>		1	<i>Potamogeton × nitens</i>		1
<i>Elatine hexandra</i>	1	1	<i>Ranunculus</i> sp.		
<i>Eleocharis acicularis</i>			<i>Schoenoplectus lacustris</i>	1	1
<i>Eleocharis multicaulis</i>			<i>Sparganium angustifolium</i>		
<i>Eleocharis palustris</i>			<i>Sparganium emersum</i>	1	
<i>Eleogiton fluitans</i>			<i>Sparganium erectum</i>		
<i>Elodea canadensis</i>	1	1	<i>Sparganium natans</i>		
<i>Equisetum fluviatile</i>	1	1	<i>Subularia aquatica</i>		
<i>Eriocaulon aquaticum</i>			<i>Typha angustifolia</i>		1
<i>Hydrilla verticillata</i>			<i>Utricularia</i> sp.	1	
<i>Isoetes echinospora</i>		1	<i>Zannichellia palustris</i>		

## *Najas flexilis*

Despite the presence of both *Isoetes lacustris* and *Potamogeton perfoliatus*, there is no well-developed deep-water vegetation, nor any *Najas flexilis*.

## Vegetation

Lough Eske is a large lake with a deep hole of 32 m in the south-centre. The water is relatively clear, with a euphotic depth of about 3 m. The lake bottom is sandy-silt with a rocky shoreline. Vegetation structure is simple with a *Littorella* – *Lobelia* shore zone and small areas of *Phragmites*, *Schoenoplectus* and *Equisetum fluviatile* in sheltered bays. Below 1 m, *Isoetes lacustris* is dominant and descends to the base of the euphotic zone. While occasional plants of *Potamogeton berchtoldii* and *Nitella translucens* occur down to c. 3 m, there is not a developed vegetation below the *Isoetes* band.



## Water chemistry data

Water quality data for the period 2009 to 2015 were made available by the EPA, for many samples from multiple depths. Values presented and used in assessment are averages of all data.

Parameter	Unit	Lough Eske EPA 2009-2015
Alkalinity	mg/l	17.1
Calcium	mg/l	4.7
Chloride	mg/l	29.5
Chlorophyll	µg/l	3.1
Colour	Hazen units	41.9
Conductivity	µS/cm	77
Magnesium	mg/l	1.4
pH		7.2
Potassium	mg/l	0.6
Sulphate	mg/l	2
Total oxidised nitrogen	mg/l	0.08
Total phosphorus	mg/l	0.009

## Pressures and threats

In the 2015 sampling round, the EPA rated Eske as being in moderate status, having declined from good status in 2012 and 2009. A possible sign of eutrophication is the absence of deep-water vegetation below *Isoetes* but even in 2005, this vegetation was not encountered.

## Conservation condition

Lough Eske has many of the characteristics of a typical *Najas flexilis*-type lake: a bedrock with some calcareous rock; the typical mix of *Isoetes lacustris* and *Potamogeton perfoliatus*; and reasonable water clarity. Alkalinity, however, is less than 20 mg/l. The all-but complete absence of deep-water vegetation is unexplained; it is either a natural feature or due to some environmental pressure, presumably a reduction in light due to run-off or algal blooms. As we have no historical evidence of a deep-water community, its absence is rated poor rather than bad

Parameter	Target for Good	Lough Eske 2018	Condition
Area of habitat	Stable or increasing	Stable or increasing	Good
Deep-water community	Full development	Absent	Bad
Number of species	Stable or increase	Increase (28)	Good
Typical species	≥9 indicator species	9	Good
<i>Najas flexilis</i> population	Stable population	Does not occur	n/a
Introduced species	Not present/not impacting on <i>Najas flexilis</i> / deep-water community	not impacting on vegetation	Good
Euphotic depth (m)	≥3	3.1	Good
Colour (Hazen units)	<40	42	Poor
Total phosphorus (TP) (mg/l)	<0.015	0.009	Good
Hydrological regime	<50% <i>Lobelia</i> – <i>Littorella</i> zone exposed in summer	-	Good
<b>Overall assessment</b>			<b>Poor</b>

Lough Fern, 2017			
Name	Fern	Code	FRN
Alternative name(s)			
Grid reference	C1802723427	Max. depth (m)	2.5
County	Donegal	EPA code	NW_39_13
Area (ha)	181	OSi 1:50,000 sheet	2 & 6
Maximum length (km)	2.6	Nutrient data	EPA 2009-2015, AFF 1973
Altitude (m)	20	SAC	002176, Leannan River SAC
Geology	Dalradian schist, quartzite		
Previous survey	EPA in 2009, 2012, 2015		
Previous <i>Najas flexilis</i> records	EPA 23/07/2009, 2012		
Other noteworthy species	-		
Snorkel survey date(s)	29/08/2017	Number of species	25
Surveyors	PM, CR, JR	Alkalinity (mg/l CaCO <sub>3</sub> )	30.5
Number of transects	5	Total phosphorus (mg/l TP)	0.027
Number of relevés	20	Colour (Hazen units)	76
Euphotic depth (m)	2.1	Secchi depth (m)	-
<i>Najas flexilis</i>	Present		
Deep-water vegetation	Partial development		
Noteworthy species	<i>Najas flexilis</i> , <i>Nitella ?spanioclema</i>		
Introduced species	<i>Elodea canadensis</i> present		
Substrates	Silt, sand, rock		
Summary	Potentially an important <i>Najas flexilis</i> -type lake but in bad conservation condition because of eutrophication		
Lake score	164	Lake rank	3
CONSERVATION CONDITION	<b>BAD</b>		

### Previous accounts

1. Hart (1898) recorded *Potamogeton alpinus* in Lough Fern in the late 19<sup>th</sup> century.
2. The EPA surveyed Lough Fern in 2009, 2012 and 2015. The species recorded are those shown in the table ('Before this survey'). The dominant species was *Nitella* sp., with some *Fontinalis* and *Najas flexilis* (eight records), while *Littorella* was the commonest shore species. No *Isoetes* was recorded. *Najas* was first recorded from the lake by the EPA in 2009.

See also NPWS (2019a, b).

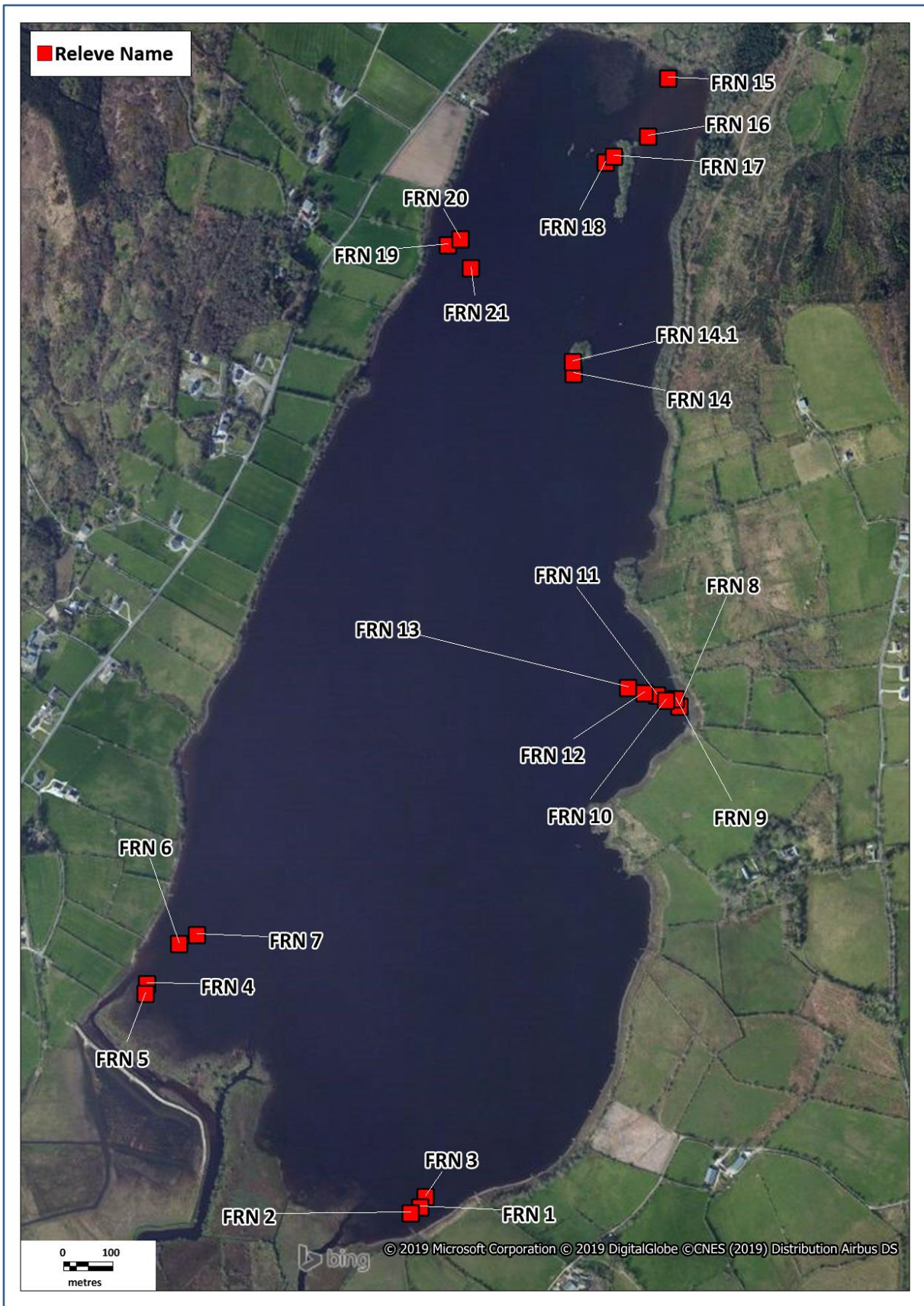
### Species recorded

A total of 25 species has been recorded from Lough Fern. All 25 were seen in 2017. All but *Najas flexilis* are common in soft-water lakes in Donegal. The lake is unusual in the absence of *Isoetes lacustris*, an otherwise universal species in *Najas flexilis* lakes. The flora has several *Potamogeton* species but few species of typical acidic oligotrophic lakes.

- A *Nitella* species is common in the lake. Its exact identity was very difficult to determine in 2017, as most material (which was abundant) was in very bad condition being very blackened and partly decayed. While probably *Nitella flexilis*, its habit and form were unusual forming 'vast tangles unlike most *N. flexilis* or *N. spanioclema*. Branches not completely reduced except in fruiting branches' (field notes of C. Roden). The fruiting branches approached those of *N. spanioclema*. Healthy un-blackened material is necessary to make a complete determination. Further samples should be collected in the future.

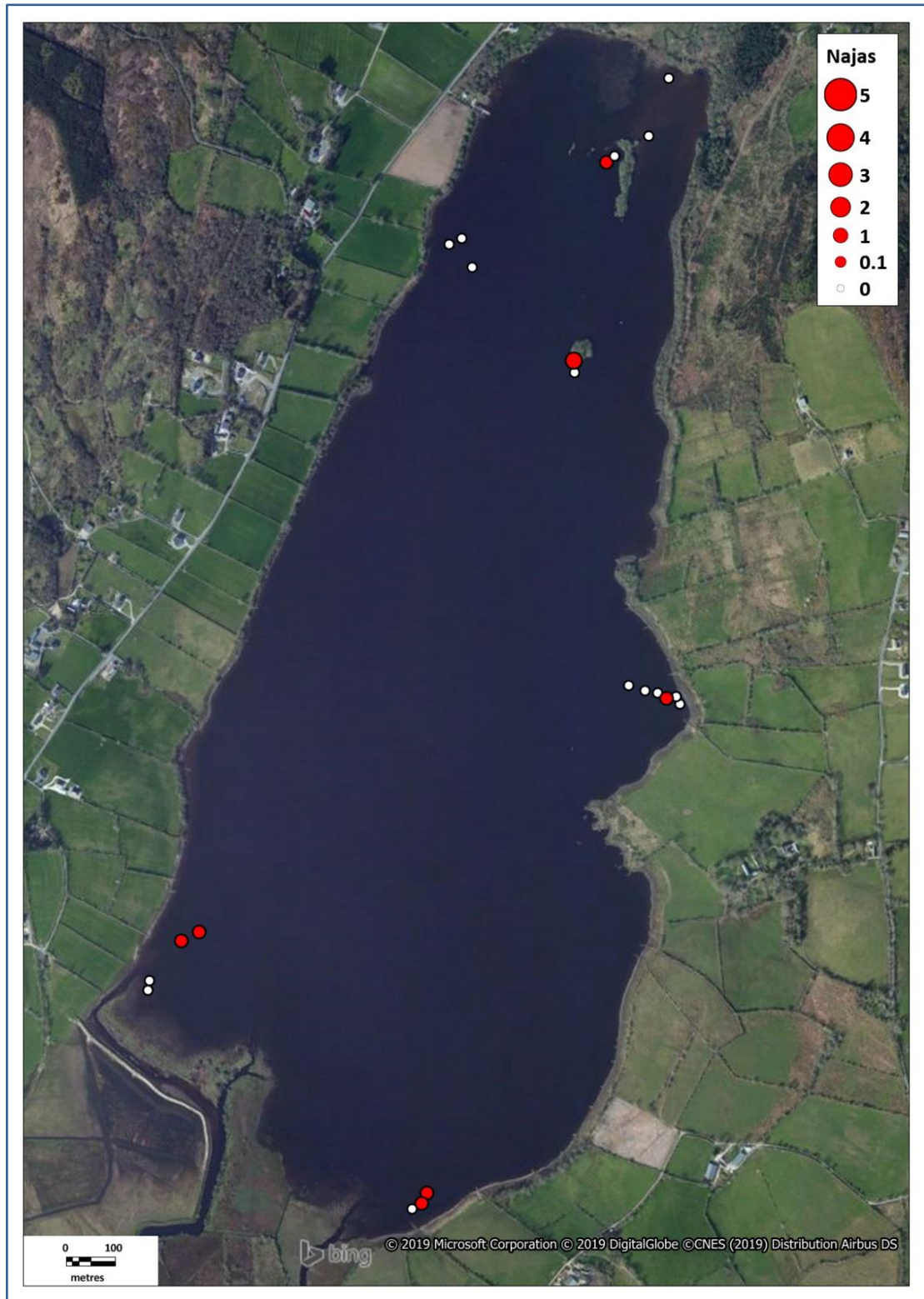


Taxon - Fern	Before this survey	In this survey (2017)	Taxon - Fern	Before this survey	In this survey (2017)
Charophytes			<i>Isoetes lacustris</i>		
<i>Chara aspera</i>		1	<i>Juncus bulbosus</i>		
<i>Chara curta</i>			<i>Lemna minor</i>		
<i>Chara globularis</i>			<i>Lemna trisulca</i>		1
<i>Chara rudis</i>			<i>Littorella uniflora</i>	1	1
<i>Chara virgata</i>		1	<i>Lobelia dortmanna</i>		
<i>Nitella confervacea</i>			<i>Myriophyllum alterniflorum</i>		
<i>Nitella flexilis</i>			<i>Myriophyllum spicatum</i>		1
<i>Nitella gracilis</i>			<i>Najas flexilis</i>	1	1
<i>Nitella opaca</i>			<i>Nuphar lutea</i>	1	1
<i>Nitella translucens</i>		1	<i>Nymphaea alba</i>		
<i>Tolypella glomerata</i>			<i>Oenanthe fluviatilis</i>		
<i>Chara cf. muscosa</i>			<i>Phragmites australis</i>		1
Other algae			<i>Pilularia globulifera</i>		
<i>Ophrydium versatile</i>			<i>Potamogeton alpinus</i>	1	1
Bryophytes			<i>Potamogeton berchtoldii</i>	1	1
<i>Fissidens fontanus</i>			<i>Potamogeton crispus</i>	1	1
<i>Fontinalis antipyretica</i>	1	1	<i>Potamogeton filiformis</i>		
<i>Sphagnum sp.</i>			<i>Potamogeton gramineus</i>		
Vascular Plants			<i>Potamogeton lucens</i>		
<i>Alisma plantago-aquatica</i>		1	<i>Potamogeton natans</i>		1
<i>Apium inundatum</i>			<i>Potamogeton obtusifolius</i>	1	1
<i>Baldellia ranunculoides</i> subsp. <i>ranunculoides</i>			<i>Potamogeton pectinatus</i>		
<i>Baldellia ranunculoides</i> subsp. <i>repens</i>			<i>Potamogeton perfoliatus</i>	1	1
<i>Callitriche brutia</i> subsp. <i>hamulata</i>		1	<i>Potamogeton polygonifolius</i>		
<i>Callitriche hermaphrodita</i>		1	<i>Potamogeton praelongus</i>		
<i>Carex rostrata</i>			<i>Potamogeton pusillus</i>	1	1
<i>Ceratophyllum demersum</i>			<i>Potamogeton × angustifolius</i>		
<i>Cladium mariscus</i>			<i>Potamogeton × nitens</i>		
<i>Elatine hexandra</i>			<i>Ranunculus sp.</i>		
<i>Eleocharis acicularis</i>			<i>Schoenoplectus lacustris</i>	1	1
<i>Eleocharis multicaulis</i>			<i>Sparganium angustifolium</i>		
<i>Eleocharis palustris</i>			<i>Sparganium emersum</i>		1
<i>Eleogiton fluitans</i>			<i>Sparganium erectum</i>		1
<i>Elodea canadensis</i>	1	1	<i>Sparganium natans</i>		
<i>Equisetum fluviatile</i>		1	<i>Subularia aquatica</i>		
<i>Eriocaulon aquaticum</i>			<i>Typha angustifolia</i>		
<i>Hydrilla verticillata</i>			<i>Utricularia sp.</i>		
<i>Isoetes echinospora</i>			<i>Zannichellia palustris</i>		



### *Najas flexilis*

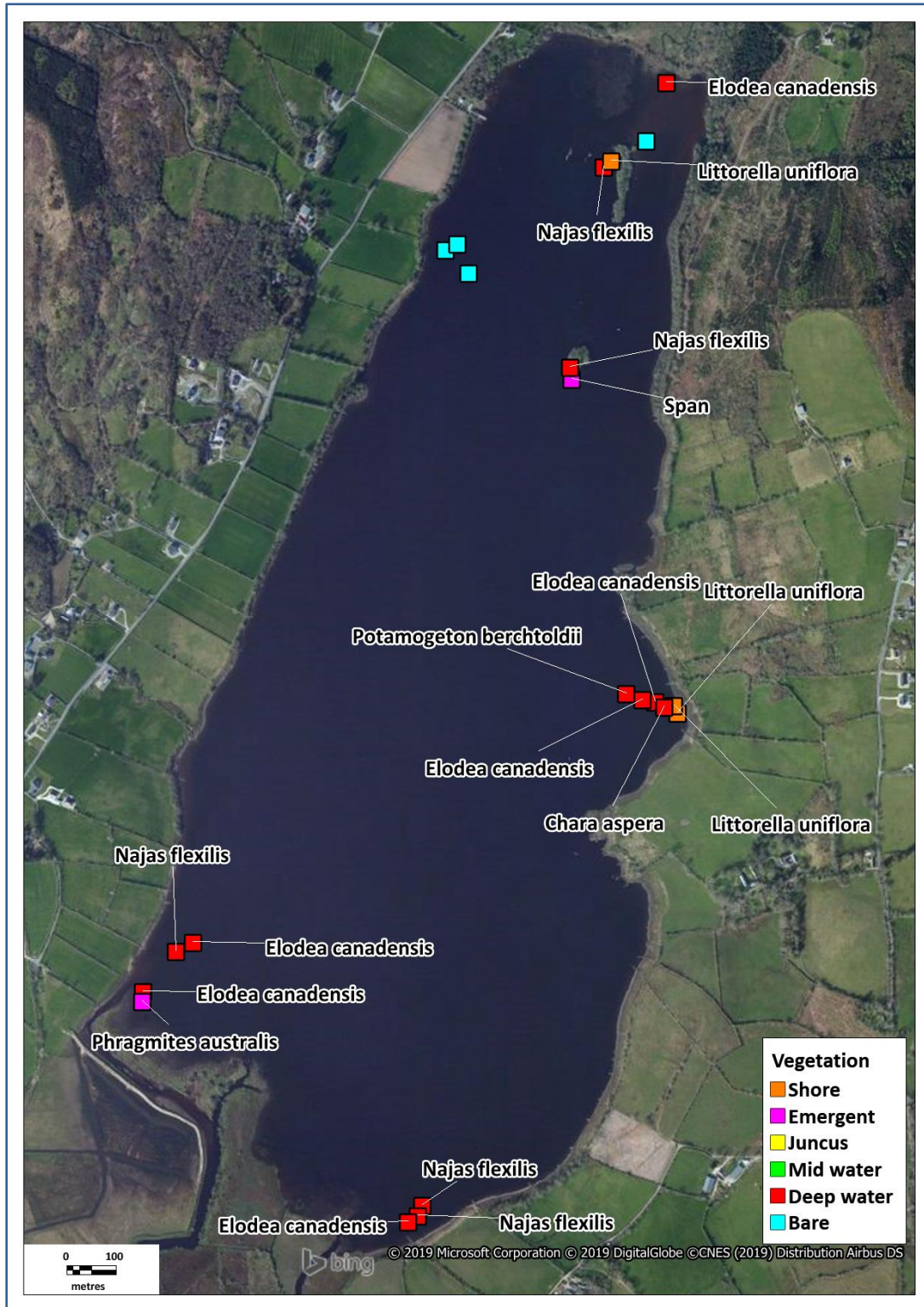
The plant is widespread in the lake, being found in seven relevés, and was absent only in the north-western segment. Previous EPA surveys also found the plant to be widespread. Cover values, however, do not exceed 10%. Because of the blackened and decaying vegetation in deeper water, it is possible deeper populations of *Najas flexilis* occur in more favourable periods. The cause of the decaying vegetation is not known but may reflect a temporary eutrophication event (see below). The area of habitat may vary to a maximum of > 150 ha or a minimum due to very poor euphotic depth of about 10 ha.



## Vegetation

As Lough Fern is a very shallow lake (maximum depth is 2.5 m), vegetation is potentially able to colonise the entire lake bed. However water colour was very dark in August 2017 with a euphotic depth of about 2.0 m.

*Phragmites* and *Schoenoplectus* beds occur mainly at the southern end of the lake and most of the shore is rocky with *Littorella* abundant. *Chara aspera* is common in slightly deeper water (>1.0 m). Below 1.0 m, *Nitella* sp. is the dominant macrophyte along with *Elodea canadensis*, *Potamogeton* sp. and occasional *Najas flexilis*. As noted above however, much of the deeper vegetation is blackened and decaying.



## Water chemistry data

Water quality data for the period 2009 to 2015 were made available by the EPA, for many samples from multiple depths. Values presented and used in assessment are averages of all data. An Foras Forbartha data for the lake in August 1973 are given for comparison (Flanagan & Toner, 1975).

Parameter	Unit	Lough Fern EPA 2009-2015	Lough Fern An Foras Forbartha 1973
Alkalinity	mg/l	30.5	30
Calcium	mg/l	10.6	
Chloride	mg/l	20.1	22
Chlorophyll	µg/l	6.96	3
Colour	Hazen units	76	25
Conductivity	µS/cm	126	130
Magnesium	mg/l	2.1	
pH		7.3	7.7-8.0
Potassium	mg/l	1.0	0.7
Secchi	m	1.3	2
Sulphate	mg/l	5.3	9
Total oxidised nitrogen	mg/l	0.19	
Total phosphorus	mg/l	0.027	

## Pressures and threats

Lough Fern appears to be under stress. EPA assessments rate it as in poor status in three successive sampling rounds. The extensive blackened vegetation does imply deoxygenation at greater depths and is a clear threat to *Najas flexilis* and other benthic plants. The much lower chlorophyll reading (2.4-3 µg/l vs 7 µg/l) taken in 1973 also suggests increased eutrophication. Equally colour has increased from 25 to 76 Hazen units between 1973 and 2016. Unless this situation is improved there is a real danger of *Najas flexilis* becoming extinct, as well as loss of the interesting benthic vegetation.

## Conservation condition

Lough Fern is a disturbed lake with large areas of decaying vegetation at depth. Colour is very high and euphotic depth low, while total phosphorus exceeds the good/poor boundary. Both colour and euphotic depth are marginal Poor/Bad, but the huge extent of decaying vegetation suggests a severe environmental incident, so the lake is classified as Bad.

Parameter	Target for Good	Lough Fern 2017	Condition
Area of habitat	Stable or increasing	Decreasing?	Poor
Deep-water community	Full development	Partial development and decaying	Poor/Bad
Number of species	Stable or increase	Increase (25)	Good
Typical species	≥9 indicator species	7	Poor
<i>Najas flexilis</i> population	Stable population	Possible decline at depth, cover abundance low	Poor
Introduced species	Not present/not impacting on <i>Najas flexilis</i> / deep-water community	Possible impact on <i>Najas flexilis</i> and deep-water community	Good/Poor
Euphotic depth (m)	≥3	2.1	Poor
Colour (Hazen units)	<40	76	Poor
Total phosphorus (TP) (mg/l)	<0.015	0.027	Poor
Hydrological regime	<50% <i>Lobelia</i> – <i>Littorella</i> zone exposed in summer	-	Good
<b>Overall assessment</b>			<b>Bad</b>

Lough Foorglass, 2018				
Name	Foorglass		Code	FOO
Alternative name(s)	Foorglas Lake, Lettershask East			
Grid reference	L6335242982	Max. depth (m)	>3	
County	Galway	EPA code	31_1003	
Area (ha)	4	OSi 1:50,000 sheet	44	
Maximum length (km)	0.7	Nutrient data	This survey 18/01/2019, C. Roden 2005	
Altitude (m)	8	SAC	-	
Geology	Gabbro			
Previous survey	van Groenendael <i>et al.</i> (1979), C. Roden for NPWS in 2005			
Previous <i>Najas flexilis</i> records	van Groenendael <i>et al.</i> 23/09/1975, C. Roden 02/09/2005, van der Weyer 2010 (see Roden & Murphy, 2014)			
Other noteworthy species	<i>Subularia aquatica</i>			
Snorkel survey date(s)	24/07/2018	Number of species	24	
Surveyors	PM, JR	Alkalinity (mg/l CaCO <sub>3</sub> )	20.9	
Number of transects	3	Total phosphorus (mg/l TP)	0.022	
Number of relevés	18	Colour (Hazen units)	114	
Euphotic depth (m)	2.2	Secchi depth (m)	-	
<i>Najas flexilis</i>	Present throughout the lake			
Deep-water vegetation	Full development			
Noteworthy species	<i>Najas flexilis</i> , <i>Callitriche hermaphroditica</i>			
Introduced species	None noted			
Substrates	Rock, silt			
Summary	A small but species rich lake on basic rock, possibly threatened by eutrophication			
Lake score	132	Lake rank	4	
CONSERVATION CONDITION	<b>POOR</b>			

### Previous accounts

1. The first description of Foorglass or Lettershask East Lough was by van Groenendael *et al.* (1979; see also by van Groenendael *et al.*, 2020). They noted the Isoetid vegetation around the lake shore with *Lobelia*, *Isoetes* and *Littorella* and drift material of *Eriocaulon*, *Potamogeton gramineus* and *P. perfoliatus*. They also found drift *Najas flexilis*, the first record from this lake. They explained the vegetation in terms of the lake's rocky or cobble shores with little substrate for emergent reed beds.
2. C. Roden examined the lake by snorkelling on 02/09/2005. He only inspected the central part of the lake but recorded 14 species. Substrate was rocks followed by mud, with euphotic depth of about 2.5 m. He described the water as clear-ish. Three zones were noted an isoetid zone with *Subularia aquatica*, a *Potamogeton gramineus* zone and a lowest *P. berchtoldii*, *Chara virgata* and *Fontinalis* zone with some *Najas flexilis*. *Najas flexilis* was described as rare with low cover value.
3. Klaus van Der Weyer confirmed the presence of *Najas flexilis* in summer 2010 (van der Weyer, pers. com.).

See also van Groenendael *et al.* (1982, 1983, 1993, 2020) and Roden & Murphy (2014).

### Species recorded

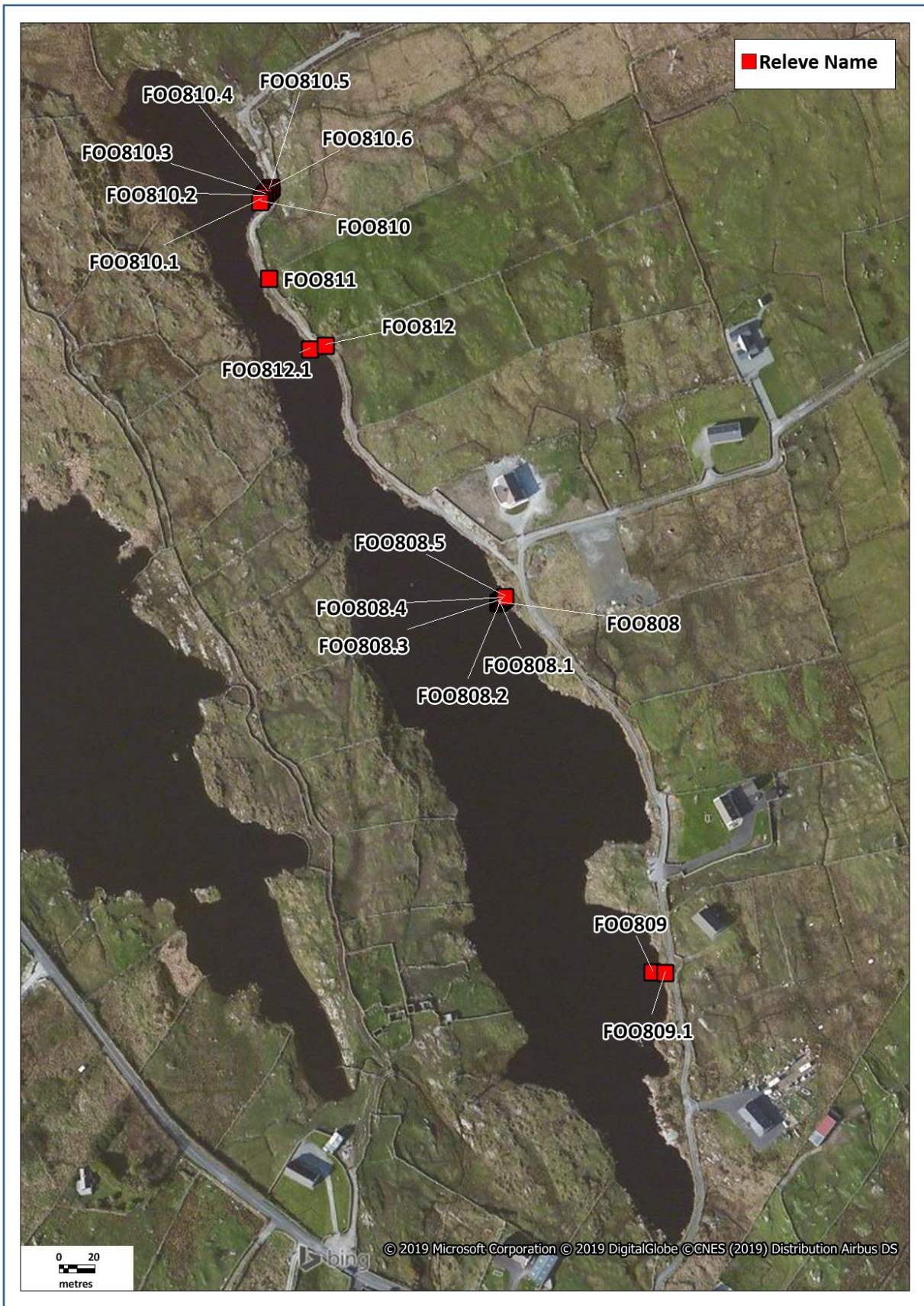
In 2018, 24 species were recorded from Foorglass, a high number for a lake only 4.4 ha, possibly on account of the base-rich bedrock and maritime location. A total of 27 species has been recorded across all surveys. Less common species include

- *Subularia aquatica* was not recorded in 2018, but probably remains as no other changes were recorded in the lake. It occurred in 2005 in shallow water, which may have been dry land in the

dry 2018 summer. Preston & Croft (1997) note that it is exposed on occasion at other sites. It occurs in at least 12 lakes in west Galway and west Mayo but otherwise has not been much recorded in Ireland in recent years.

- *Callitriche hermaphrodita* while common in the north of Ireland is rare in the west and south, and often co-occurs with *Najas flexilis*.
- *Potamogeton obtusifolius* is usually a species of more eutrophic lakes but appears to occur in *Najas* lakes in south Connemara.

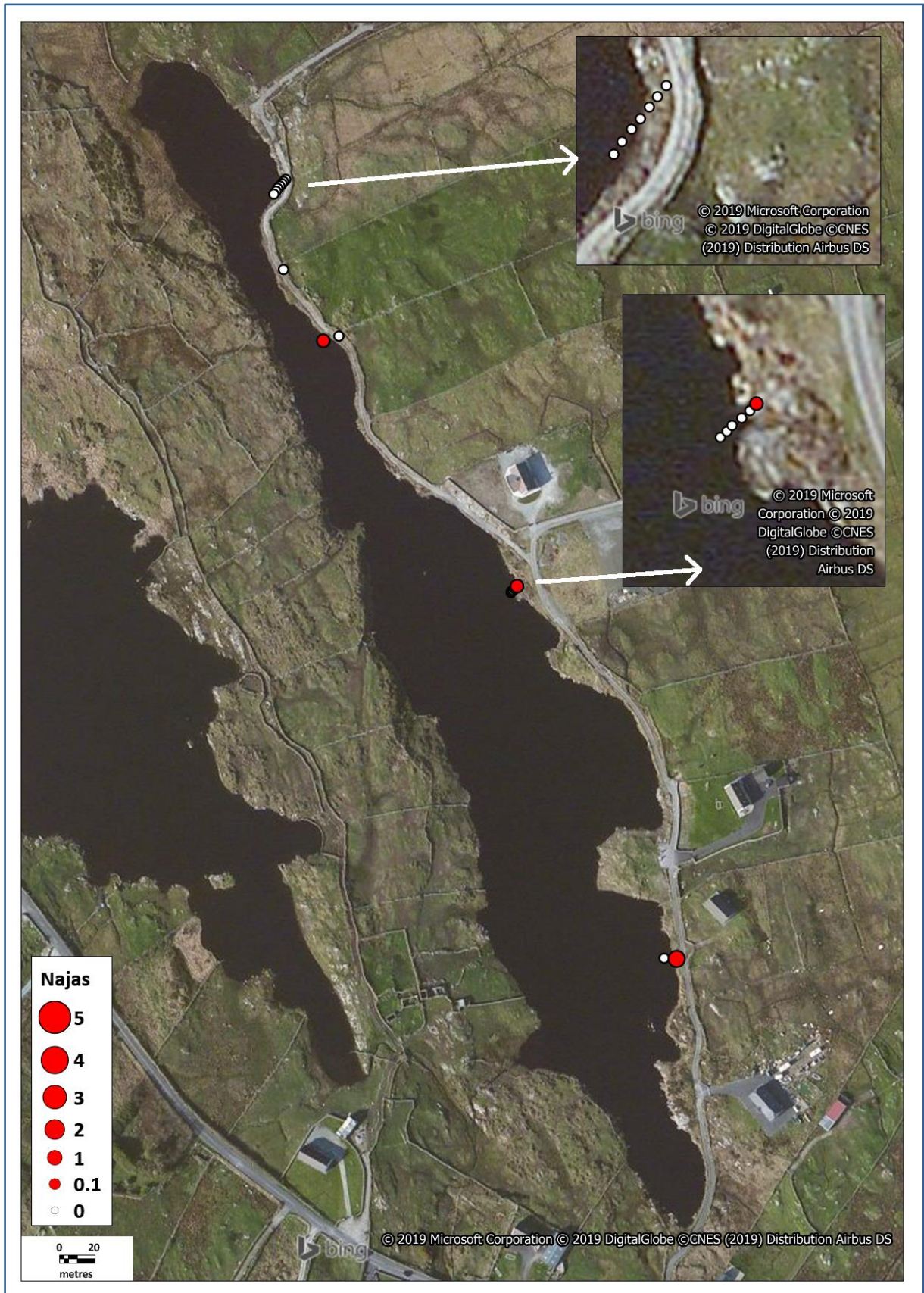
Taxon - Foorglass	Before this survey	In this survey (2018)	Taxon - Foorglass	Before this survey	In this survey (2018)
Charophytes			<i>Isoetes lacustris</i>	1	1
<i>Chara aspera</i>			<i>Juncus bulbosus</i>		
<i>Chara curta</i>			<i>Lemna minor</i>		
<i>Chara globularis</i>			<i>Lemna trisulca</i>		
<i>Chara rudis</i>			<i>Littorella uniflora</i>	1	1
<i>Chara virgata</i>	1	1	<i>Lobelia dortmanna</i>	1	1
<i>Nitella confervacea</i>			<i>Myriophyllum alterniflorum</i>	1	1
<i>Nitella flexilis</i>			<i>Myriophyllum spicatum</i>		
<i>Nitella gracilis</i>			<i>Najas flexilis</i>	1	1
<i>Nitella opaca</i>			<i>Nuphar lutea</i>		
<i>Nitella translucens</i>		1	<i>Nymphaea alba</i>		1
<i>Tolypella glomerata</i>			<i>Oenanthe fluviatilis</i>		
<i>Chara cf. muscosa</i>			<i>Phragmites australis</i>		1
Other algae			<i>Pilularia globulifera</i>		
<i>Ophrydium versatile</i>			<i>Potamogeton alpinus</i>		
Bryophytes			<i>Potamogeton berchtoldii</i>	1	1
<i>Fissidens fontanus</i>			<i>Potamogeton crispus</i>		
<i>Fontinalis antipyretica</i>	1	1	<i>Potamogeton filiformis</i>		
<i>Sphagnum</i> sp.			<i>Potamogeton gramineus</i>	1	1
Vascular Plants			<i>Potamogeton lucens</i>		
<i>Alisma plantago-aquatica</i>			<i>Potamogeton natans</i>		1
<i>Apium inundatum</i>	1	1	<i>Potamogeton obtusifolius</i>		1
<i>Baldellia ranunculoides</i> subsp. <i>ranunculoides</i>	1	1	<i>Potamogeton pectinatus</i>		
<i>Baldellia ranunculoides</i> subsp. <i>repens</i>			<i>Potamogeton perfoliatus</i>	1	1
<i>Callitriche brutia</i> subsp. <i>hamulata</i>			<i>Potamogeton polygonifolius</i>		
<i>Callitriche hermaphrodita</i>		1	<i>Potamogeton praelongus</i>		
<i>Carex rostrata</i>			<i>Potamogeton pusillus</i>		
<i>Ceratophyllum demersum</i>			<i>Potamogeton × angustifolius</i>		
<i>Cladium mariscus</i>	1		<i>Potamogeton × nitens</i>	1	
<i>Elatine hexandra</i>	1	1	<i>Ranunculus</i> sp.		1
<i>Eleocharis acicularis</i>			<i>Schoenoplectus lacustris</i>		
<i>Eleocharis multicaulis</i>			<i>Sparganium angustifolium</i>		1
<i>Eleocharis palustris</i>			<i>Sparganium emersum</i>		
<i>Eleogiton fluitans</i>			<i>Sparganium erectum</i>		1
<i>Elodea canadensis</i>			<i>Sparganium natans</i>		1
<i>Equisetum fluviatile</i>			<i>Subularia aquatica</i>	1	
<i>Eriocaulon aquaticum</i>	1	1	<i>Typha angustifolia</i>		
<i>Hydrilla verticillata</i>			<i>Utricularia</i> sp.		
<i>Isoetes echinospora</i>			<i>Zannichellia palustris</i>		





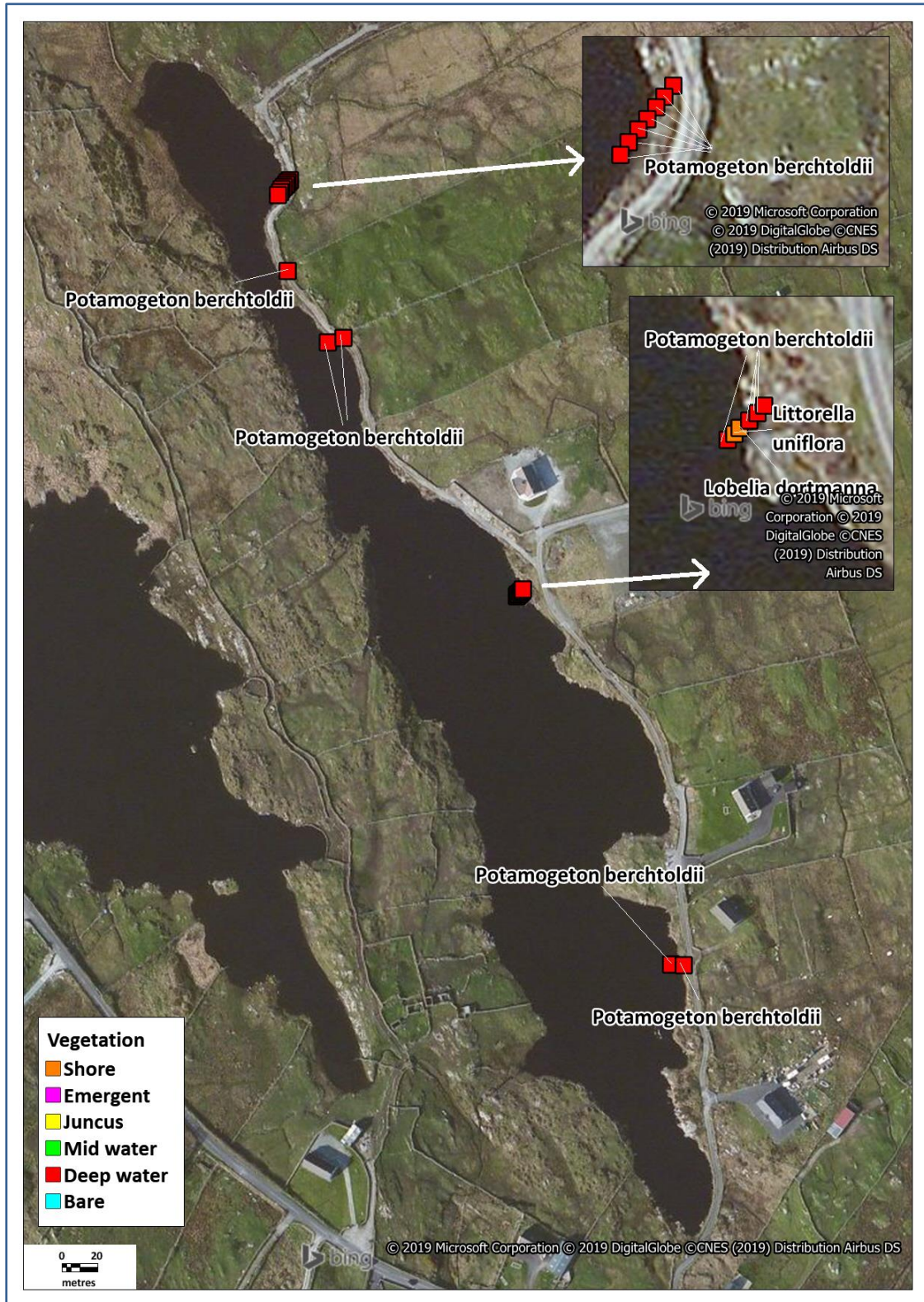
*Najas flexilis*

The plant occurs throughout the lake with the largest population in 2018 on the eastern side. Depths range from 1.0-1.5 m, but cover values do not exceed 5%. The plant grows amongst *Potamogeton* and *Chara* sp. In 2005 it was found at 2 m with *P. berchtoldii*, *Chara virgata* and *Fontinalis* on sloping soft mud.



## Vegetation

Compared to many other *Najas flexilis* lakes, the vegetation of Foorglass is unusual. *Potamogeton berchtoldii* and *Chara virgata* occur throughout the lake from 0.5 m to the euphotic depth of 2.2 m, *P. gramineus*, *P. obtusifolius* and *P. perfoliatus* are also common. *Potamogeton* and *Chara* cover values often exceed 50%. *Najas flexilis* and *Callitriche hermaphroditica* grow in this species mix. Isoetid vegetation does occur but, as noted by van Groenendael *et al.* (1979, 2020) is patchy, possibly due to extensive areas of bedrock. Other species are less common.



## Water chemistry data

Water samples were taken on a single occasion on the 18 January 2019 as part of this survey. Data are also available from samples taken by C. Roden in 2005.

Parameter	Unit	Foorglass This survey	Foorglass C. Roden 2005
Alkalinity	mg/l	20.9	26
Calcium	mg/l	5.4	2.8
Chloride	mg/l	47	54
Chlorophyll	µg/l	1.9	2.9
Colour	Hazen units	113.8	54.6
Conductivity	µS/cm	189.5	206
Magnesium	mg/l		2.9
pH		7.25	7.5
Total phosphorus	mg/l	0.022	

## Pressures and threats

Based on the species lists and the presence of *Najas*, no large change can be seen since 1975. However Roden & Murphy (2014) noted that the neighbouring Lettershask Lough to the north-west was heavily eutrophied probably due to discharges from a farmyard on the lake edge. There are also a number of houses (eight in 2013, six in 2000, Geohive website) within 150 m of the lake. The abundant growth of *Potamogeton* in 2018 contrasts with van Groenendael *et al.* (1979) who only found a little drift *Potamogeton*, as the plants now grow in shallow (<0.5 m) water. This might indicate increased nutrient input.

## Conservation condition

An interesting coastal lake but possibly under some environmental pressure. Total phosphorus and colour are high (colour, however, was measured in winter) and euphotic depth is low, so the lake is rated *Poor*.

Parameter	Target for Good	Foorglass 2018	Condition
Area of habitat	Stable or increasing	Stable or increasing	Good
Deep-water community	Full development	Full development	Good
Number of species	Stable or increase	Increase (24)	Good
Typical species	≥9 indicator species	11	Good
<i>Najas flexilis</i> population	Stable population	Appears stable	Good
Introduced species	Not present/not impacting on <i>Najas flexilis</i> / deep-water community	Not present	Good
Euphotic depth (m)	≥3	2.2	Poor
Colour (Hazen units)	<40	114	Bad
Total phosphorus (TP) (mg/l)	<0.015	0.022	Poor
Hydrological regime	<50% <i>Lobelia</i> – <i>Littorella</i> zone exposed in summer	-	Good
<b>Overall assessment</b>			<b>Poor</b>

Lough Illauntrasna, 2018			
Name	Illaustrasna		
Alternative name(s)			
Grid reference	L8878425340	Max. depth (m)	9
County	Galway	EPA code	31_1126
Area (ha)	8	OSi 1:50,000 sheet	45
Maximum length (km)	0.5	Nutrient data	EPA 2009-2015
Altitude (m)	20	SAC	-
Geology	Galway granite		
Previous survey	EPA in 2007, 2010, 2013		
Previous <i>Najas flexilis</i> records	EPA 25/07/2007 – unconfirmed (see account below)		
Other noteworthy species	<i>Isoetes echinospora</i>		
Snorkel survey date(s)	13/09/2018	Number of species	17
Surveyors	CR, JR	Alkalinity (mg/l CaCO <sub>3</sub> )	11.5
Number of transects	2	Total phosphorus (mg/l TP)	0.010
Number of relevés	9	Colour (Hazen units)	45
Euphotic depth (m)	3.5	Secchi depth (m)	-
<i>Najas flexilis</i>	<i>Najas flexilis</i> was not recorded		
Deep-water vegetation	Absent		
Noteworthy species	<i>Isoetes echinospora</i>		
Introduced species	None noted		
Substrates	Rock, sand silt		
Summary	A small Connemara lake probably too oligotrophic to support <i>Najas flexilis</i>		
CONSERVATION CONDITION	Not assessed		

### Previous accounts

There appear to be no plant records from Illauntrasna Lough before the EPA surveys of 2007, 2010 and 2013. The EPA species list is given in the table below. Some species, including *Chara* sp., *Myriophyllum alterniflorum* and *Najas flexilis* were only recorded on one or two occasions. The EPA recorded a euphotic depth of about 3.5 m. Their data indicate an Isoetid lake with *Eriocaulon*, *Littorella* and *Lobelia* in shallow water and *Isoetes lacustris* abundant to the euphotic depth. In addition, *Nitella* sp. and *Fontinalis* were common below 1 m. In sheltered areas, *Nuphar* and *Potamogeton natans* were common. The status of the *Najas* and *Potamogeton polygonifolius* records are discussed below.

### Species recorded

In 2018, 17 species were recorded from the lake. A total of 25 species has been recorded, including *Najas flexilis*, which requires verification. The following records are unusual

- *Isoetes echinospora* was recorded both by the EPA and the present survey, it appears to be an under-recorded species.
- The record by the EPA for *Potamogeton polygonifolius* was not confirmed in the present survey, instead the more frequently recorded *P. alpinus* was recorded. It is possible that an error occurred, as all four EPA records for *Potamogeton polygonifolius* were made in 2007 and they did not record the species subsequently.
- *Chara* sp. and *Myriophyllum alterniflorum* were also recorded on single occasions by the EPA and were not seen in 2018. These species were frequently recorded in the 2016-18 survey in other lakes. They probably still occur in Illauntrasna in small numbers.



Taxon - Illauntras na	Before this survey	In this survey (2018)
<b>Charophytes</b>		
<i>Chara virgata</i>	1	
<i>Nitella translucens</i>		1
<b>Bryophytes</b>		
<i>Fontinalis antipyretica</i>	1	
<i>Sphagnum</i> sp.	1	
<b>Vascular Plants</b>		
<i>Baldellia ranunculoides</i> subsp. <i>ranunculoides</i>		1
<i>Carex rostrata</i>		1
<i>Elatine hexandra</i>		1
<i>Eleocharis multicaulis</i>		1
<i>Eleocharis palustris</i>	1	1
<i>Equisetum fluviatile</i>	1	
<i>Eriocaulon aquaticum</i>	1	1
<i>Isoetes echinospora</i>	1	1
<i>Isoetes lacustris</i>	1	1
<i>Juncus bulbosus</i>	1	1
<i>Littorella uniflora</i>	1	1
<i>Lobelia dortmanna</i>	1	1
<i>Myriophyllum alterniflorum</i>	1	
<i>Najas flexilis</i>	1*	
<i>Nuphar lutea</i>	1	1
<i>Nymphaea alba</i>	1	
<i>Phragmites australis</i>	1	1
<i>Potamogeton alpinus</i>		1
<i>Potamogeton natans</i>	1	1
<i>Potamogeton polygonifolius</i>	1	
<i>Sparganium angustifolium</i>		1

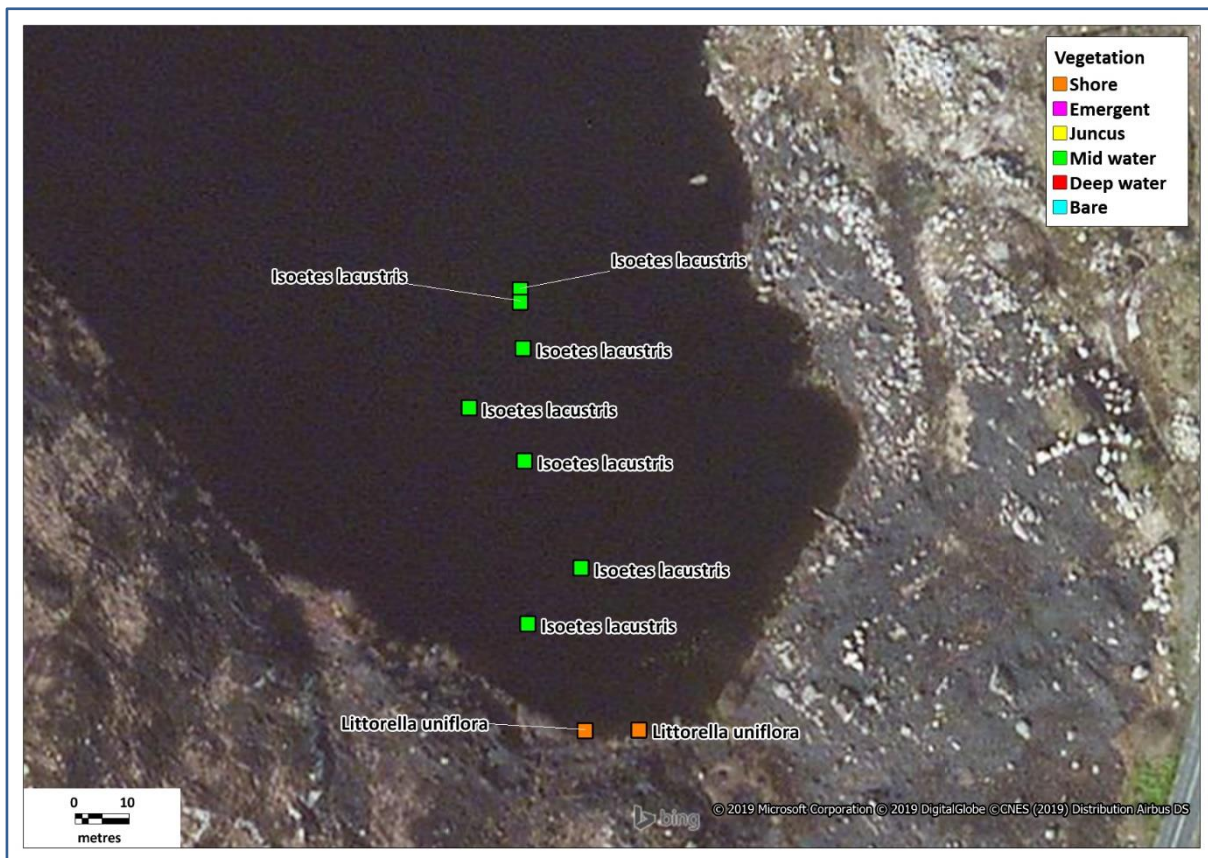
\* record not currently accepted as has not been verified

## *Najas flexilis*

It is debatable whether *Najas flexilis* occurs in the lake. It was recorded by the EPA in two samples at the southern end of the lake in 2007, but was not recorded in 2010 or 2013. Despite intensive searching by JR, no trace of the plant could be found in September 2018. As the population in Loch an Chaolaigh demonstrates, *Najas* does not occur every year in some lakes and 2018 appears to have been an unfavorable year for the species in certain lakes. Nevertheless, abundant *Najas* was found on the same day at the nearby Loughauneala. The alkalinity of Illauntrasna is very low compared to most *Najas flexilis* loughs surveyed in 2016-18 and, more significantly, its flora lacks many of the constant species seen in *Najas flexilis* lakes such as *Potamogeton perfoliatus* or *P. berchtoldii*. We suggest that until the 2007 record is confirmed, that the lake is not listed as a *Najas* lake.

## Vegetation

Lough Illauntrasna lies on granite bedrock with steeply sloping shores except in the north-eastern section. Its main axis runs north-west to south-east and the lake has a maximum depth of 9 m. Substrates include sand gravel and soft silt. In shallow water (<1 m), *Eriocaulon*, *Lobelia* and *Littorella* are dominant with *Nuphar*, *Potamogeton natans* and *P. alpinus* in sheltered areas. Below 1 m, *Isoetes* is abundant to the euphotic depth of 3.5 m. Some *Nitella translucens* occurs along with *Eleocharis multicaulis*.



## Water chemistry data

Water quality data for the period 2009 to 2015 were made available by the EPA, for many samples from multiple depths. Values presented and used in assessment are averages of all data.

Parameter	Unit	Illauntrasna EPA 2009-2015
Alkalinity	mg/l	11.5
Calcium	mg/l	5.4
Chloride	mg/l	41
Chlorophyll	µg/l	4.8
Colour	Hazen units	44.5
Conductivity	µS/cm	166
Magnesium	mg/l	2.7
pH		7.2
Potassium	mg/l	0.9
Sulphate	mg/l	7.2
Total oxidised nitrogen	mg/l	0.18
Total phosphorus	mg/l	0.0095

## Pressures and threats

The lake is used as a local water supply and does not appear to be threatened by eutrophication or other disturbances

## Conservation condition

This lake was not assessed as both low alkalinity, and absence of *Najas flexilis* and *Potamogeton perfoliatus* shows that it is not a *Najas* type lake and, therefore, the targets for *Najas flexilis*-type lakes are not appropriate.

Lough Kiltorris, 2017			
Name	Kiltorris	Code	KTS
Alternative name(s)			
Grid reference	G6774797080	Max. depth (m)	16
County	Donegal	EPA code	38_47
Area (ha)	43	OSi 1:50,000 sheet	10
Maximum length (km)	1.5	Nutrient data	EPA 2009-2015
Altitude (m)	7	SAC	000197, WestOf Ardara/Maas Road SAC
Geology	Dalradian schist and marble		
Previous survey	N.F. Stewart and C.D. Preston in 1989, Roden (2004), EPA in 2009, 2012, 2015		
Previous <i>Najas flexilis</i> records	N.F. Stewart 22/08/1989, C. Roden 16/09/1999, EPA 30/07/2009, 2012		
Other noteworthy species	<i>Eriocaulon aquaticum</i> , <i>Nitella confervacea</i>		
Snorkel survey date(s)	24/07/2017, 26/07/2017	Number of species	31
Surveyors	PM, CR, JR	Alkalinity (mg/l CaCO <sub>3</sub> )	28.9
Number of transects	5	Total phosphorus (mg/l TP)	0.009
Number of relevés	35	Colour (Hazen units)	48
Euphotic depth (m)	3.0	Secchi depth (m)	-
<i>Najas flexilis</i>	Large population present		
Deep-water vegetation	Full development		
Noteworthy species	<i>Eriocaulon aquaticum</i> , <i>Isoetes echinospora</i> , <i>Najas flexilis</i> , <i>Nitella confervacea</i>		
Introduced species	None noted		
Substrates	Silt, mud, sand, cobble		
Summary	Potentially one of the most interesting <i>Najas flexilis</i> lakes due to water clarity, the lake has been grossly disturbed due to drainage with a severe reduction in euphotic depth. Remedial work may have improved the situation and the lake retains great conservation value		
Lake score	203	Lake rank	2
CONSERVATION CONDITION	<b>BAD</b>		

### Previous accounts

1. Nick Stewart and C.D. Preston visited the lake in 1989 and noted drift *Najas flexilis*. They also recorded *Nymphaea alba*, *Myriophyllum alterniflorum*, *Potamogeton berchtoldii*, *P. gramineus*, *P. perfoliatus*, *P. natans*, *Eriocaulon aquaticum*, *Lobelia dortmanna*.
2. C. Roden snorkelled the lake on 16/09/1999. He noted exceptionally clear water and had difficulty in reaching the base of the euphotic zone. He estimated (but did not have a depth meter) that *Najas flexilis* and *Nitella confervacea* were growing below 8 m. He noted three vegetation zones in the north-eastern sector of the lake as follows: a) an Isoetid zone with *Eriocaulon* and *Lobelia*; b) an *Isoetes Chara aspera*, *Nitella translucens* zone; and c) a *Najas*, *Nitella confervacea*, *N. translucens*, *P. perfoliatus*, *Fontinalis* zone at depth. The shallow southern basin had large mounds of *Chara virgata* with some *Apium inundatum*. He also recorded *Callitriche hermaphroditica* and *P. crispus*. The site was described as follows in a report to the Heritage Council (Roden, 1999)

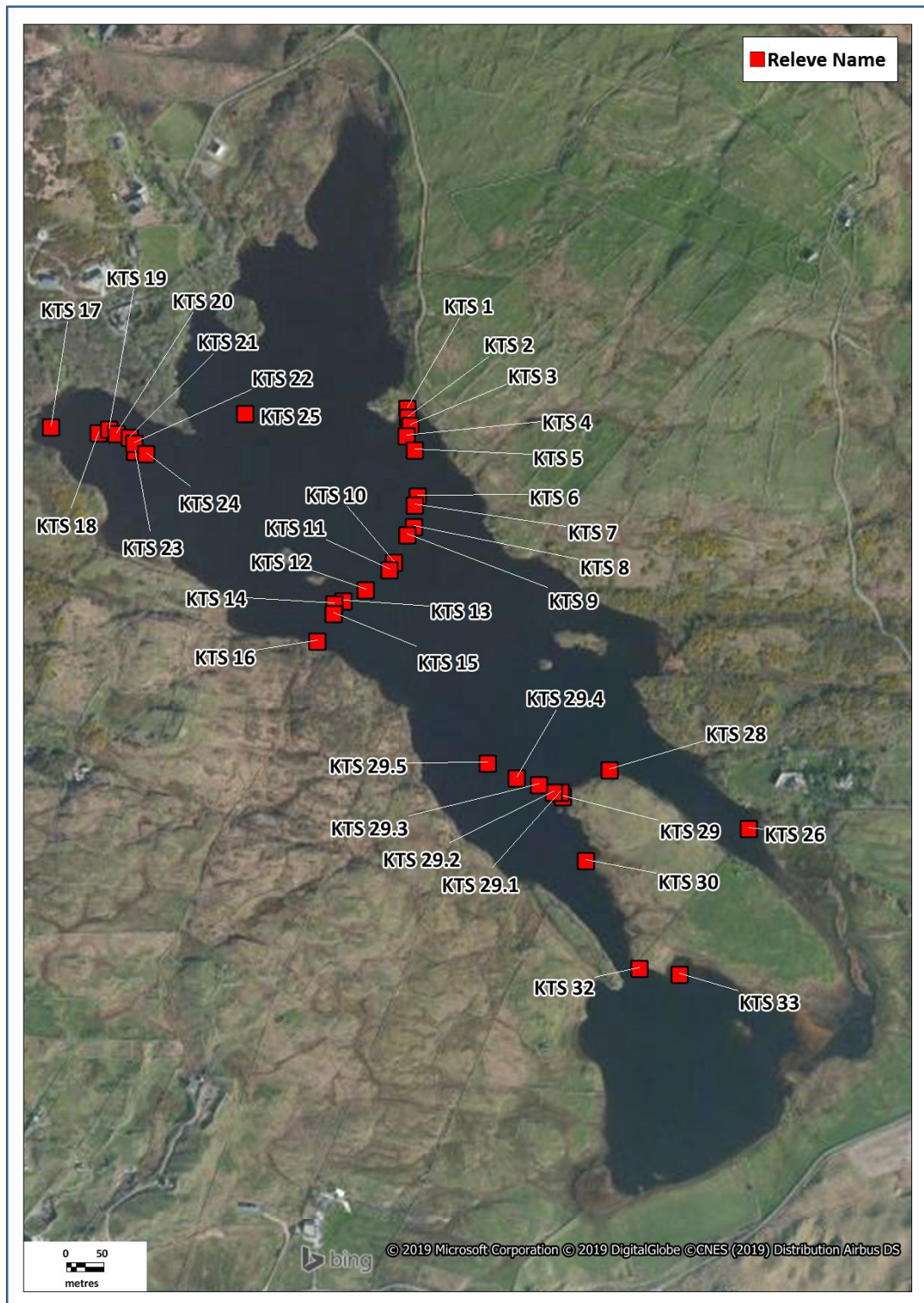
*This large and attractive lake is mainly situated on rock but the south-eastern basin is separated from the sea by sand dunes and sandy fields. While a typical sand shelf is not found, much of the lake has a sandy bottom. With the exception of the south-east basin, the shores are of rock or sandy-gravel. Much of the lake bed is between six and eight metres, but the floor of a deep hole at the north-west end was too deep to be reached by snorkelling. In general, the lake water was exceptionally transparent. The shallow south-eastern basin is covered by a monoculture of Chara globularis [Chara virgata] while the remainder of the lake supports typical soft-water communities. However small populations of Callitriche hermaphroditica, P. pectinatus and P. crispus also occur. A rich flora and*



*well-developed vegetation includes Nitella batrachosperma, Elatine hexandra and Najas flexilis. It is the only lake where Apium inundatum was found.*

- The EPA have surveyed the lake on three occasions: 2009, 2012 and 2015. Their stations did not exceed 2-3 m in measured depth and they recorded relatively few submerged macrophytes, for example *Isoetes*, which is abundant in the lake, was only recorded in six of 111 samples taken. Their species list agrees with other workers with the exception of *Potamogeton obtusifolius* which was not noted in other surveys. *Najas* was recorded in 2009 and 2012 near the centre of the lake off the south-western shore at 1.5-2.1 m.

See also NPWS (2015c, d).



## Species recorded

Taxon - Kiltorris	Before this survey	In this survey (2017)	Taxon - Kiltorris	Before this survey	In this survey (2017)
Charophytes			<i>Isoetes lacustris</i>	1	1
<i>Chara aspera</i>	1	1	<i>Juncus bulbosus</i>	1	1
<i>Chara curta</i>			<i>Lemna minor</i>		
<i>Chara globularis</i>			<i>Lemna trisulca</i>		
<i>Chara rudis</i>			<i>Littorella uniflora</i>	1	1
<i>Chara virgata</i>	1	1	<i>Lobelia dortmanna</i>	1	1
<i>Nitella confervacea</i>	1	1	<i>Myriophyllum alterniflorum</i>	1	1
<i>Nitella flexilis</i>	1	1	<i>Myriophyllum spicatum</i>	1	1
<i>Nitella gracilis</i>			<i>Najas flexilis</i>	1	1
<i>Nitella opaca</i>			<i>Nuphar lutea</i>		
<i>Nitella translucens</i>	1	1	<i>Nymphaea alba</i>	1	1
<i>Tolypella glomerata</i>			<i>Oenanthe fluviatilis</i>		
<i>Chara cf. muscosa</i>			<i>Phragmites australis</i>	1	1
Other algae			<i>Pilularia globulifera</i>		
<i>Ophrydium versatile</i>			<i>Potamogeton alpinus</i>		
Bryophytes			<i>Potamogeton berchtoldii</i>	1	1
<i>Fissidens fontanus</i>			<i>Potamogeton crispus</i>	1	
<i>Fontinalis antipyretica</i>	1	1	<i>Potamogeton filiformis</i>		
<i>Sphagnum</i> sp.			<i>Potamogeton gramineus</i>	1	1
Vascular Plants			<i>Potamogeton lucens</i>		
<i>Alisma plantago-aquatica</i>			<i>Potamogeton natans</i>	1	1
<i>Apium inundatum</i>	1	1	<i>Potamogeton obtusifolius</i>	1	
<i>Baldellia ranunculoides</i> subsp. <i>ranunculoides</i>	1	1	<i>Potamogeton pectinatus</i>	1	
<i>Baldellia ranunculoides</i> subsp. <i>repens</i>			<i>Potamogeton perfoliatus</i>	1	1
<i>Callitriche brutia</i> subsp. <i>hamulata</i>			<i>Potamogeton polygonifolius</i>		
<i>Callitriche hermaphroditica</i>	1		<i>Potamogeton praelongus</i>		
<i>Carex rostrata</i>			<i>Potamogeton pusillus</i>		
<i>Ceratophyllum demersum</i>			<i>Potamogeton × angustifolius</i>		
<i>Cladium mariscus</i>			<i>Potamogeton × nitens</i>		
<i>Elatine hexandra</i>	1	1	<i>Ranunculus</i> sp.		
<i>Eleocharis acicularis</i>			<i>Schoenoplectus lacustris</i>		1
<i>Eleocharis multicaulis</i>	1	1	<i>Sparanium angustifolium</i>		1
<i>Eleocharis palustris</i>		1	<i>Sparanium emersum</i>	1	1
<i>Eleogiton fluitans</i>			<i>Sparanium erectum</i>		
<i>Elodea canadensis</i>			<i>Sparanium natans</i>		1
<i>Equisetum fluviatile</i>	1	1	<i>Subularia aquatica</i>		
<i>Eriocaulon aquaticum</i>	1	1	<i>Typha angustifolia</i>		
<i>Hydrilla verticillata</i>			<i>Utricularia</i> sp.		
<i>Isoetes echinospora</i>		1	<i>Zannichellia palustris</i>		

A total of 31 species was recorded in Kiltorris Lough in 2017, and 35 species have been recorded in all surveys combined. Several of these are noteworthy

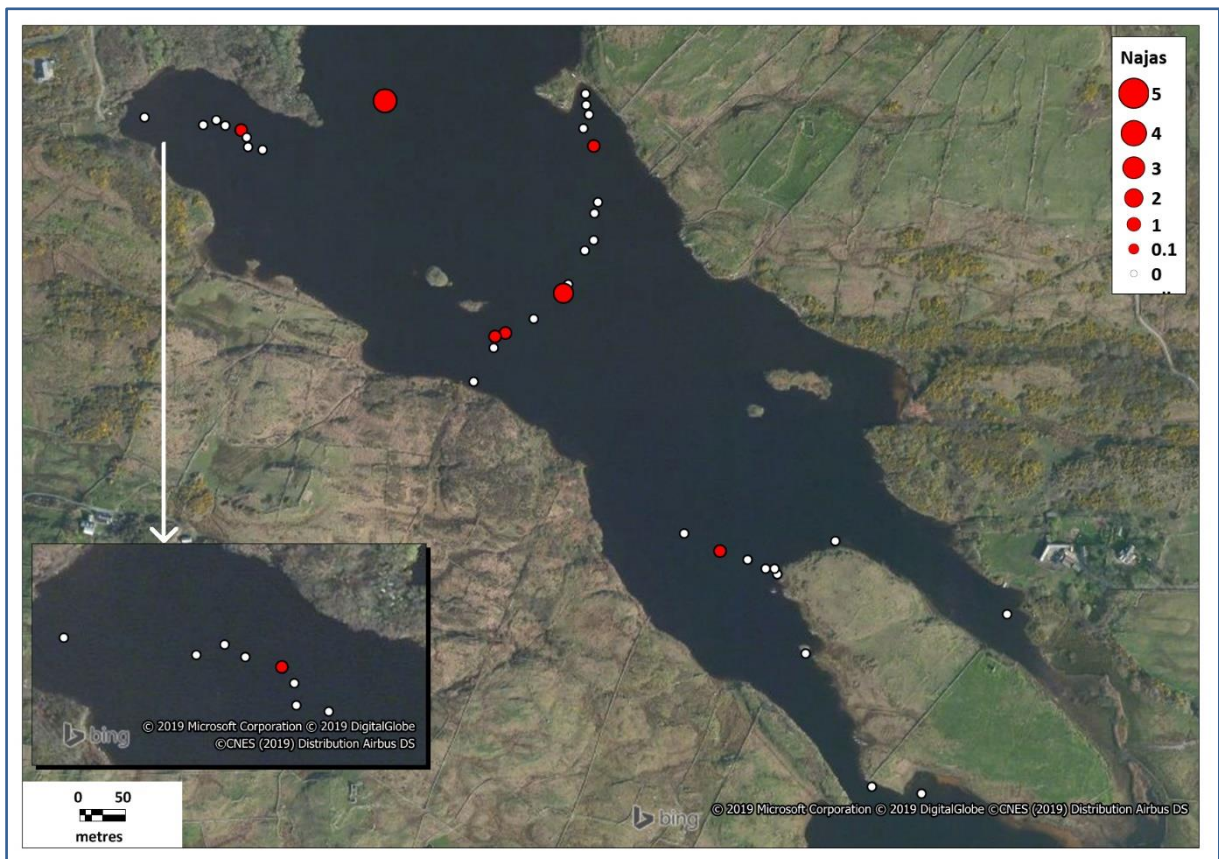
- *Isoetes echinospora* occurs in the northern sector and appears widespread, it is probably under-recorded in Irish habitats
- *Nitella confervacea* is known at present from c. 25 hectads; seven of these are in Donegal. The plant is widespread in the northern basin from 1 m to the euphotic depth of 3 m
- *Eriocaulon aquaticum*, while common in Connemara this plant is restricted to eight hectads in Donegal

- *Potamogeton obtusifolius* was only recorded by EPA surveyors at four points in 2009. It was not seen in 2017.

### *Najas flexilis*

The plant was first noted as drift material by N.F. Stewart and C.D. Preston in 1989. C. Roden noted a well-developed *Najas flexilis* community in 1999, apparently growing at great depth in clear water. It was noted in one location in 2009 and 2012 by the EPA. In 2017, it occurred throughout the northern basin between 1 m and 3 m with cover values up to 50% and companion species *Nitella confervacea*, *N. translucens*, *Potamogeton perfoliatus* and *P. berchtoldii*.

Since 1999 the lake has been grossly disturbed and this has reduced the habitat available to *Najas flexilis*. Recent actions may have improved the situation. Nevertheless, it is estimated that 10 ha of lake bed contain *Najas flexilis*.



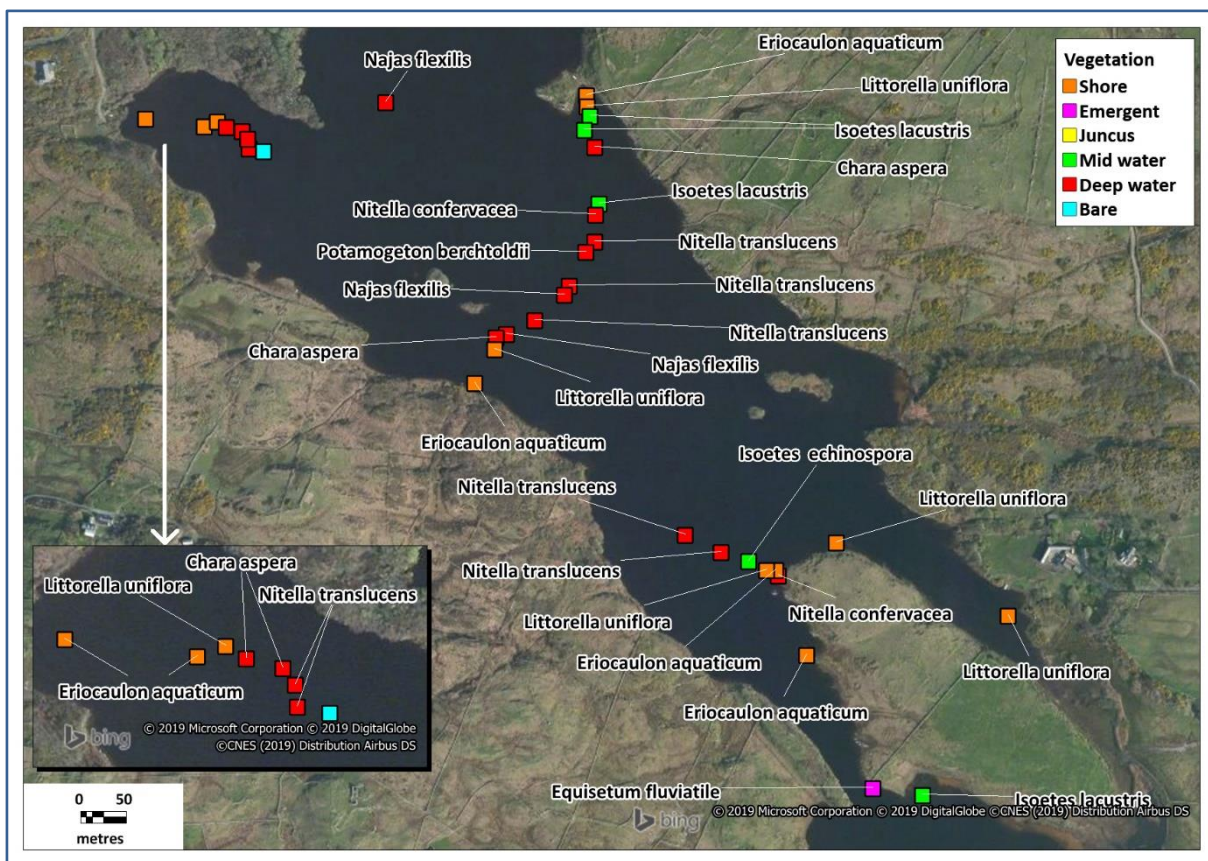
### Vegetation

Kiltorish Lough is situated partly on Dalradian schist and marble and partly on sea sand. The north-western basin is deep and surrounded by rock, while the south-eastern basin is on sandy-silt with soft sediment shores. The lake was lowered in the last few years by deepening a drainage channel that flows north to the sea. Consequently, the bottom was shallower in the 2017 survey than during C. Roden's 1999 survey, possibly by 1 m. The current euphotic depth of 3 m is considerably lower than reported in 1999 (Roden, 1999). C. Roden recalls that, in 1999, Kiltorish Lough was notable as the only *Najas* lake where only with difficulty could he snorkel to the euphotic limit, suggesting a euphotic depth of 7-10 m. He was also impressed by the great clarity of the water, which is no longer the case. A deep hole still occurs in the northern basin, but at present it is dark and muddy.

As in 1999, an Isoetid shore zone with *Eriocaulon* descends to 1 m. This is followed by *Isoetes* sp. to 2 m; below 2 m, a vegetation of *Nitella translucens*, *N. confervacea*, *Potamogeton perfoliatus*, *P. berchtoldii* and

*Najas* extends to the euphotic limit of 3 m. On the sheltered western shore, beds of *Chara aspera* are well-developed between 0.5-1.5 m. *Phragmites* beds also occur in the north-western corner of the lake.

The south-eastern basin is very different: it is shallow (1 m) and sandy and the dominant vegetation is beds of *Chara virgata* (identified as *C. globularis* in 1999) and *C. aspera* with some *Apium inundatum*. *Sparganium* species grow in the connecting channel.



### Water chemistry data

Water quality data for the period 2009 to 2015 were made available by the EPA, for many samples from multiple depths. Values presented and used in assessment are averages of all data.

Parameter	Unit	Kiltooris Lough EPA 2009-2015
Alkalinity	mg/l	28.9
Calcium	mg/l	11.8
Chlorophyll	µg/l	3.7
Colour	Hazen units	48
Conductivity	µS/cm	233
Magnesium	mg/l	4.2
pH		7.4
Potassium	mg/l	1.9
Secchi	m	2.5
Sulphate	mg/l	7.4
Total oxidised nitrogen	mg/l	0.14
Total phosphorus	mg/l	0.009

## Pressures and threats

In 1999, the lake was exceptionally clear with an unusually deep euphotic zone (not unlike Sessiagh Lake). In 2017, the euphotic depth was unexceptional (3 m) and water transparency moderate. Conversations with local residents established that some years previously, land at the southern end of the lake had been sold by the NPWS and the new owner had deepened the northern outflow in order to reduce flooding. This action had exposed part of the lake bed and may have disturbed sediments, thus reducing water clarity. The drainage channel has been raised recently and it is hoped that water level will rise in the future.

The EPA rated the lake as in good ecological status in 2009, 2012 and 2015.

## Conservation condition

Due to lowering of the lake level and decreasing the euphotic depth, much lake bottom habitat was lost, so the overall assessment is *Bad* conservation condition. It should be noted that the lake is still of great conservation value and may improve in future if the drain blockage raises water levels.

Parameter	Target for Good	Kiltooris 2017	Condition
Area of habitat	Stable or increasing	Large decrease	Bad
Deep-water community	Full development	Full development	Good
Number of species	Stable or increase	Stable (31)	Good
Typical species	≥9 indicator species	12	Good
<i>Najas flexilis</i> population	Stable population	Significant decline	Poor
Introduced species	Not present/not impacting on <i>Najas flexilis</i> / deep-water community	Not present	Good
Euphotic depth (m)	≥3	3.0	Good
Colour (Hazen units)	<40	48	Poor
Total phosphorus (TP) (mg/l)	<0.015	0.009	Good
Hydrological regime	<50% <i>Lobelia</i> – <i>Littorella</i> zone exposed in summer	Severe hydrological impacts evident	Bad
<b>Overall assessment</b>			<b>Bad</b>

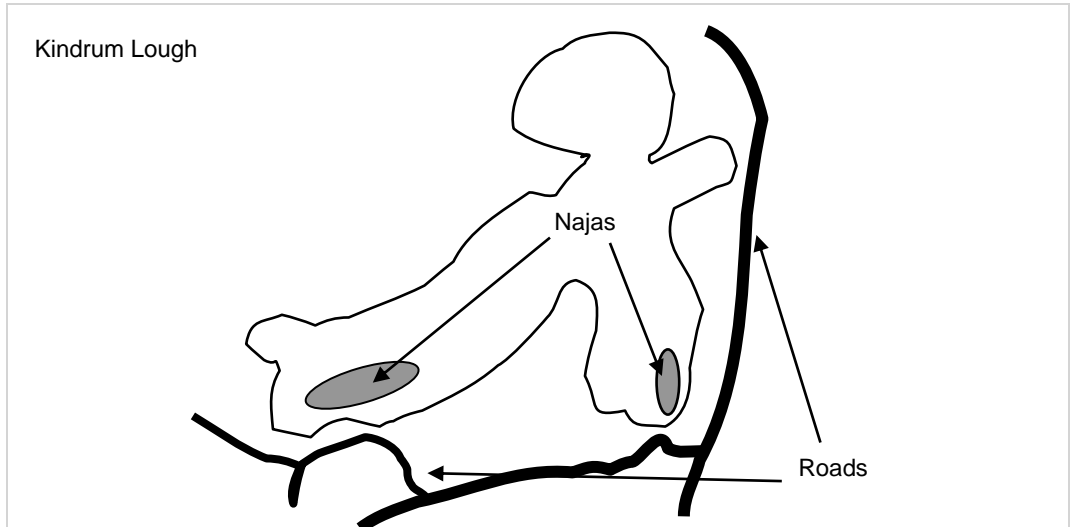
Lough Kindrum, 2016			
Name	Kindrum	Code	KIN
Alternative name(s)			
Grid reference	C1866943076	Max. depth (m)	14 (EPA survey)
County	Donegal	EPA code	38_670
Area (ha)	61	OSi 1:50,000 sheet	2
Maximum length (km)	1.7	Nutrient data	EPA 2009-2015
Altitude (m)	8	SAC	001151, Kindrum Lough SAC
Geology	Marble, schist		
Previous survey	Multiple surveys including Bullock-Webster (1917) (see also Bullock-Webster, 1918; Groves & Bullock-Webster, 1920, 1924a, b), C.D. Preston and N.F. Stewart in 1989, Wingfield <i>et al.</i> (2004), Roden (2004), EPA in 2009, 2012, 2015		
Previous <i>Najas flexilis</i> records	G.R. Bullock-Webster 1916, P.E.P. Metcalfe and R.L. Praeger 1937, J.P.M. Brenan and N.D. Simpson 11/08/1939, R.L. Praeger August 1939, N.F. Stewart 10/08/1989, C.D. Preston and N.F. Stewart 25/08/1989, J. Conaghan and K. Molloy 10/08/1998, R.A. Wingfield 18/08/2000, C. Roden 31/08/2002, 12/09/2002, EPA 22/07/2009, 2015		
Other noteworthy species	<i>Chara curta</i> , <i>Chara rudis</i> , <i>Nitella confervacea</i> , <i>Nitella spanioclema</i>		
Snorkel survey date(s)	17/08/2016	Number of species	26
Surveyors	PM, CR, JR	Alkalinity (mg/l CaCO <sub>3</sub> )	73.0
Number of transects	7	Total phosphorus (mg/l TP)	0.009
Number of relevés	26	Colour (Hazen units)	28
Euphotic depth (m)	3.5	Secchi depth (m)	3.0
<i>Najas flexilis</i>	Present at several stations		
Deep-water vegetation	Partial development		
Noteworthy species	<i>Chara curta</i> , <i>Chara rudis</i> , <i>Najas flexilis</i> , <i>Nitella confervacea</i> , <i>Nitella spanioclema</i>		
Introduced species	<i>Elodea canadensis</i> is present		
Substrates	Gravel, fine mud, bedrock		
Lake score	194	Lake rank	3
Summary	A medium sized lake of great interest as its flora suggests a transition from <i>Najas flexilis</i> -type lake to marl lake. It also contains the populations of <i>Nitella spanioclema</i> , an ill-defined endemic species. While of conservation importance, it is rated poor at present due to the poor development of the deep-water macrophyte community		
CONSERVATION CONDITION	<b>POOR</b>		

### Previous accounts

1. Hart (1898) notes a few records from Kindrum Lough, Bullock-Webster collected charophytes in the lake in 1916-1919 (see Bullock-Webster, 1917, 1918; Groves & Bullock-Webster, 1920, 1924a, b) and also found *Najas flexilis* in 1916 (between 27 July and 2 August) (Bullock-Webster, 1917).
2. C.D. Preston and N.F. Stewart recorded detailed plant lists from Kindrum in 1989 and 1990. Species recorded are shown in the table ('Before this survey'). A number of shore species were not noted in 2016, probably due to different survey methods. However, *Potamogeton pectinatus* was not recorded in 2016.
3. C. Roden examined the lake briefly in 2002 and confirmed *Najas* at two stations, along with a brief description of vegetation zoning (Roden, 2002, 2004). See copy of his report below.
4. The EPA have surveyed the lake on three occasions: 2009, 2012 and 2015. Their results are shown in the sketch map below. Their record for *Potamogeton obtusifolius* has not been confirmed by other surveyors. They located *Najas flexilis* in the north and east of the lake.

See also NPWS (2021b).

## Rodan (2002) data

<b><i>Najas flexilis</i></b>	<b>Discovery series map: 2</b>	<b>Grid reference:</b> C178428
<b>Locality:</b> Kindrum Lough	<b>Vice county:</b> H35	<b>SAC/NHA name &amp; no:</b> 001151
<b>Date:</b> 31/08/2002 & 12/09/2002	<b>Recorder:</b> Cilian Rodan	
<b>Site description:</b> Kindrum Lough is a large lough north of Mulroy Bay. The south-west and south-east corners were examined. Here water depth was less than 3 m and the lake bottom was sandy-mud. The water was quite dark.		
<b>Population:</b> <i>Najas flexilis</i> was found growing in both locations. In the south-west corner, a large population was present at about 3 m depth, while some plants were dredged at a depth of 1.5 m in the south-east corner of the lake.		
<b>Vegetation:</b> The plant was found growing with <i>Nitella flexilis</i> , <i>Callitriche hermaphroditica</i> and <i>Potamogeton berchtoldii</i> at 2-4 m. However some of the bottom was covered with <i>Cladophora</i> species and <i>Elodea canadensis</i> which may have reduced the area available for <i>Najas</i> .		
<b>Management:</b> The lake is managed by an angling club.		
<b>Threats:</b> The presence of <i>Cladophora</i> is of note and may indicate eutrophication. Equally the rather dark water may be due to algal growth.		
<b>Access:</b> By road along the south shore.		
<b>Conservation:</b> The possibility of eutrophication should be investigated by a monitoring programme.		
<b>Remarks:</b> Given the large size of this lake, it is very probable that further extensive populations of <i>Najas</i> occur in other bays.		
		

### Species recorded

The lake has both a population of *Najas flexilis* and several species typical of marl lakes including *Chara curta*, *Chara rudis*; an unusual species combination. In 2016, 26 species were recorded at Kindrum, down from the 35 of previous surveys. The total number of species recorded across all surveys in 37. Species of note include

- *Nitella spanioclema*. This obscure taxon is only known from several lakes in the Fanad peninsula. It was described in the 1920s by Groves and Bullock-Webster (Bullock-Webster, 1919; Groves & Bullock-Webster, 1920) but even today its exact status is not clear. Good material was found in 2016 and notes made on its habitat. Unlike *Nitella flexilis*, which normally grows at depth, *Nitella spanioclema* grows in shallower water in Kindrum.
- *Nitella confervacea* is occasional.
- *Chara curta* is normally a plant of marl lakes, here it grows in shallow water in an un-encrusted form, a similar population occurs in Port Lough.
- *Chara rudis*, like *C. curta*, is normally an indicator of marl lakes, here a small population occurs in the northern bay.

Taxon - Kindrum	Before this survey	In this survey (2016)	Taxon - Kindrum	Before this survey	In this survey (2016)
Charophytes			<i>Isoetes lacustris</i>	1	1
<i>Chara aspera</i>	1		<i>Juncus bulbosus</i>	1	1
<i>Chara curta</i>	1	1	<i>Lemna minor</i>		
<i>Chara globularis</i>		1	<i>Lemna trisulca</i>		
<i>Chara rudis</i>	1	1	<i>Littorella uniflora</i>	1	1
<i>Chara virgata</i>	1	1	<i>Lobelia dortmanna</i>	1	1
<i>Nitella confervacea</i>	1	1	<i>Myriophyllum alterniflorum</i>	1	1
<i>Nitella flexilis</i>			<i>Myriophyllum spicatum</i>	1	1
<i>Nitella gracilis</i>			<i>Najas flexilis</i>	1	1
<i>Nitella opaca</i>			<i>Nuphar lutea</i>		
<i>Nitella spanioclema</i>	1	1	<i>Nymphaea alba</i>	1	
<i>Nitella translucens</i>			<i>Oenanthe fluviatilis</i>		
<i>Tolypella glomerata</i>			<i>Phragmites australis</i>	1	1
<i>Chara cf. muscosa</i>			<i>Pilularia globulifera</i>		
Other algae			<i>Potamogeton alpinus</i>		
<i>Ophrydium versatile</i>			<i>Potamogeton berchtoldii</i>	1	1
Bryophytes			<i>Potamogeton crispus</i>	1	1
<i>Fissidens fontanus</i>			<i>Potamogeton filiformis</i>		
<i>Fontinalis antipyretica</i>	1	1	<i>Potamogeton gramineus</i>	1	1
<i>Sphagnum</i> sp.			<i>Potamogeton lucens</i>	1	1
Vascular Plants			<i>Potamogeton natans</i>	1	
<i>Alisma plantago-aquatica</i>	1		<i>Potamogeton obtusifolius</i>	1	
<i>Apium inundatum</i>	1		<i>Potamogeton pectinatus</i>	1	
<i>Baldellia ranunculoides</i> subsp. <i>ranunculoides</i>	1		<i>Potamogeton perfoliatus</i>	1	1
<i>Baldellia ranunculoides</i> subsp. <i>repens</i>			<i>Potamogeton polygonifolius</i>		
<i>Callitriche brutia</i> subsp. <i>hamulata</i>		1	<i>Potamogeton praelongus</i>	1	1
<i>Callitriche hermaphroditica</i>	1	1	<i>Potamogeton pusillus</i>		
<i>Carex rostrata</i>			<i>Potamogeton × angustifolius</i>		
<i>Ceratophyllum demersum</i>			<i>Potamogeton × nitens</i>	1	
<i>Cladium mariscus</i>	1		<i>Ranunculus</i> sp.		
<i>Elatine hexandra</i>			<i>Schoenoplectus lacustris</i>	1	1
<i>Eleocharis acicularis</i>			<i>Sparganium angustifolium</i>		
<i>Eleocharis multicaulis</i>	1		<i>Sparganium emersum</i>		
<i>Eleocharis palustris</i>			<i>Sparganium erectum</i>		
<i>Eleogiton fluitans</i>			<i>Sparganium natans</i>		
<i>Elodea canadensis</i>	1	1	<i>Subularia aquatica</i>		
<i>Equisetum fluviatile</i>			<i>Typha angustifolia</i>		
<i>Eriocaulon aquaticum</i>			<i>Utricularia</i> sp.	1	1
<i>Hydrilla verticillata</i>			<i>Zannichellia palustris</i>		
<i>Isoetes echinospora</i>					





*Najas flexilis*

The plant occurred in four relevés out of 26 and was not very abundant. C. Roden in 2002 also recorded it in the south-western corner in a slightly different area to the 2016 transect (Roden, 2002, 2004). His record from the south-eastern corner could not be confirmed in 2016.

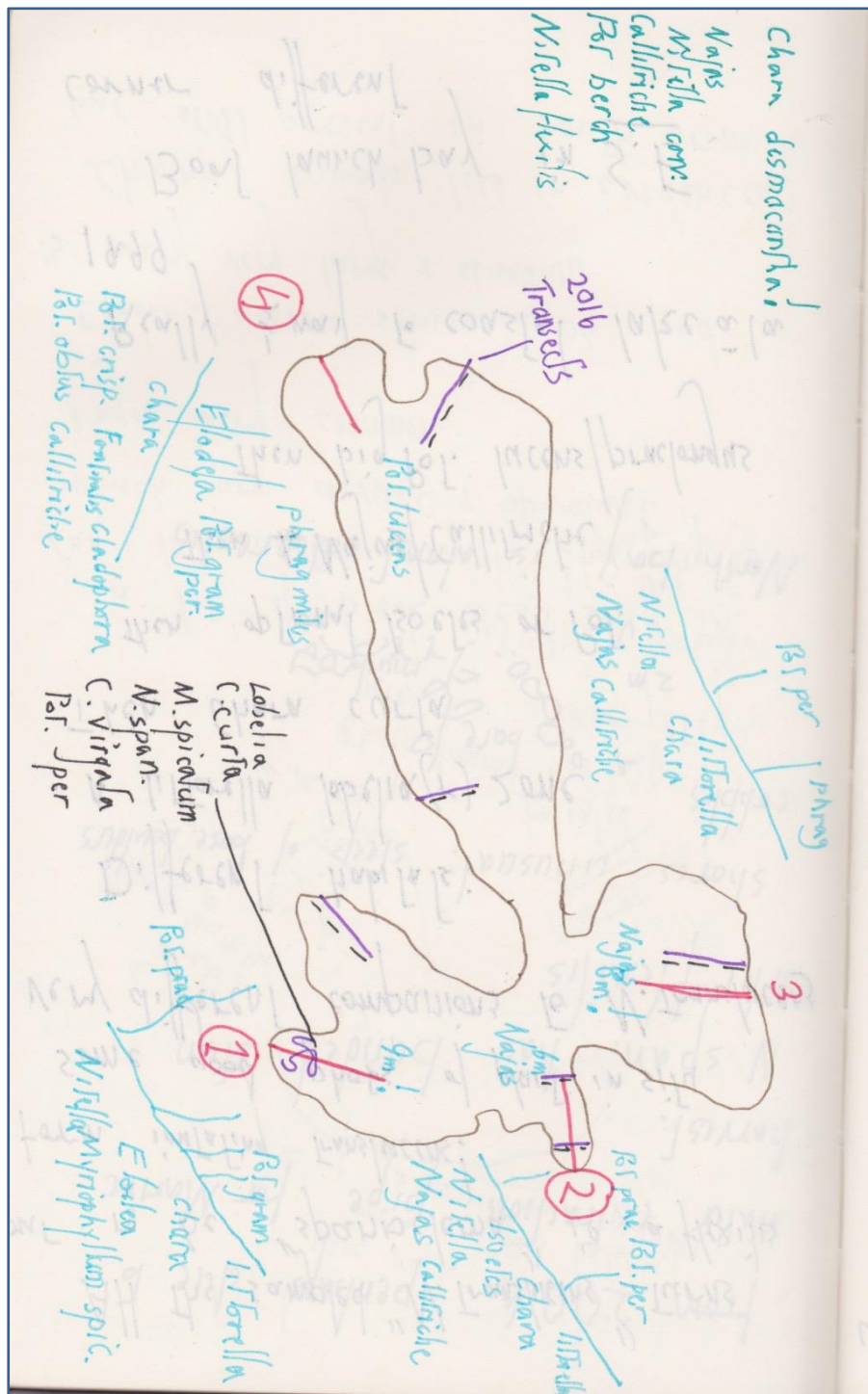


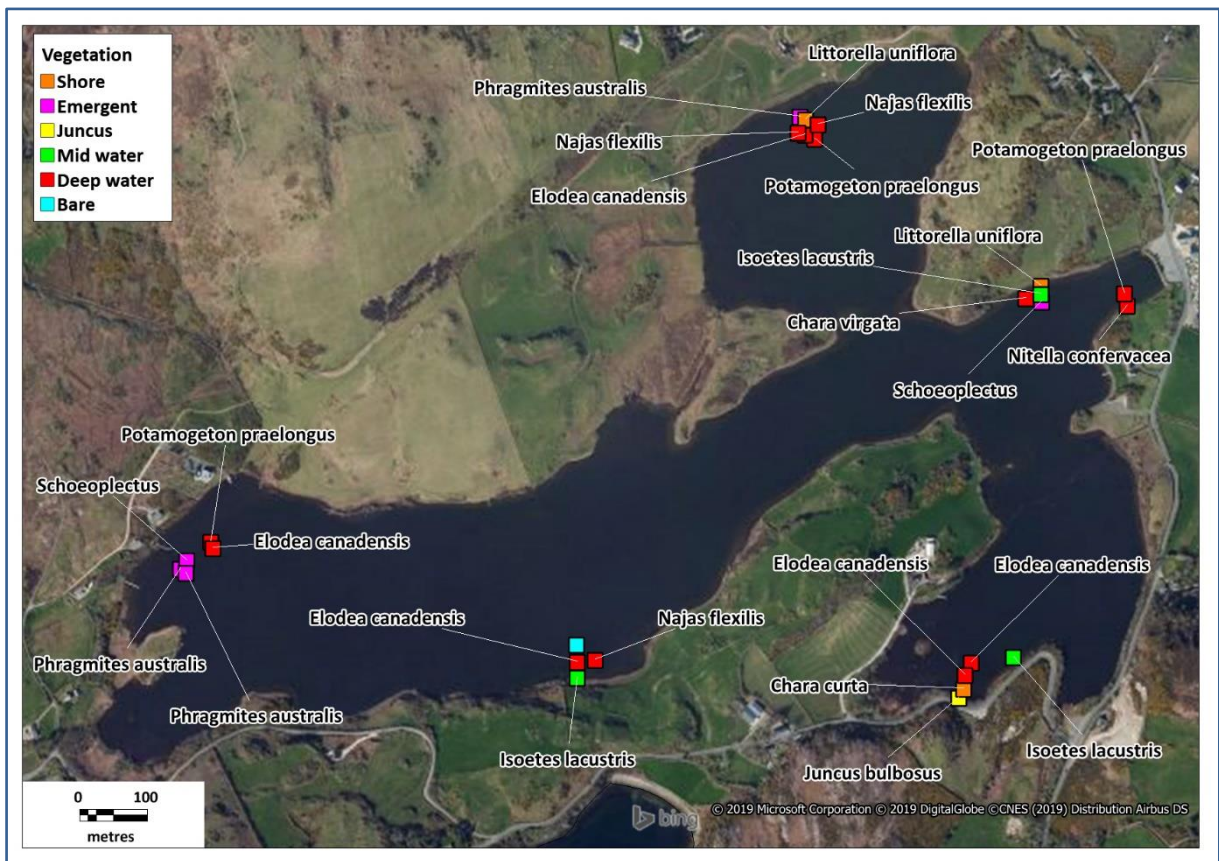
## Vegetation

Kindrum is a mesotrophic lake with several species typical of marl lakes and a very diverse *Potamogeton* flora. More oligotrophic species such as *Lobelia dortmanna* and *Isoetes lacustris* also occur. Most of the shoreline is rocky and slopes steeply with few stands of reeds. Shallower (<2.0 m) areas occur in the north-eastern and south-eastern bays.

Rocky shores support a vegetation of *Littorella*, *Chara curta* and *Lobelia dortmanna*. In deeper silty areas, *Elodea*, *Potamogeton* spp., *Najas flexilis*, *Nitella confervacea* and *N. spaniolema* occur. The water is dark and the euphotic zone rarely exceeds 3.0 m. Drifts of a *Cladophora* sp. occur at depth in some places.

Vegetation map based on EPA data





### Water chemistry data

Water quality data for the period 2009 to 2015 were made available by the EPA, for many samples from multiple depths. Values presented and used in assessment are averages of all data.

Parameter	Unit	Kindrum EPA 2009-2015
Alkalinity	mg/l	73.0
Calcium	mg/l	24.7
Chloride	mg/l	13.95
Chlorophyll	µg/l	6.5
Colour	Hazen units	28.4
Conductivity	µS/cm	281.3
Magnesium	mg/l	6.6
pH		7.9
Potassium	mg/l	2.6
Sulphate	mg/l	10.3
Total oxidised nitrogen	mg/l	0.12
Total phosphorus	mg/l	0.009

### Pressures and threats

Kindrum Lough was only assessed as moderate ecological status in all three WFD sampling rounds (2009, 2011 and 2015). The water is noticeably dark and *Cladophora* occurs on the lake bed at depth. A pipeline for abstraction of freshwater for a salmon hatchery was inserted in the south-eastern Bay since C. Roden's 2002 survey and *Najas flexilis* has gone from this area. No significant changes occurred around the lake between 2005 and 2013. Intensive grassland management continues close to the shore at several points.

## Conservation condition

Kindrum Lough has shown signs of eutrophication for many years. The deep-water vegetation, although present, is not well-developed. Early accounts around 1920 suggest an exceptional example of a *Najas flexilis*-type lake. The lake still retains vegetation and species of note but is not in good condition due to partial absence of the deep-water community.

Parameter	Target for Good	Kindrum 2016	Condition
Area of habitat	Stable or increasing	Stable or increasing	Good
Deep-water community	Full development	Partial	Poor
Number of species	Stable or increase	26% decrease (26)	Bad
Typical species	≥9 indicator species	10	Good
<i>Najas flexilis</i> population	Stable population	Possible decline in extent	Poor
Introduced species	Not present/not impacting on <i>Najas flexilis</i> / deep-water community	Possible impact on <i>Najas flexilis</i> and deep-water community	Good/Poor
Euphotic depth (m)	≥3	3.5	Good
Colour (Hazen units)	<40	28	Good
Total phosphorus (TP) (mg/l)	<0.015	0.009	Good
Hydrological regime	<50% <i>Lobelia</i> – <i>Littorella</i> zone exposed in summer	-	Good
<b>Overall assessment</b>			<b>Poor</b>

Knocka Lough, 2017			
Name	Knocka	Code	KNA
Alternative name(s)			
Grid reference	R1374063275	Max. depth (m)	>5
County	Clare	EPA code	28_67
Area (ha)	33	OSi 1:50,000 sheet	57
Maximum length (km)	1.2	Nutrient data	This survey 24/01/2019, M. Hensey and C. Roden 1999
Altitude (m)	66	SAC	-
Geology	Namurian shale and sandstone		
Previous survey	M. Hensey and C. Roden in 1999		
Previous <i>Najas flexilis</i> records	There were no previous records for <i>Najas flexilis</i> in Knocka Lough		
Other noteworthy species	-		
Snorkel survey date(s)	03/08/2017, 10/08/2017	Number of species	30
Surveyors	PM, CR, JR	Alkalinity (mg/l CaCO <sub>3</sub> )	19.9
Number of transects	4	Total phosphorus (mg/l TP)	0.016
Number of relevés	25	Colour (Hazen units)	83
Euphotic depth (m)	3.0	Secchi depth (m)	-
<i>Najas flexilis</i>	A large population of <i>Najas flexilis</i> was discovered in the eastern sector of the lake		
Deep-water vegetation	Full development		
Noteworthy species	<i>Callitriche hermaphroditica</i> , <i>Elatine hexandra</i> , <i>Isoetes echinospora</i> , <i>Najas flexilis</i> , <i>Nitella confervacea</i> , <i>Potamogeton alpinus</i> As species-rich soft-water lakes are almost unknown in west Clare, the entire flora of the lake is noteworthy		
Introduced species	<i>Elodea canadensis</i> present		
Substrates	Fine mud, sand, cobbles, rock		
Summary	A <i>Najas flexilis</i> -type lake on carboniferous shale in an area remote from other <i>Najas flexilis</i> sites. It has a diverse flora, otherwise uncommon in west Clare. There are some signs of eutrophication but the conservation condition is assessed as <i>Good</i>		
Lake score	198	Lake rank	3
CONSERVATION CONDITION	<b>GOOD</b>		

### Previous accounts

This lake appears to have been unexamined by botanists until 1999, when a local man commissioned Glan Uisce Teo, Furbo, Co. Galway to examine the lake's ecology as he feared it was becoming eutrophic. Ms Mary Hensey measured nitrogen and phosphorus inputs and asked C. Roden to examine the plankton and benthic flora. No snorkelling was undertaken. The brief report made is reproduced below.

### Report by C. Roden from survey by M. Hensey and C. Roden, 1999

*Knocka Lough is a small lake lying on shales and sandstones of the Upper Carboniferous period. The surrounding countryside is or was largely covered in bog or cutaway-bog with very imperfect drainage. One stream enters the lough at the south-eastern corner but it is unclear if this drains into or from the lake. The western end of the lake lies on eroded peatland with protruding pine stumps.*

*The lake was visited on 02/06/1999 and the planktonic algae, benthic plants and emergent plants were examined.*

#### 1) The plankton

A net plankton sample was collected in 1.5 m depth off the car park at the eastern end. The following genera were dominant:

Cyanophyceae or blue green algae: *Coelosphaerium*, *Anabaena*

Chlorophyta or green algae: *Pediastrum*, *Crucigenia*, *Dictyosphaerium*.

## 2) Benthic plants

The lake bottom is a mixture of peat, gravel and sand. The commonest macrophyte on gravel is *Isoetes lacustris* with some *Littorella uniflora* close to the shore and rare plants of *Myriophyllum alterniflorum*. Two pond weeds, *Potamogeton perfoliatus* and *P. alpinus*, were found as well as a charophyte *Nitella flexilis* on sand.

Nearly all the benthic plants were covered by a blanket of green algae, chiefly *Cladophora* sp.

## 3) Emergent plants

In general most of the lake shore is stony with very few marginal plants. An exception to this, is the area around the stream entrance. Here an outer ring of Common Reed (*Phragmites australis*) surrounds a floating scraw of vegetation with much *Agrostis stolonifera*, *Typha latifolia*, *Carex rostrata*, *Narsturtium officinale* agg., *Mentha aquatica*, *Galium palustre* and *Cardamine pratense*.

At the western end, *Phragmites australis* and *Nuphar lutea* are found growing on submerged peat.

## Evaluation

The lake is unusual because of a marked contrast between the different types of vegetation. The plankton, which is dominated by green and blue green algae, is typical of a eutrophic lake. However the benthic flora, which is dominated by *Isoetes lacustris*, is typical of a very oligotrophic lake. The persistent blanket of *Cladophora* suggests recent eutrophication. The absence of marginal vegetation is again typical of an oligotrophic lake. Therefore the scraw of *Agrostis stolonifera* and other species around the stream entrance is peculiar, as such development of plants requires a substantial nutrient input. The most likely explanation of these contrasting vegetation types is that the lake was originally a nutrient-poor or oligotrophic lake but it is now undergoing eutrophication or nutrient enrichment. Typically the plankton community is the first vegetation type to reflect this change but the development of the *Cladophora* blanket is also a symptom. Equally the scraw at the mouth of the stream is probably caused by a heavy nutrient input.

Both *Isoetes lacustris* and *Potamogeton alpinus* are rare plants in County Clare. If eutrophication continues, it is quite possible that they will become extinct in the lake. Thus the eutrophication or nutrient pollution of the lake is affecting both the natural history and conservation value of the lake, as well as its angling potential.

Based on the co-occurrence of *Potamogeton perfoliatus* and *Isoetes lacustris*, the lake was identified as a possible *Najas flexilis* site and visited on a reconnaissance survey on 03/08/2017. A full survey was undertaken on 10/08/2017.

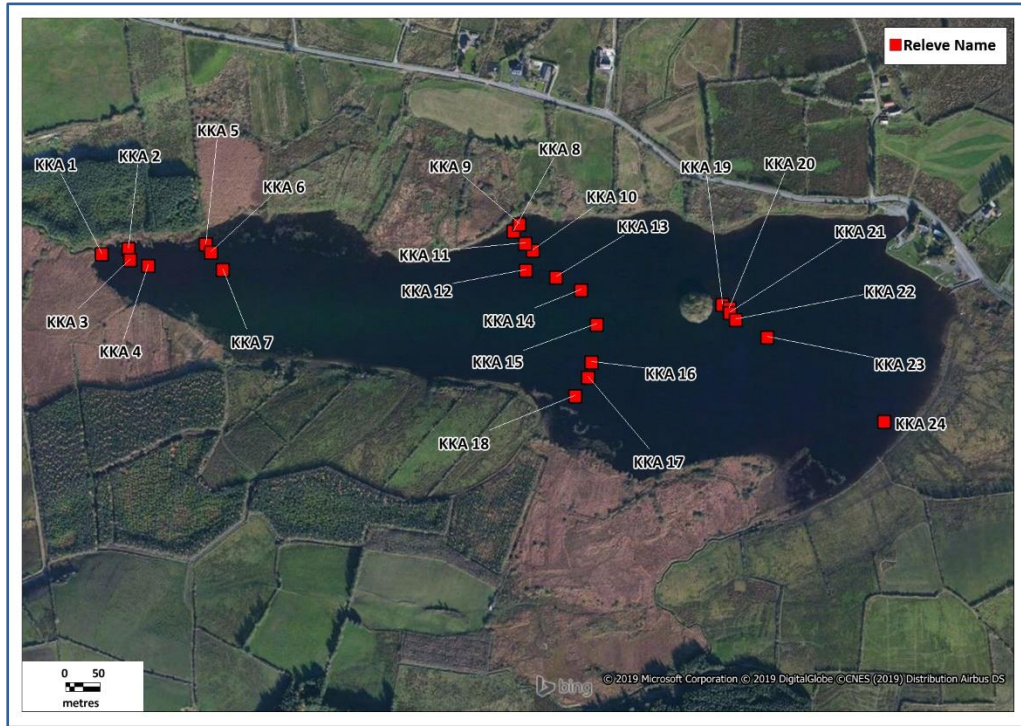
## Species recorded

In 2017, 30 species were recorded from Knocka Lough, bringing the total of species known from the lake to 31. Most are widespread in soft-water lakes in Connemara, Kerry and Donegal but have not been recorded in or are very rare in west Clare, e.g. *Callitriche hermaphroditica*, *Elatine hexandra*, *Potamogeton alpinus*, while *Najas flexilis*, *Isoetes echinospora* and *Nitella confervacea* are nationally scarce.

Taxon - Knocka	Before this survey	In this survey (2017)	Taxon - Knocka	Before this survey	In this survey (2017)
Charophytes			<i>Isoetes lacustris</i>	1	1
<i>Chara aspera</i>			<i>Juncus bulbosus</i>		
<i>Chara curta</i>			<i>Lemna minor</i>		1
<i>Chara globularis</i>			<i>Lemna trisulca</i>		
<i>Chara rudis</i>			<i>Littorella uniflora</i>	1	1
<i>Chara virgata</i>		1	<i>Lobelia dortmanna</i>		
<i>Nitella confervacea</i>		1	<i>Myriophyllum alterniflorum</i>	1	1
<i>Nitella flexilis</i>	1		<i>Myriophyllum spicatum</i>		
<i>Nitella gracilis</i>			<i>Najas flexilis</i>		1
<i>Nitella opaca</i>			<i>Nuphar lutea</i>	1	1
<i>Nitella translucens</i>		1	<i>Nymphaea alba</i>		
<i>Tolypella glomerata</i>			<i>Oenanthe fluviatilis</i>		
<i>Chara cf. muscosa</i>			<i>Phragmites australis</i>	1	1
Other algae			<i>Pilularia globulifera</i>		
<i>Ophrydium versatile</i>			<i>Potamogeton alpinus</i>	1	1
Bryophytes			<i>Potamogeton berchtoldii</i>		1
<i>Fissidens fontanus</i>			<i>Potamogeton crispus</i>		
<i>Fontinalis antipyretica</i>		1	<i>Potamogeton filiformis</i>		
<i>Sphagnum</i> sp.			<i>Potamogeton gramineus</i>		
Vascular Plants			<i>Potamogeton lucens</i>		
<i>Alisma plantago-aquatica</i>		1	<i>Potamogeton natans</i>		1
<i>Apium inundatum</i>		1	<i>Potamogeton obtusifolius</i>		1
<i>Baldellia ranunculoides</i> subsp. <i>ranunculoides</i>		1	<i>Potamogeton pectinatus</i>		
<i>Baldellia ranunculoides</i> subsp. <i>repens</i>			<i>Potamogeton perfoliatus</i>	1	1
<i>Callitriche brutia</i> subsp. <i>hamulata</i>		1	<i>Potamogeton polygonifolius</i>		
<i>Callitriche hermaphroditica</i>		1	<i>Potamogeton praelongus</i>		
<i>Carex rostrata</i>	1	1	<i>Potamogeton pusillus</i>		
<i>Ceratophyllum demersum</i>			<i>Potamogeton × angustifolius</i>		
<i>Cladium mariscus</i>			<i>Potamogeton × nitens</i>		
<i>Elatine hexandra</i>		1	<i>Ranunculus</i> sp.		
<i>Eleocharis acicularis</i>		1	<i>Schoenoplectus lacustris</i>		
<i>Eleocharis multicaulis</i>		1	<i>Sparganium angustifolium</i>		1
<i>Eleocharis palustris</i>			<i>Sparganium emersum</i>		1
<i>Eleogiton fluitans</i>			<i>Sparganium erectum</i>		1
<i>Elodea canadensis</i>		1	<i>Sparganium natans</i>		
<i>Equisetum fluviatile</i>		1	<i>Subularia aquatica</i>		
<i>Eriocaulon aquaticum</i>			<i>Typha angustifolia</i>		
<i>Hydrilla verticillata</i>			<i>Utricularia</i> sp.		
<i>Isoetes echinospora</i>			<i>Zannichellia palustris</i>		

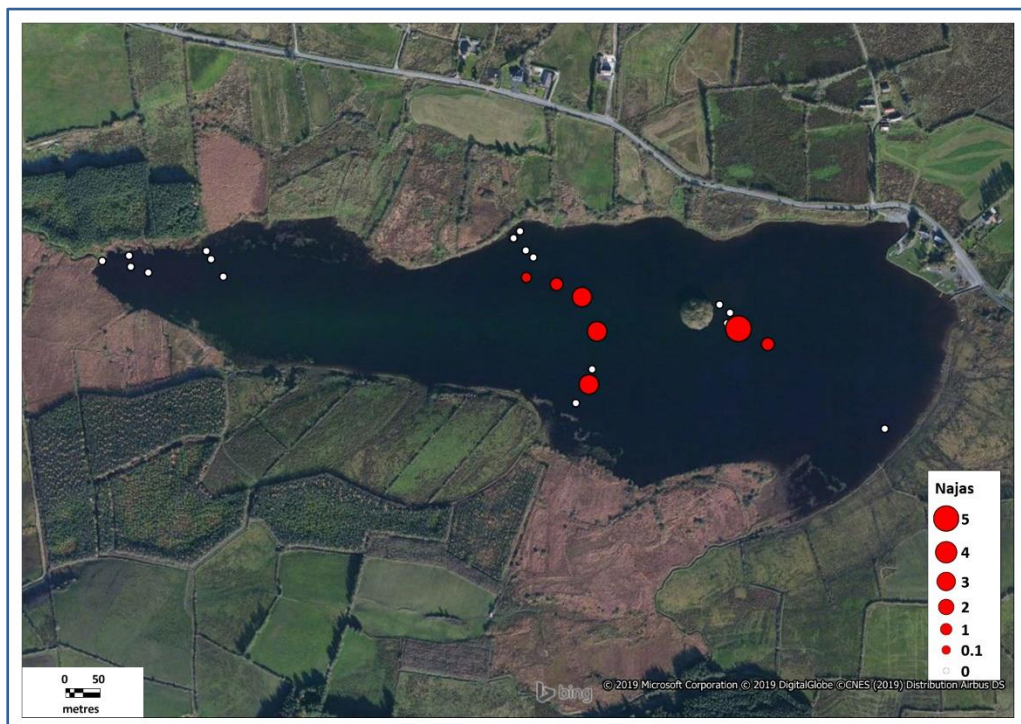
- *Callitriche hermaphroditica* is commoner in the north of Ireland, with only a few records in Munster or Connemara where it can occur in *Najas* lakes (Maumeen, Ballynakill Connemara, Leane). It occurs in the eastern sector at 1-2.5 m depth
- *Elatine hexandra* only known from a few sites in Clare. It occurs throughout the lake to 1 m depth
- *Potamogeton alpinus* occurs in water <1 m depth throughout the lake
- *Isoetes echinospora* occurs in the eastern sector and might be more widespread. It is probably under-recorded in Irish habitats
- *Najas flexilis* occurs (see below).

- *Nitella confervacea* is known at present from c. 25 hectads and this record is nearly 100 km from the nearest known stations in Kerry and Connemara. It occurs at the eastern end of the lake below 2 m depth.



### *Najas flexilis*

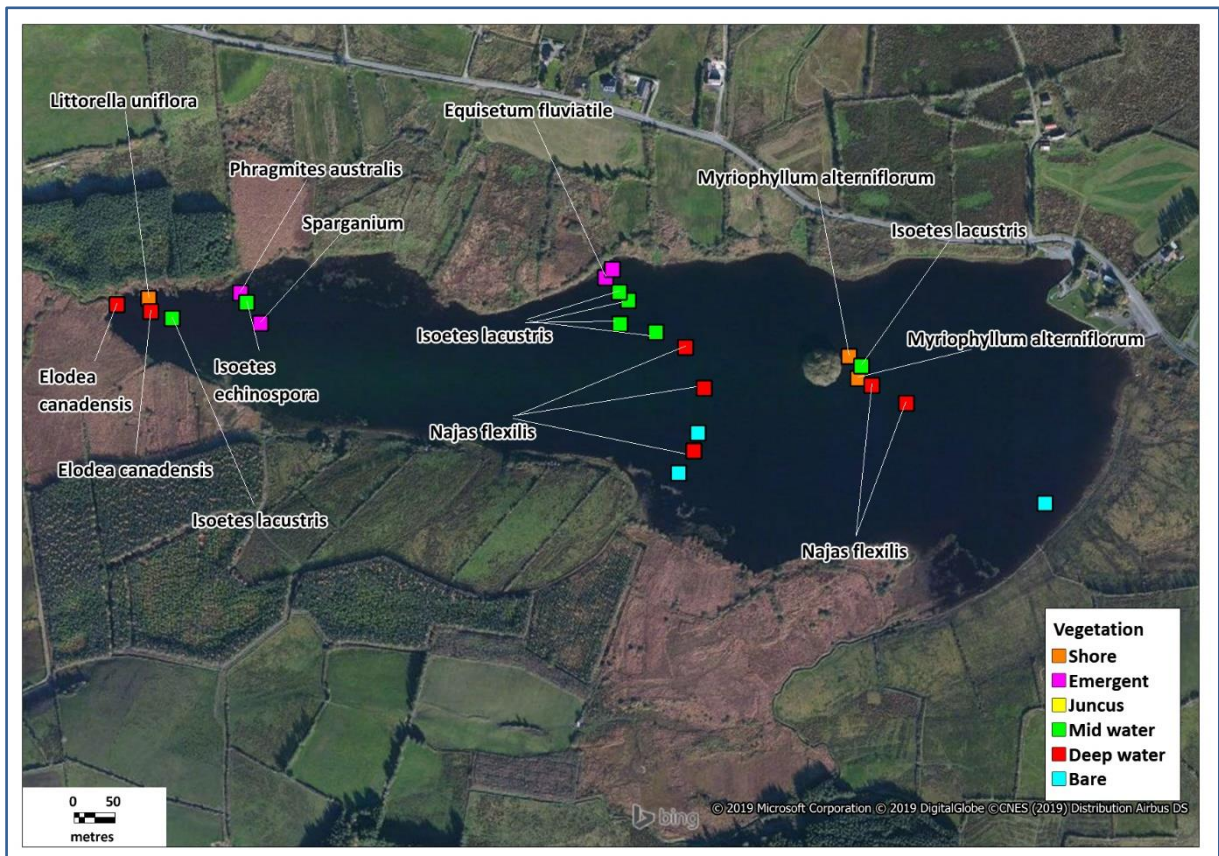
The plant was recorded in the eastern section of the lake, especially around the small island, with a depth range from 2-3m, at densities up to 80% cover. The plant grows on reddish silt. It appears the plant occurs throughout the lake except the western end. The plant grows widely at depth and is estimated to cover an area of about 7 ha. The deep community it occurs in is rich with *Callitriche hermaphroditica*, *Nitella confervacea*, *Potamogeton berchtoldii*, *P. perfoliatus* and *Isoetes sp.* Threats to the population are similar to those on the lake.





## Vegetation

Knocka Lough is a west to east aligned lake with both peat, rock and soft silt in its basin. Consequently there is a variety of vegetation types. In the west, emergent species (*Nuphar lutea*, *Equisetum fluviatile*) near the shore are followed by *Elodea*, *Lemma trisulca*, *Potamogeton alpinus*, *P. obtusifolius* and *Sparganium angustifolium* on peat, while *Isoetes* occurs on mineral surfaces. Further east, on more exposed shores, *Littorella* and *Isoetes* are dominant with some emergents (*Eleocharis palustris* and *Equisetum fluviatile*). *Isoetes lacustris* (and some *I. echinospora*) are dominant to 2.0 m depth with several associates (*Elodea*, *P. obtusifolius*, *Chara virgata*). Below 2 m, *Najas flexilis* is common with species including *Nitella confervacea*, *C. hermaphroditica*, *P. berchtoldii* and *P. perfoliatus*.



## Water chemistry data

Water samples were taken on a single occasion on the 24 January 2019 as part of this survey. Data are also available from samples taken as part of survey by M. Hensey and C. Roden on 24/08/1999.

Parameter	Unit	Knocka This survey	Knocka 1999
Alkalinity	mg/l	19.9	
Calcium	mg/l	10	
Chloride	mg/l	22	
Chlorophyll	µg/l	2.67	3.5
Colour	Hazen units	83.4	
Conductivity	µS/cm	143	
pH		7.2	7.31
Total oxidised nitrogen	mg/l		0.005
Total phosphorus	mg/l	0.016	

## Pressures and threats

The lake was first studied because of fears of pollution from nearby agriculture. In 1999, there was a significant quantity of *Cladophora* fouling and other evidence of eutrophication. Almost 20 years later the threat does not seem as obvious but blanketing algae were again noted in 2017. The presence of *Lemna trisulca*, a rare species in *Najas flexilis* lakes, may indicate some eutrophication at the western end of the lake. Aerial photos show extensive forestry planting since 1995 in the vicinity of the lake. This activity may have caused the *Cladophora* bloom noted in 1999. The very small catchment of the lake may help to protect it from severe eutrophication. The lake, given its great conservation importance, should be monitored in future.

No other threats were noted however the lake lacks any statutory protection.

## Conservation condition

Knocka is an exceptionally interesting lake, but there are some indicators of eutrophication. The single colour reading (in winter) was very high and euphotic depth was not exceptional. Nevertheless at present the lake is rated *Good*.

Parameter	Target for Good	Knocka 2017	Condition
Area of habitat	Stable or increasing	Stable or increasing	Good
Deep-water community	Full development	Full development	Good
Number of species	Stable or increase	Increase (30)	Good
Typical species	≥9 indicator species	10	Good
<i>Najas flexilis</i> population	Stable population	First record	Good
Introduced species	Not present/not impacting on <i>Najas flexilis</i> / deep-water community	Not impacting on <i>Najas flexilis</i> or deep-water community	Good
Euphotic depth (m)	≥3	3.0	Good
Colour (Hazen units)	<40	83	Bad
Total phosphorus (TP) (mg/l)	<0.015	0.016	Poor
Hydrological regime	<50% <i>Lobelia – Littorella</i> zone exposed in summer	-	Good
<b>Overall assessment</b>			<b>Good</b>

Lough Leane, 2016			
Name	Leane	Code	LEA
Alternative name(s)			
Grid reference	V9342488845	Max. depth (m)	67
County	Kerry	EPA code	22_185
Area (ha)	1,952	OSi 1:50,000 sheet	78
Maximum length (km)	8	Nutrient data	EPA 2009-2015, Wingfield 2000, AFF 1973/4
Altitude (m)	17	SAC	000365, Killamey National Park, Macgillycuddy's Reeks and Caragh River Catchment SAC
Geology	Old Red Sandstone and Carboniferous limestone		
Previous survey	Multiple surveys including Linton (1886), Scully (1888, 1916), FitzGerald & Preston (1994), Wingfield <i>et al.</i> (2004), C. Roden in 2004-05, Murphy & Roden (2013, 2019), EPA in 2008, 2011 and 2014, and surveys by NPWS staff		
Previous <i>Najas flexilis</i> records	First recorded in Leane by Rev. E.F. Linton 30/07/1886. Multiple records 1886-1906, particularly by R.W. Scully. N.D. Simpson 07/08/1935, A. Casement 28/10/1976, R. FitzGerald and C.D. Preston 29/07/1994, R.A. Wingfield 18/08/2000, C. Roden 13/09/2005, EPA 2010, and others		
Other noteworthy species	<i>Baldellia ranunculoides</i> subsp. <i>repens</i> , <i>Callitriche hermaphroditica</i> , <i>Eleocharis acicularis</i> , <i>Isoetes echinospora</i> , <i>Nitella conferva</i> , <i>Pilularia globulifera</i> , <i>Potamogeton praelongus</i> , <i>Subularia aquatica</i>		
Snorkel survey date(s)	05/09/2018	Number of species	31
Surveyors	PM, CR, JR	Alkalinity (mg/l CaCO <sub>3</sub> )	22.6
Number of transects	4	Total phosphorus (mg/l TP)	0.010
Number of relevés	14	Colour (Hazen units)	40
Euphotic depth (m)	2.8	Secchi depth (m)	-
<i>Najas flexilis</i>	Almost extinct, one plant seen in 2018 and 2019		
Deep-water vegetation	Nearly absent		
Noteworthy species	<i>Baldellia ranunculoides</i> subsp. <i>repens</i> , <i>Callitriche hermaphroditica</i>		
Introduced species	<i>Elodea canadensis</i> present. <i>Nymphoides peltata</i> also occurs		
Substrates	Rock, gravel, silt		
Summary	Formerly, one of the best and largest example of a <i>Najas flexilis</i> lake in Ireland, the site is now seriously impacted with loss of characteristic species and habitats, due to eutrophication		
Lake score	145	Lake rank	4
CONSERVATION CONDITION	<b>BAD</b>		

### Previous accounts

1. Lough Leane has been studied since the mid-19<sup>th</sup> century, and *Najas flexilis* was first recorded in 1886 by Linton (1886). Scully (1916) summarised the floristics of the lake up to 1914. Nearly all the currently known flora had been recorded by this time, as well as some species that have not been seen for some time such as *Nitella conferva*, *Potamogeton praelongus*, *Subularia aquatica* or *Chara aspera*.
2. Because of eutrophication issues, many studies of Lough Leane were conducted from 1970 onwards but no vegetation studies were undertaken until 1994 when R. FitzGerald and C.D. Preston relocated *Najas flexilis* at several stations in the northern and eastern shores of the lake (FitzGerald & Preston, 1994).
3. In 2000, R. Wingfield recorded *Najas flexilis* and other species and classified Lough Leane as eutrophic relative to other Irish and Scottish sites (Wingfield *et al.*, 2004).
4. C. Roden examined two locations in 2004-05 in the north-west and south-east of the lake and found *Najas flexilis* in both places, along with associates such as *Isoetes lacustris*, *Nitella translucens*, *Potamogeton perfoliatus* and *Elatine hexandra*.

5. The EPA surveyed the lake on three occasions, 2007, 2010 and 2013. They noted a euphotic depth of 2.8-3.0 m and recorded most of the common species in the lake, including one record for *Najas flexilis* in the 2010 survey.
6. In 2013, C. Roden and P. Murphy undertook a general survey for *Najas flexilis* within the lake (Murphy & Roden, 2013). They examined stations in the north-west, north, Ross Island area, Glena Bay and Castlough Bay and recorded the species and associates in the north-west and east of the lake.

See also NPWS (2017d, e).



### Species recorded

A total of over 43 species has been recorded from Lough Leane, however in 2013-18 only 31 species were recorded. This partly reflects the very large area of the lake, but may also reflect declining water quality with the apparent loss of species such as *Subularia aquatica* and *Potamogeton praelongus*.

- *Baldellia ranunculoides* subsp. *repens*. This very distinct stoloniferous taxon is only known from Caragh, Leane, Muckcross and the Long Range. It has been confused with *Luronium natans* but on-growing of material to flowering by C. Roden shows it is undoubtedly *Baldellia ranunculoides* subsp. *repens*. Its Irish distribution has yet to be determined but at present it appears confined to *Najas flexilis*-type lakes. It forms large mats, similar to *Eriocaulon* on sand or silt.
- *Callitriche hermaphroditica* is common further north but is very rare in Munster and is frequently an associate of *Najas flexilis*.

Taxon - Leane	Before this survey	In this survey (2016)	Taxon - Leane	Before this survey	In this survey (2016)
Charophytes			<i>Isoetes lacustris</i>	1	1
<i>Chara aspera</i>	1		<i>Juncus bulbosus</i>	1	1
<i>Chara curta</i>			<i>Lemna minor</i>		
<i>Chara globularis</i>			<i>Lemna trisulca</i>		
<i>Chara rudis</i>			<i>Littorella uniflora</i>	1	1
<i>Chara virgata</i>	1	1	<i>Lobelia dortmanna</i>	1	1
<i>Nitella confervacea</i>	1		<i>Myriophyllum alterniflorum</i>	1	1
<i>Nitella flexilis</i>	1	1	<i>Myriophyllum spicatum</i>		
<i>Nitella gracilis</i>			<i>Najas flexilis</i>	1	1
<i>Nitella opaca</i>			<i>Nuphar lutea</i>	1	1
<i>Nitella translucens</i>	1	1	<i>Nymphaea alba</i>	1	1
<i>Tolypella glomerata</i>			<i>Oenanthe fluviatilis</i>		
<i>Chara cf. muscosa</i>			<i>Phragmites australis</i>	1	1
Other algae			<i>Pilularia globulifera</i>	1	
<i>Ophrydium versatile</i>			<i>Potamogeton alpinus</i>	1	1
Bryophytes			<i>Potamogeton berchtoldii</i>	1	1
<i>Fissidens fontanus</i>	1	1	<i>Potamogeton crispus</i>	1	1
<i>Fontinalis antipyretica</i>	1	1	<i>Potamogeton filiformis</i>		
<i>Sphagnum</i> sp.			<i>Potamogeton gramineus</i>	1	1
Vascular Plants			<i>Potamogeton lucens</i>	1	
<i>Alisma plantago-aquatica</i>			<i>Potamogeton natans</i>	1	1
<i>Apium inundatum</i>	1	1	<i>Potamogeton obtusifolius</i>	1	1
<i>Baldellia ranunculoides</i> subsp. <i>ranunculoides</i>	1	1	<i>Potamogeton pectinatus</i>		
<i>Baldellia ranunculoides</i> subsp. <i>repens</i>	1	1	<i>Potamogeton perfoliatus</i>	1	1
<i>Callitriche brutia</i> subsp. <i>hamulata</i>	1		<i>Potamogeton polygonifolius</i>		
<i>Callitriche hermaphrodita</i>	1	1	<i>Potamogeton praelongus</i>	1	
<i>Carex rostrata</i>			<i>Potamogeton pusillus</i>	1	1
<i>Ceratophyllum demersum</i>	1	1	<i>Potamogeton × angustifolius</i>	1	
<i>Cladium mariscus</i>			<i>Potamogeton × nitens</i>		
<i>Elatine hexandra</i>	1	1	<i>Ranunculus</i> sp.		
<i>Eleocharis acicularis</i>	1		<i>Schoenoplectus lacustris</i>	1	
<i>Eleocharis multicaulis</i>	1		<i>Sparganium angustifolium</i>	1	
<i>Eleocharis palustris</i>			<i>Sparganium emersum</i>		
<i>Eleogiton fluitans</i>		1	<i>Sparganium erectum</i>		
<i>Elodea canadensis</i>	1	1	<i>Sparganium natans</i>		
<i>Equisetum fluviatile</i>			<i>Subularia aquatica</i>	1	
<i>Eriocaulon aquaticum</i>			<i>Typha angustifolia</i>		
<i>Hydrilla verticillata</i>			<i>Utricularia</i> sp.		
<i>Isoetes echinospora</i>	1	1	<i>Zannichellia palustris</i>		

### *Najas flexilis*

Despite the eutrophication problems of Lough Leane, *Najas flexilis* has been recorded on many occasions since 1886, but the population in 2018 was reduced to a few plants at a single station in Victoria Bay where it was found by Mr Seán Forde of the NPWS. Given the size of the lake and the widespread distribution of the species, the total population of *Najas flexilis* is potentially very large. Equally in certain years, such as 2018, the population is critically small.

### Vegetation

Lough Leane is the largest lake containing *Najas flexilis* in Ireland (unless a single record from Lough Corrib is confirmed). It lies on the border between Old Red Sandstone and Carboniferous limestone. It

has a maximum depth of 67 m, so vegetation is confined to shallower areas especially on the eastern shore. Shore lines are very varied ranging from steep cobble shores to sheltered sandy bays. Euphotic depth in 2018 was 2.8 m maximum.

Cobble shores have an Isoetid vegetation with *Littorella* and *Isoetes lacustris*, while sheltered areas have *Phragmites* with *Potamogeton* spp. and *Myriophyllum alterniflorum*. *Isoetes* spp. are common below 1 m, sometimes along with *Chara virgata* or *C. hermaphroditica* and *P. perfoliatus*.

In 2013, a deeper vegetation of *Nitella flexilis*, *Nitella translucens*, *Potamogeton berchtoldii* and *Najas flexilis* was recorded at several stations, but in 2018 this deeper vegetation was not noted and *Najas flexilis* was only recorded in one location in the entire lake.



### Water chemistry data

Water quality data for the period 2009 to 2015 were made available by the EPA, for many samples from multiple depths. Values presented and used in assessment are averages of all data. An Foras Forbartha data for the lake in November 1973 and June 1974 (Flanagan & Toner, 1975) and from R. Wingfield's survey in 2000 (Wingfield *et al.*, 2004) are given for comparison.

Parameter	Unit	Lough Leane EPA 2009-2015	Lough Leane Wingfield 2000	Lough Leane An Foras Forbartha 1973/4
Alkalinity	mg/l	22.6	30.6	27.5
Calcium	mg/l	8.6		11.42
Chloride	mg/l	15.97		15.5
Chlorophyll	µg/l	4.24		3.15
Colour	Hazen units	40.1		22.5
Conductivity	µS/cm	90	143	100
Magnesium	mg/l	1.9		2.08
pH		7.35	7.11	7.4
Potassium	mg/l	0.74		0.75
Secchi	m	3.1		4.0
Sulphate	mg/l	3.6		2
Total oxidised nitrogen	mg/l	0.31		0.88
Total phosphorus	mg/l	0.0097		0.056

### Pressures and threats

Overall, the vegetation and flora of Lough Leane has declined since the 19<sup>th</sup> century. This is shown by the disappearance of nationally scarce species such as *Subularia* or *Nitella confervacea*. The lake had severe eutrophication problems in the 20<sup>th</sup> century. These have been partly improved by sewage treatment before discharge into the lake, but blooms are still an occasional problem such as in 2018 when a green blanket of dead algae was noted at depth. This decaying bloom probably explained the absence of the deep-water community and *Najas flexilis*. The EPA rates the lake as of good WFD status. The 2018 survey was followed by further searches in 2019 by C. Roden and P. Murphy, and these revealed a single plant at the north-west corner of the lake. *Najas flexilis* was not found in other locations examined. The future of *Najas flexilis*, in a site that once contained the species' largest Irish population, must be deemed to be very uncertain unless practical steps are taken to reduce eutrophication in the very near future.

### Conservation condition

The lake was re-examined in September 2019 (Roden & Murphy, 2019). Fewer than five plants of *Najas flexilis* was found (at Tommies East) and, in most places, euphotic depth was shallow (2.0 m) and diminished species numbers were found. In Ross Bay no benthic vegetation was recorded. A preliminary analysis of these results rates the lake as unfavourable *Bad*. Unless more stringent action is taken to prevent eutrophication, Lough Leane will soon lose nearly all the unusual aquatic macrophytes once known to grow there. This event must significantly devalue the area's reputation for natural beauty and biodiversity, so that in future it risks becoming more an out-worn cliché than an ongoing reality.

Parameter	Target for Good	Lough Leane 2016 (and 2019)	Condition
Area of habitat	Stable or increasing	Decreasing	Poor/Bad
Deep-water community	Full development	Nearly absent	Bad
Number of species	Stable or increase	26% decrease (31)	Bad
Typical species	≥9 indicator species	13	Good
<i>Najas flexilis</i> population	Stable population	Significant decline	Bad
Introduced species	Not present/not impacting on <i>Najas flexilis</i> / deep-water community	not impacting	Good
Euphotic depth (m)	≥3	2.8	Poor
Colour (Hazen units)	<40	40	Poor
Total phosphorus (TP) (mg/l)	<0.015	0.01	Good
Hydrological regime	<50% <i>Lobelia</i> – <i>Littorella</i> zone exposed in summer	-	Good
<b>Overall assessment</b>			<b>Bad</b>

Long Range, 2016				
Name	Long Range		Code	LOR
Alternative name(s)				
Grid reference	V9328283637	Max. depth (m)		
County	Kerry	EPA code	22_187	
Area (ha)	18	OSi 1:50,000 sheet	78	
Maximum length (km)	1.1	Nutrient data	EPA 2009-2015	
Altitude (m)	20	SAC	000365, Killarney National Park, Macgillycuddy's Reeks and Caragh River Catchment SAC	
Geology	Old red sandstone			
Previous survey	FitzGerald & Preston (1994), Roden & Murphy (2014)			
Previous <i>Najas flexilis</i> records	R. FitzGerald and C.D. Preston 26/07/1994, C. Roden and P. Murphy 05/09/2014			
Other noteworthy species	<i>Baldellia ranunculoides</i> subsp. <i>repens</i> , <i>Isoetes echinospora</i> , <i>Pilularia globulifera</i>			
Snorkel survey date(s)	08/09/2016	Number of species	28	
Surveyors	PM, CR, JR	Alkalinity (mg/l CaCO <sub>3</sub> )	5.4	
Number of transects	6	Total phosphorus (mg/l TP)	0.008	
Number of relevés	19	Colour (Hazen units)	30	
Euphotic depth (m)	2.9	Secchi depth (m)	3	
<i>Najas flexilis</i>	Large population in the lake			
Deep-water vegetation	Full development			
Noteworthy species	<i>Baldellia ranunculoides</i> subsp. <i>repens</i> , <i>Isoetes echinospora</i> , <i>Najas flexilis</i> , <i>Pilularia globulifera</i>			
Introduced species	<i>Elodea canadensis</i> present			
Substrates	Gravel, fine mud, bedrock			
Summary	A long narrow water body on Old Red Sandstone, with a largely oligotrophic flora of Isoetids and <i>Juncus bulbosus</i> . There is an appreciable flow of water through the Long Range. Some scarce species such as <i>Pilularia globulifera</i> and <i>Nitella confervacea</i> occur, as well as a population of <i>Najas flexilis</i> . There are no major threats, with the exception of the recent fires in the watershed.			
Lake score	166	Lake rank	3	
CONSERVATION CONDITION	<b>GOOD</b>			

### Previous accounts

1. The Long Range has been visited by many botanists in the last 150 years. Most of the unusual species were known by the time of Scully (1916).
2. *Najas flexilis*, however, was first recorded in 1994 by R. FitzGerald and C.D. Preston (FitzGerald & Preston, 1994).
3. Roden & Murphy (2014) confirmed the plant's location (see account below).

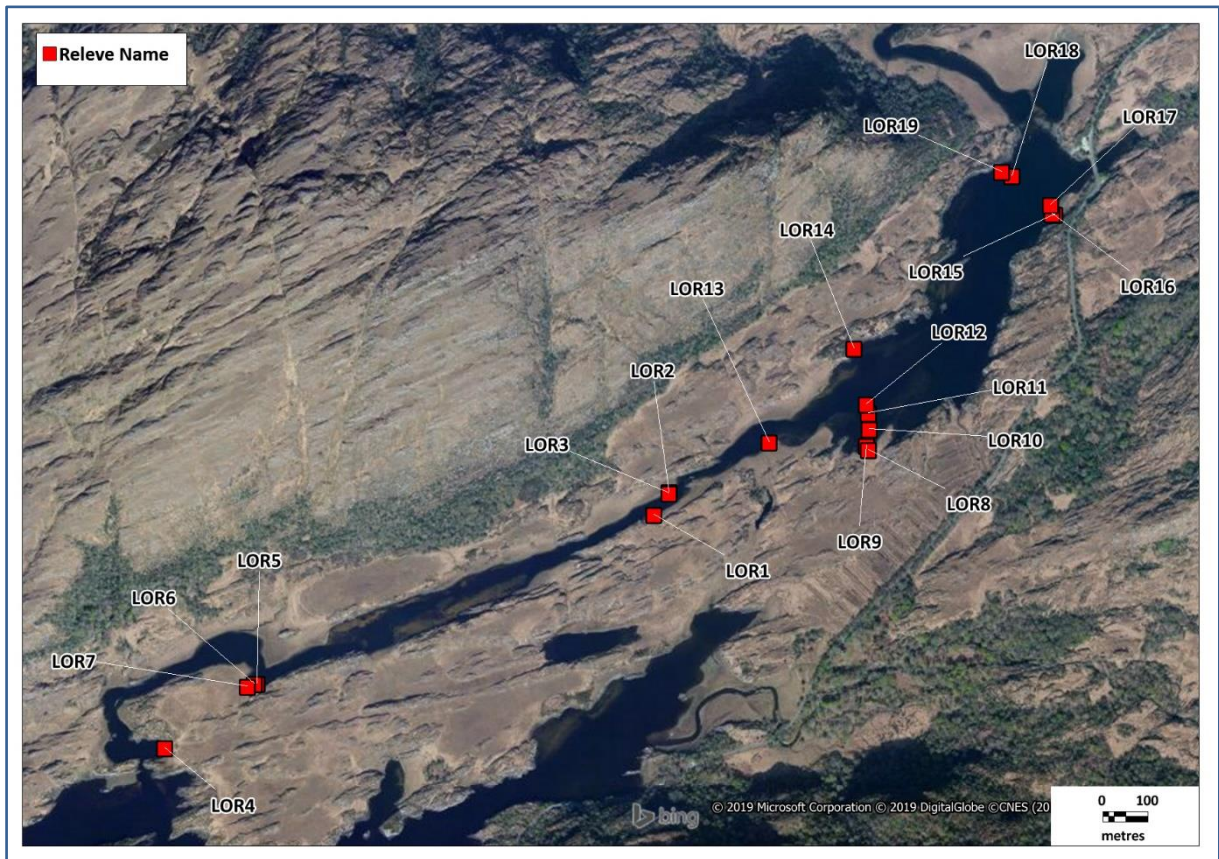
See also NPWS (2017d, e).

### Account of the Long Range from Roden & Murphy (2014)

*The Long Range has a flora typical of Old Red Sandstone lakes with mainly oligotrophic species including Isoetes lacustris, Juncus bulbosus and Callitriche hamulata. Nevertheless, a very large population of Najas flexilis was recorded at the north-eastern end of the lake. In addition, the scarce charophyte Nitella confervacea was recorded. The Najas flexilis occurred in both the northern most bay and to the west of the Five Mile Bridge. It occurs at depths of 2-3 m near the base of the euphotic zone with Potamogeton berchtoldii, Isoetes lacustris and Nitella translucens. The population is very large west of Five Mile Bridge with at least 1000 individuals growing between 3-3.5 m on silt over gravel. Euphotic depth is about 4 m.*



The population in the Long Range appears to be in excellent condition with many hundreds of plants. It differs from many sites in having so large a population in conditions which appear to be marginal. A possible threat could be boat traffic as in the Lower Lake (Roden & Murphy, 2013). This danger is less likely as boats in the upper lake are smaller and traffic over many years has not damaged the population.



### Species recorded

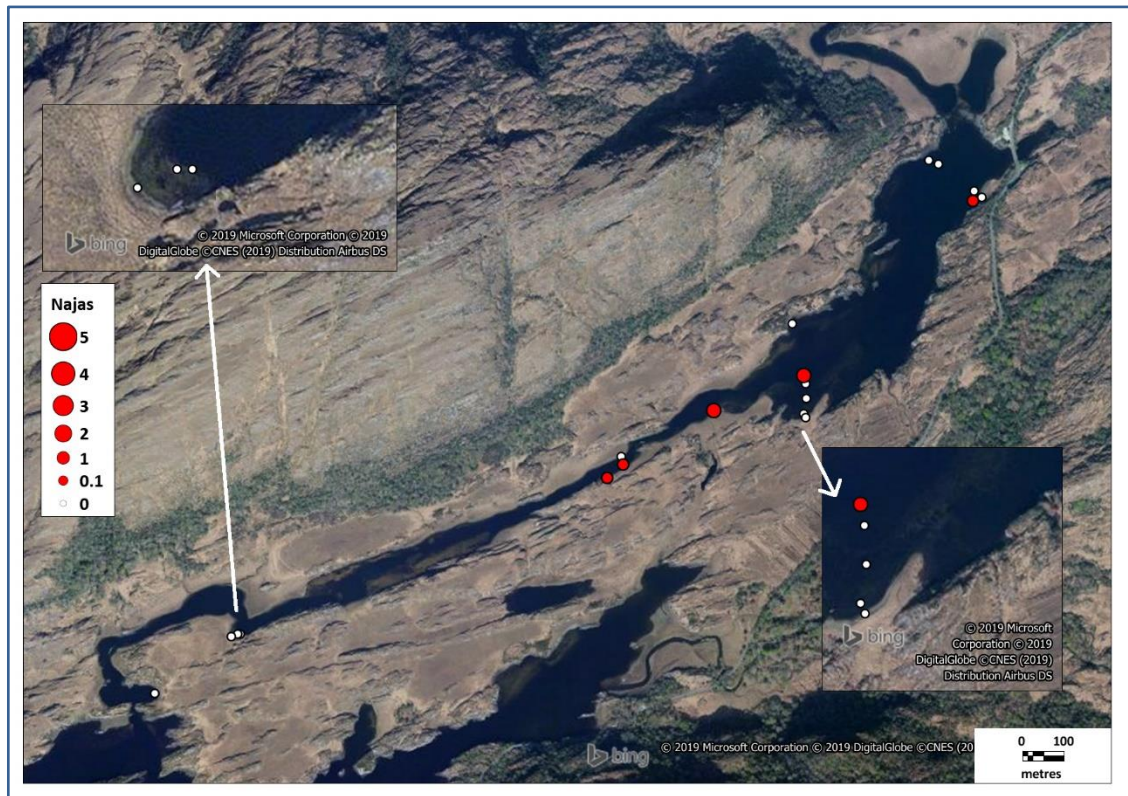
In 2016, 28 species were recorded in the Long Range. The following species are of note

- *Najas flexilis*, first recorded in 1994, still persists.
- *Baldellia ranunculoides* subsp. *repens*. This very distinct stoloniferous species. is only known from Caragh, Leane and the Long Range. It has been confused with *Luronium natans* but on-growing of material to flowering by C. Roden shows it is undoubtedly *Baldellia ranunculoides* subsp. *repens*. Its Irish distribution has yet to be determined but it appears confined to *Najas flexilis*-type lakes. It forms large mats, similar to *Eriocaulon* on sand or silt. It was found at two locations.
- *Isoetes echinospora* was recorded in three relevés.
- *Pilularia globulifera* is known from the Long Range since 1902. It was found at two stations.

Taxon - Long Range	Before this survey	In this survey (2016)	Taxon - Long Range	Before this survey	In this survey (2016)
Charophytes			<i>Isoetes lacustris</i>	1	1
<i>Chara aspera</i>			<i>Juncus bulbosus</i>	1	1
<i>Chara curta</i>			<i>Lemna minor</i>		
<i>Chara globularis</i>			<i>Lemna trisulca</i>		
<i>Chara rudis</i>			<i>Littorella uniflora</i>	1	1
<i>Chara virgata</i>		1	<i>Lobelia dortmanna</i>	1	1
<i>Nitella confervacea</i>	1	1	<i>Myriophyllum alterniflorum</i>	1	1
<i>Nitella flexilis</i>		1	<i>Myriophyllum spicatum</i>		
<i>Nitella gracilis</i>			<i>Najas flexilis</i>	1	1
<i>Nitella opaca</i>			<i>Nuphar lutea</i>		1
<i>Nitella translucens</i>	1	1	<i>Nymphaea alba</i>		1
<i>Tolypella glomerata</i>			<i>Oenanthe fluviatilis</i>		
<i>Chara cf. muscosa</i>			<i>Phragmites australis</i>		1
Other algae			<i>Pilularia globulifera</i>	1	1
<i>Ophrydium versatile</i>			<i>Potamogeton alpinus</i>		
Bryophytes			<i>Potamogeton berchtoldii</i>	1	1
<i>Fissidens fontanus</i>			<i>Potamogeton crispus</i>		
<i>Fontinalis antipyretica</i>		1	<i>Potamogeton filiformis</i>		
<i>Sphagnum</i> sp.		1	<i>Potamogeton gramineus</i>		
Vascular Plants			<i>Potamogeton lucens</i>		
<i>Alisma plantago-aquatica</i>			<i>Potamogeton natans</i>		1
<i>Apium inundatum</i>	1	1	<i>Potamogeton obtusifolius</i>		
<i>Baldellia ranunculoides</i> subsp. <i>ranunculoides</i>			<i>Potamogeton pectinatus</i>		
<i>Baldellia ranunculoides</i> subsp. <i>repens</i>	1	1	<i>Potamogeton perfoliatus</i>		1
<i>Callitriche brutia</i> subsp. <i>hamulata</i>	1	1	<i>Potamogeton polygonifolius</i>		
<i>Callitriche hermaphroditica</i>			<i>Potamogeton praelongus</i>		
<i>Carex rostrata</i>			<i>Potamogeton pusillus</i>		
<i>Ceratophyllum demersum</i>			<i>Potamogeton × angustifolius</i>		
<i>Cladium mariscus</i>			<i>Potamogeton × nitens</i>		
<i>Elatine hexandra</i>	1	1	<i>Ranunculus</i> sp.		
<i>Eleocharis acicularis</i>			<i>Schoenoplectus lacustris</i>		1
<i>Eleocharis multicaulis</i>		1	<i>Sparganium angustifolium</i>		
<i>Eleocharis palustris</i>			<i>Sparganium emersum</i>		
<i>Eleogiton fluitans</i>			<i>Sparganium erectum</i>		
<i>Elodea canadensis</i>	1	1	<i>Sparganium natans</i>		
<i>Equisetum fluviatile</i>			<i>Subularia aquatica</i>		
<i>Eriocaulon aquaticum</i>			<i>Typha angustifolia</i>		
<i>Hydrilla verticillata</i>			<i>Utricularia</i> sp.	1	1
<i>Isoetes echinospora</i>	1	1	<i>Zannichellia palustris</i>		

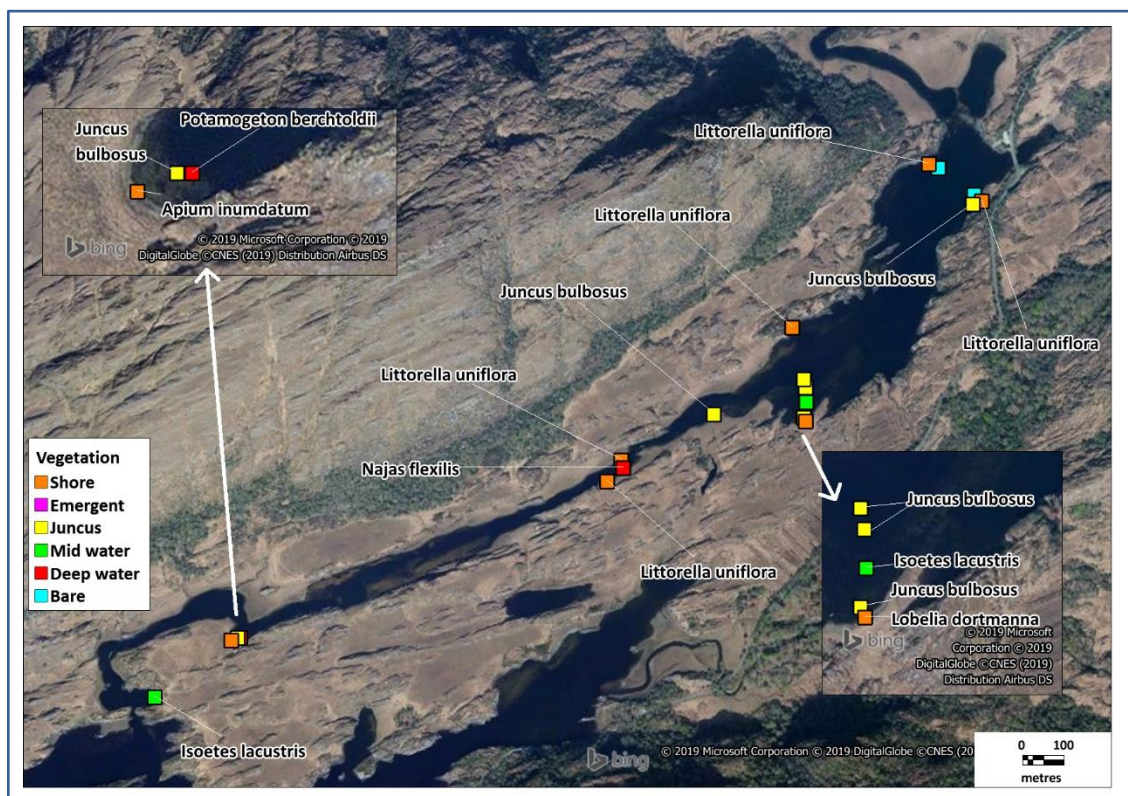
### *Najas flexilis*

The plant was found in five relevés but at low densities (+ to 1) throughout the wider section of the lake. The very large population seen in 2014 was not found, probably due to sampling in a slightly different area, but possibly due to population fluctuations in an annual plant.



### Vegetation

The vegetation of the Long Range is intermediate between that of the Upper Lake and that of Lough Leane. Increased water flow may lead to some nutrient enhancement compared to the Upper Lake. The vegetation is typical of many soft-water lakes, with a *Littorella*—*Lobelia* zone followed by an *Isoetes* and *Juncus bulbosus* zone to about 3 m. *Potamogeton* spp. are rare with some *Potamogeton berchtoldii* on silt in deeper water along with *Najas flexilis* and rare *Nitella confervacea*. Most other species are rare to occasional.



## Water chemistry data

Water quality data for the period 2009 to 2015 were made available by the EPA, for many samples from multiple depths. Values presented and used in assessment are averages of all data.

Parameter	Unit	Long Range EPA 2009-2015
Alkalinity	mg/l	5.4
Calcium	mg/l	1.7
Chloride	mg/l	11.7
Chlorophyll	µg/l	2.1
Colour	Hazen units	29.9
Conductivity	µS/cm	49
Magnesium	mg/l	0.99
pH		6.4
Potassium	mg/l	0.3
Secchi	m	5.4
Sulphate	mg/l	3.7
Total oxidised nitrogen	mg/l	0.13
Total phosphorus	mg/l	0.008

## Pressures and threats

As the Long Range is part of the Killarney National Park it is protected from many environmental threats. Damage to water quality in the Long Range is very possible, however, as a result of fires, such as those that occurred in 2021. The passage of tour boats may influence the distribution of macrophyte vegetation.

## Conservation condition

The deep-water vegetation community is limited by lake morphology, with many areas steeply sloping. In flatter parts of the lake bed, large *Najas flexilis* populations have been recorded.

Parameter	Target for Good	The Long Range 2016	Condition
Area of habitat	Stable or increasing	Stable or increasing	Good
Deep-water community	Full development	Full development	Good
Number of species	Stable or increase	Increase (28)	Good
Typical species	≥9 indicator species	13	Good
<i>Najas flexilis</i> population	Stable population	Low density assumed to be natural spatial or temporal variation	Good
Introduced species	Not present/not impacting on <i>Najas flexilis</i> / deep-water community	Not impacting	Good
Euphotic depth (m)	≥3	2.9	Good/Poor
Colour (Hazen units)	<40	30	Good
Total phosphorus (TP) (mg/l)	<0.015	0.008	Good
Hydrological regime	<50% <i>Lobelia</i> – <i>Littorella</i> zone exposed in summer	-	Good
<b>Overall assessment</b>			<b>Good</b>

Loughauneala, 2018			
Name	Loughauneala	Code	??
Alternative name(s)			
Grid reference	L9288223333	Max. depth (m)	1
County	Galway	EPA code	31_1107
Area (ha)	3.3	OSi 1:50,000 sheet	45
Maximum length (km)	0.3	Nutrient data	None available
Altitude (m)	22	SAC	-
Geology	Granite		
Previous survey	C. Roden in 2005		
Previous <i>Najas flexilis</i> records	C. Roden 29/08/2005		
Other noteworthy species	-		
Snorkel survey date(s)	22/09/2018, 28/07/21	Number of species	18
Surveyors	CR, JR	Alkalinity (mg/l CaCO <sub>3</sub> )	-
Number of transects	-	Total phosphorus (mg/l TP)	-
Number of relevés	-	Colour (Hazen units)	-
Euphotic depth (m)	>1	Secchi depth (m)	-
<i>Najas flexilis</i>	Large population throughout the lake		
Deep-water vegetation	Present in shallow water		
Noteworthy species	<i>Nitella confervacea</i> , <i>Najas flexilis</i>		
Introduced species	None noted		
Substrates	Fine mud, silt, rock		
Summary	A small very shallow lake with a large population of <i>Najas flexilis</i> . While <i>Najas flexilis</i> was first recorded in 2005, and again on 22/09/2021 (during the study), a snorkel survey was not undertaken until 2021.		
CONSERVATION CONDITION	<b>GOOD</b>		

### Previous accounts

C. Roden visited Loughauneala in 2005 and recorded *Najas flexilis* and *Potamogeton perfoliatus* in drift material.

### 2018

During the project, the site was sampled by grapnel in September 2018 and large, healthy plants of *Najas flexilis* retrieved.

### 2021

An opportunity for a snorkel survey arose in 2021 as part of a training day under the BSBI Aquatic Plants Project. The results of this 2021 survey are given below.

### Species recorded

A total of 18 species was recorded from Loughauneala, but most are widespread in softwater lakes.

- *Nitella confervacea* known at present from c. 25 hectads. Unusually, it grows in very shallow water at Loughauneala
- *Najas flexilis* occurs (see below).

Taxon - Loughauneala	Before this survey	In 2021)	Taxon - Loughauneala	Before this survey	In 2021
Charophytes			<i>Isoetes lacustris</i>		1
<i>Chara aspera</i>			<i>Juncus bulbosus</i>		1
<i>Chara curta</i>			<i>Lemna minor</i>		
<i>Chara globularis</i>			<i>Lemna trisulca</i>		
<i>Chara rudis</i>			<i>Littorella uniflora</i>		
<i>Chara virgata</i>		1	<i>Lobelia dortmanna</i>		
<i>Nitella confervacea</i>		1	<i>Myriophyllum alterniflorum</i>		1
<i>Nitella flexilis</i>			<i>Myriophyllum spicatum</i>		
<i>Nitella gracilis</i>			<i>Najas flexilis</i>	1	1
<i>Nitella opaca</i>			<i>Nuphar lutea</i>		
<i>Nitella translucens</i>		1	<i>Nymphaea alba</i>		1
<i>Tolypella glomerata</i>			<i>Oenanthe fluviatilis</i>		
<i>Chara cf. muscosa</i>			<i>Phragmites australis</i>		1
Other algae			<i>Pilularia globulifera</i>		
<i>Ophrydium versatile</i>			<i>Potamogeton alpinus</i>		1
Bryophytes			<i>Potamogeton berchtoldii</i>		1
<i>Fissidens fontanus</i>			<i>Potamogeton crispus</i>		
<i>Fontinalis antipyretica</i>			<i>Potamogeton filiformis</i>		
<i>Sphagnum</i> sp.			<i>Potamogeton gramineus</i>		
Vascular Plants			<i>Potamogeton lucens</i>		
<i>Alisma plantago-aquatica</i>			<i>Potamogeton natans</i>		1
<i>Apium inundatum</i>			<i>Potamogeton obtusifolius</i>		
<i>Baldellia ranunculoides</i> subsp. <i>ranunculoides</i>		1	<i>Potamogeton pectinatus</i>		
<i>Baldellia ranunculoides</i> subsp. <i>repens</i>			<i>Potamogeton perfoliatus</i>	1	1
<i>Callitriche brutia</i> subsp. <i>hamulata</i>			<i>Potamogeton polygonifolius</i>		
<i>Callitriche hermaphroditica</i>			<i>Potamogeton praelongus</i>		
<i>Carex rostrata</i>			<i>Potamogeton pusillus</i>		
<i>Ceratophyllum demersum</i>			<i>Potamogeton × angustifolius</i>		
<i>Cladium mariscus</i>			<i>Potamogeton × nitens</i>		
<i>Elatine hexandra</i>		1	<i>Ranunculus</i> sp.		
<i>Eleocharis acicularis</i>			<i>Schoenoplectus lacustris</i>		1
<i>Eleocharis multicaulis</i>			<i>Spartanium angustifolium</i>		1
<i>Eleocharis palustris</i>			<i>Spartanium emersum</i>		
<i>Eleogiton fluitans</i>		1	<i>Spartanium erectum</i>		
<i>Elodea canadensis</i>			<i>Spartanium natans</i>		
<i>Equisetum fluviatile</i>			<i>Subularia aquatica</i>		
<i>Eriocaulon aquaticum</i>			<i>Typha angustifolia</i>		
<i>Hydrilla verticillata</i>			<i>Utricularia</i> sp.		
<i>Isoetes echinospora</i>			<i>Zannichellia palustris</i>		

### *Najas flexilis*

The plant is very abundant in Loughauneala. Plants were large and in fruit in July 2021. Such large populations in shallow water show that *Najas flexilis* is not always found at depth (>2 m). Other examples of shallow-water populations include Sheskinmore Lough and Clooney Lough, both in Donegal.

### Vegetation

Loughauneala consists of two basins separated by a narrow and very shallow (<0.5 m) neck that is choked with *Phragmites* and *Schoenoplectus*. The larger western basin has not been examined and may well contain additional species. The eastern basin is easily accessed from a minor road on its eastern

shore. This basin is a shallow (1 m) pan with abrupt rocky shores and no developed gravel or shingle beds. The centre consists of soft silt.

A typical Isoetid shore zone does not occur. Instead stands of *Nymphaea alba*, *Potamogeton alpinus* and *P. natans* occur, with beds of *Phragmites australis* and *Schoenoplectus lacustris* at the western side. The greater part of the shallow lake bed is covered by a 'deep-water' community of *Najas flexilis* (cover value 4) with *Chara virgata*, *Nitella translucens*, *Nitella confervacea*, *Schoenoplectus lacustris* and *Elatine hexandra* (all cover values of 1). Some *Potamogeton perfoliatus*, *P. berchtoldii* and *Isoetes lacustris* occur. This community resembles the deep-water community identified in the main report but occurs in very shallow water. The reason for this anomaly is not obvious but of interest when trying to identify the ecological constraints on vegetation development.

### Pressures and threats

There are no obvious threats to the lake, which appears unchanged since 2005, when it was first visited.

### Conservation condition

The lake is difficult to assess using the scheme proposed, but the very large *Najas flexilis* population suggests it is in good conservation condition.

Parameter	Target for Good	Loughauneala 2021	Condition
Area of habitat	Stable or increasing	Stable	Good
Deep-water community	Full development	Full development (in shallow water)	Good
Number of species	Stable or increase	Unknown (18)	n/a
Typical species	≥9 indicator species		
<i>Najas flexilis</i> population	Stable population	Unknown	n/a
Introduced species	Not present/not impacting on <i>Najas flexilis</i> / deep-water community	Not present	Good
Euphotic depth (m)	≥3	>1 m/max depth	Good
Colour (Hazen units)	<40	None available	n/a
Total phosphorus (TP) (mg/l)	<0.015	None available	n/a
Hydrological regime	<50% <i>Lobelia</i> – <i>Littorella</i> zone exposed in summer	-	Good
<b>Overall assessment</b>			<b>Good</b>

Lough Mask, 2016			
Name	Mask		
Alternative name(s)			
Grid reference	M1070463710	Max. depth (m)	23 (SW arm only)
County	Galway & Mayo	EPA code	30_665b
Area (ha)	421 (south-western arm only)	OSi 1:50,000 sheet	38
Maximum length (km)	7 (south-western arm only)	Nutrient data	Not examined
Altitude (m)	17	SAC	001774, Lough Carra/Mask Complex SAC
Geology	Schist, sandstone, volcanics		
Previous survey	EPA in 2009, 2011, 2014		
Previous <i>Najas flexilis</i> records	There are no records for the species in Lough Mask		
Other noteworthy species	<i>Pilularia globulifera</i> , <i>Potamogeton filiformis</i>		
Snorkel survey date(s)	26/07/2016	Number of species	25
Surveyors	PM, CR, JR	Alkalinity (mg/l CaCO <sub>3</sub> )	-
Number of transects	1	Total phosphorus (mg/l TP)	-
Number of relevés	11	Colour (Hazen units)	-
Euphotic depth (m)	3.5	Secchi depth (m)	-
<i>Najas flexilis</i>	Does not occur		
Deep-water vegetation	Absent		
Noteworthy species	<i>Callitriche hermaphroditica</i> , <i>Pilularia globulifera</i> , <i>Potamogeton filiformis</i>		
Introduced species	<i>Elodea canadensis</i> present		
Substrates	Gravel, fine mud, bedrock		
Summary	An interesting lake, but too oligotrophic for <i>Najas flexilis</i>		
CONSERVATION CONDITION	Not assessed		

### Previous accounts

1. Many botanists have briefly visited the Lough Mask shore and found species such as *Pilularia globulifera* and *Potamogeton filiformis* (Webb & Scannell, 1983).
2. In 2009, 2012 and 2015, it was surveyed by the EPA who recorded a typical oligotrophic lake flora of Isoetids, but also *Pilularia* and *Persicaria*.

### 2016 survey

The site was chosen for survey as it was thought that the alkaline main water body of Lough Mask would influence the oligotrophic western arm sufficiently to create an intermediate site suitable for *Najas flexilis*.

The survey demonstrated that, in general, the Kilbride or western arm of Lough Mask is too oligotrophic to be a suitable habitat for *Najas flexilis* and that the lake was outside the scope of the project. However, the survey did reveal a feature which may be of importance in understanding the distribution of *Najas flexilis*. At several locations on the southern shore (M04052 57816 (MSK9)) ground water springs result in very atypical vegetation. The possibility that *Najas* is confined to springs has been suggested for lakes such as Upper Lake Killarney and Glenade.

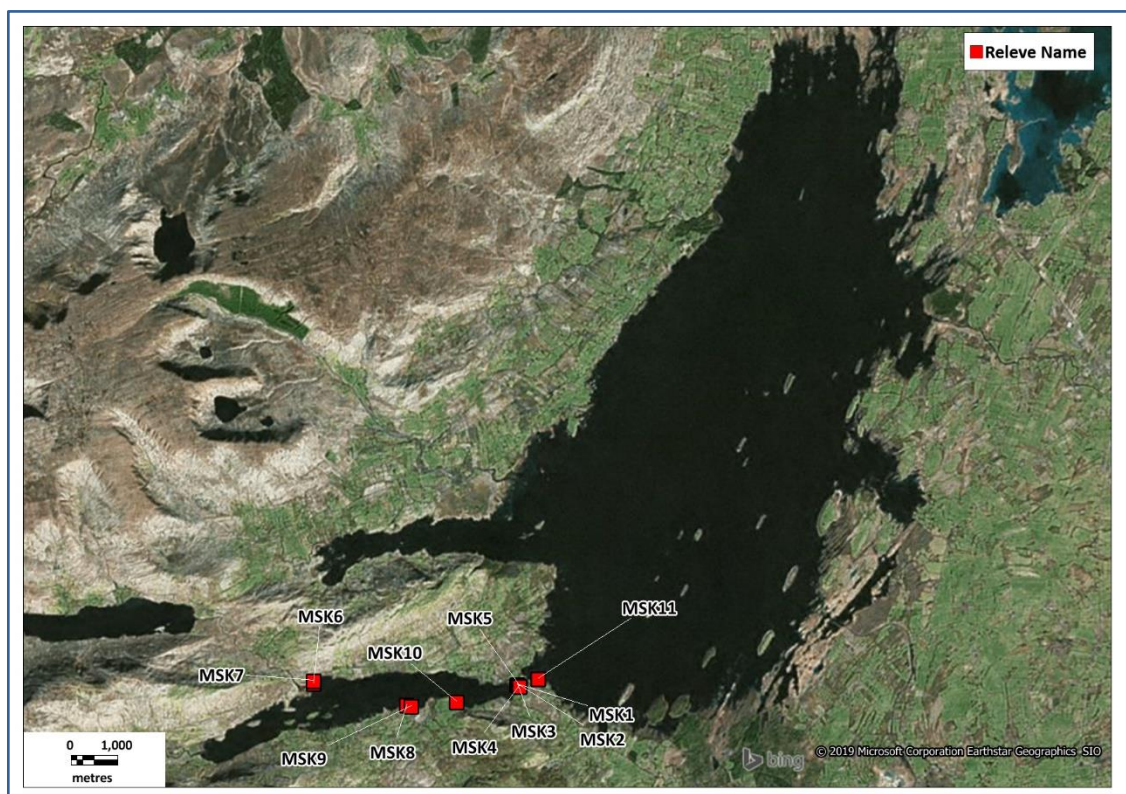
### Species recorded

The species recorded included

- *Callitriche hermaphroditica*, which is scarce in lakes in the west of Ireland
- *Pilularia globulifera*, which is very abundant at several points, especially in the groundwater springs.



Taxon - Mask	Before this survey	In this survey (2016)
Charophytes		
<i>Chara virgata</i>	1	1
<i>Nitella flexilis</i>	1	1
<i>Nitella translucens</i>		1
Vascular Plants		
<i>Alisma plantago-aquatica</i>		1
<i>Apium inundatum</i>	1	1
<i>Callitriche hermaphrodita</i>		1
<i>Elatine hexandra</i>	1	
<i>Elodea canadensis</i>	1	1
<i>Equisetum fluviatile</i>	1	1
<i>Erioca ulon aquaticum</i>	1	1
<i>Isoetes lacustris</i>	1	1
<i>Juncus bulbosus</i>	1	1
<i>Lemna trisulca</i>		1
<i>Littorella uniflora</i>	1	1
<i>Lobelia dortmanna</i>	1	1
<i>Myriophyllum alterniflorum</i>	1	1
<i>Nuphar lutea</i>	1	1
<i>Persicaria amphibia</i>	1	1
<i>Pilularia globulifera</i>	1	1
<i>Potamogeton alpinus</i>	1	
<i>Potamogeton berchtoldii</i>		1
<i>Potamogeton filiformis</i>	1	1
<i>Potamogeton gramineus</i>		1
<i>Potamogeton natans</i>		1
<i>Potamogeton pectinatus</i>		1
<i>Potamogeton perfoliatus</i>		1
<i>Schoenoplectus lacustris</i>	1	
<i>Utricularia</i> sp.		1



## *Najas flexilis*

The species has never been recorded in Lough Mask.

### Vegetation

Outside the spring zone, the vegetation is typical of oligotrophic lakes with *Lobelia dortmanna*, *Littorella uniflora* and *Eriocaulon aquaticum* in shallow water giving way to *Isoetes lacustris* at depth. A little *Chara virgata* occurs with some *Nitella opaca* on sandy substrates.

The springs were detected by the presence of a large stand of *Persicaria amphibia* growing along the shore. This species is not usually found in oligotrophic lakes. A nearby gravel quarry may indicate the underlying substrate is not rock but permeable glacial gravel. Further offshore, large areas are covered with filamentous algae including *Mougeotia*, *Spirogyra* and Cyanobacteria. Freshwater sponges are common on the bottom, while macrophytes are covered by dense coatings of brown epiphytic algae. The most striking feature is the presence of long floating ropes or tangles of *Pilularia globulifera* half attached to the bottom. *Apium inundatum* is also common, as is *Nitella translucens* and *Potamogeton* spp. Most of these species are otherwise rare on the lake floor, presumably due to a different nutrient regime.

For comparison an area of the main lake east of the ferry bridge was examined. It showed a more eutrophic vegetation with *Potamogeton* sp. and *Myriophyllum spicatum*.



### Pressures and threats

EPA WFD classification rates the Kilbride arm of Lough Mask as good. No obvious impacts on water quality were noted in the 2016 survey.

### Conservation condition

The conservation condition of the lake was not assessed as the targets for *Najas flexilis*-type lakes were not considered appropriate the Kilbride arm of Lough Mask surveyed.

Lough Maumeen, 2016			
Name	Maumeen	Code	MAM
Alternative name(s)			
Grid reference	L6547741132	Max. depth (m)	>10
County	Galway	EPA code	31_189
Area (ha)	56	OSi 1:50,000 sheet	44
Maximum length (km)	1.5	Nutrient data	This survey 18/01/2019, C. Roden 2005, Free <i>et al.</i> (2006) 2002
Altitude (m)	5	SAC	002034, Connemara Bog Complex SAC
Geology	Gabbro		
Previous survey	C. Roden for NPWS in 2005		
Previous <i>Najas flexilis</i> records	C. Roden 02/09/2005		
Other noteworthy species	<i>Callitriche hermaphroditica</i>		
Snorkel survey date(s)	21/09/2016	Number of species	17
Surveyors	PM, CR	Alkalinity (mg/l CaCO <sub>3</sub> )	16.4
Number of transects	4	Total phosphorus (mg/l TP)	0.014
Number of relevés	12	Colour (Hazen units)	38
Euphotic depth (m)	3.9	Secchi depth (m)	3.2
<i>Najas flexilis</i>	Large population in south of lake		
Deep-water vegetation	Full development		
Noteworthy species	<i>Callitriche hermaphroditica</i> , <i>Najas flexilis</i> , <i>Subularia aquatica</i>		
Introduced species	None noted		
Substrates	Gravel, fine mud, bedrock		
Summary	A shallow lake on hard igneous rock with a large <i>Najas flexilis</i> population and few signs of environmental pressures		
Lake score	188	Lake rank	3
CONSERVATION CONDITION	<b>GOOD</b>		

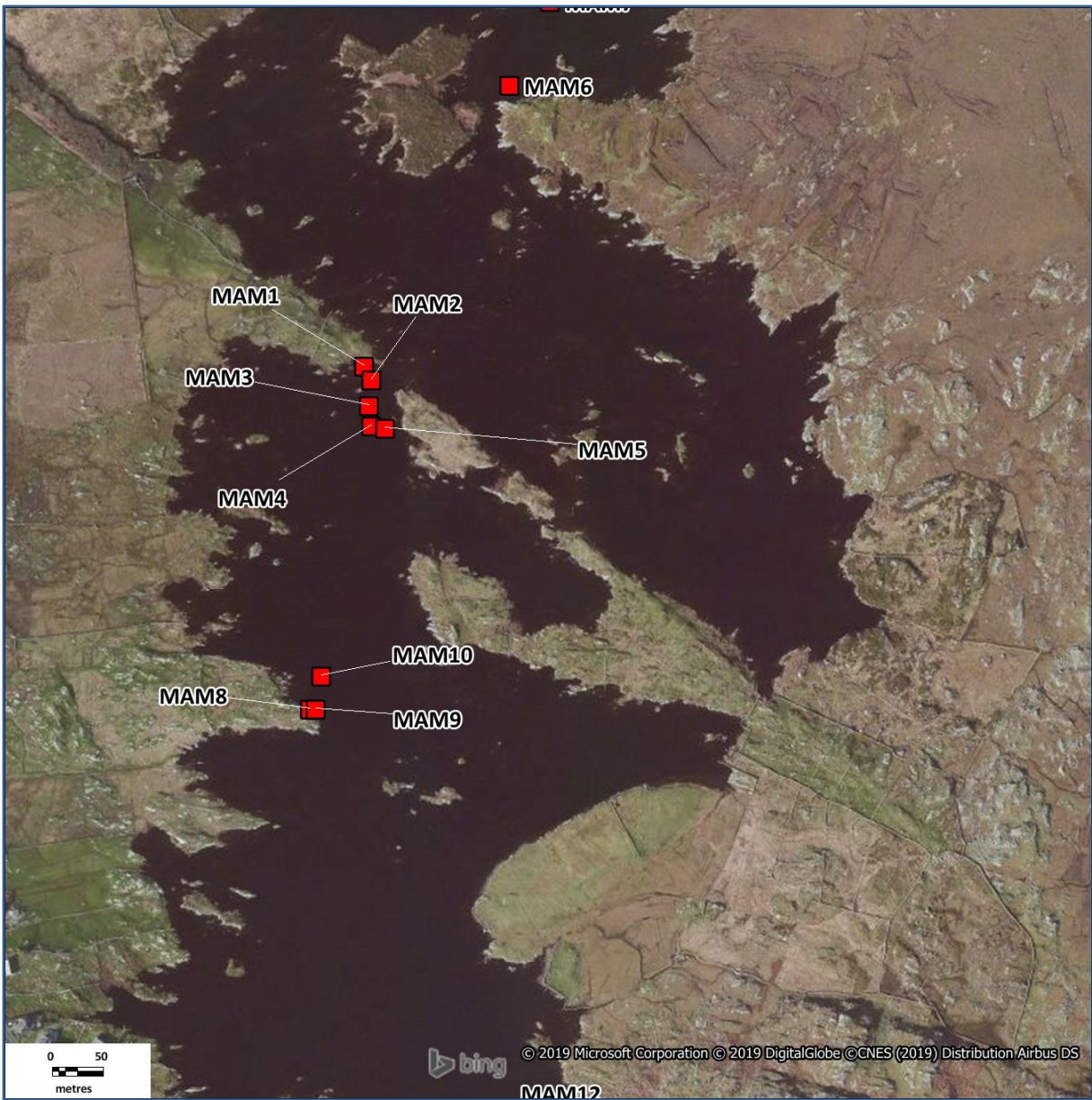
### Previous accounts

C. Roden briefly explored the southern end of the lake on 02/09/2005, as part of a survey for NPWS. He found a population of *Najas flexilis* along with the regionally rare *Callitriche hermaphroditica* and seven other species. He noted '*Nitella translucens* forms bottom cover with *Najas* and *Callitriche hermaphroditica* in clearings. Other species occasional.' See also NPWS (2015e, f).

### Species recorded

A total of 18 species has been recorded from Maumeen, 17 of these in 2016

- *Najas flexilis* is present
- *Subularia aquatica* is abundant at the northern end of the lake, but also occurs in the southern part. This species is rare in Ireland
- *Callitriche hermaphroditica* is not rare nationally but is scarce in Connemara, where it co-occurs in several lakes with *Najas flexilis*.

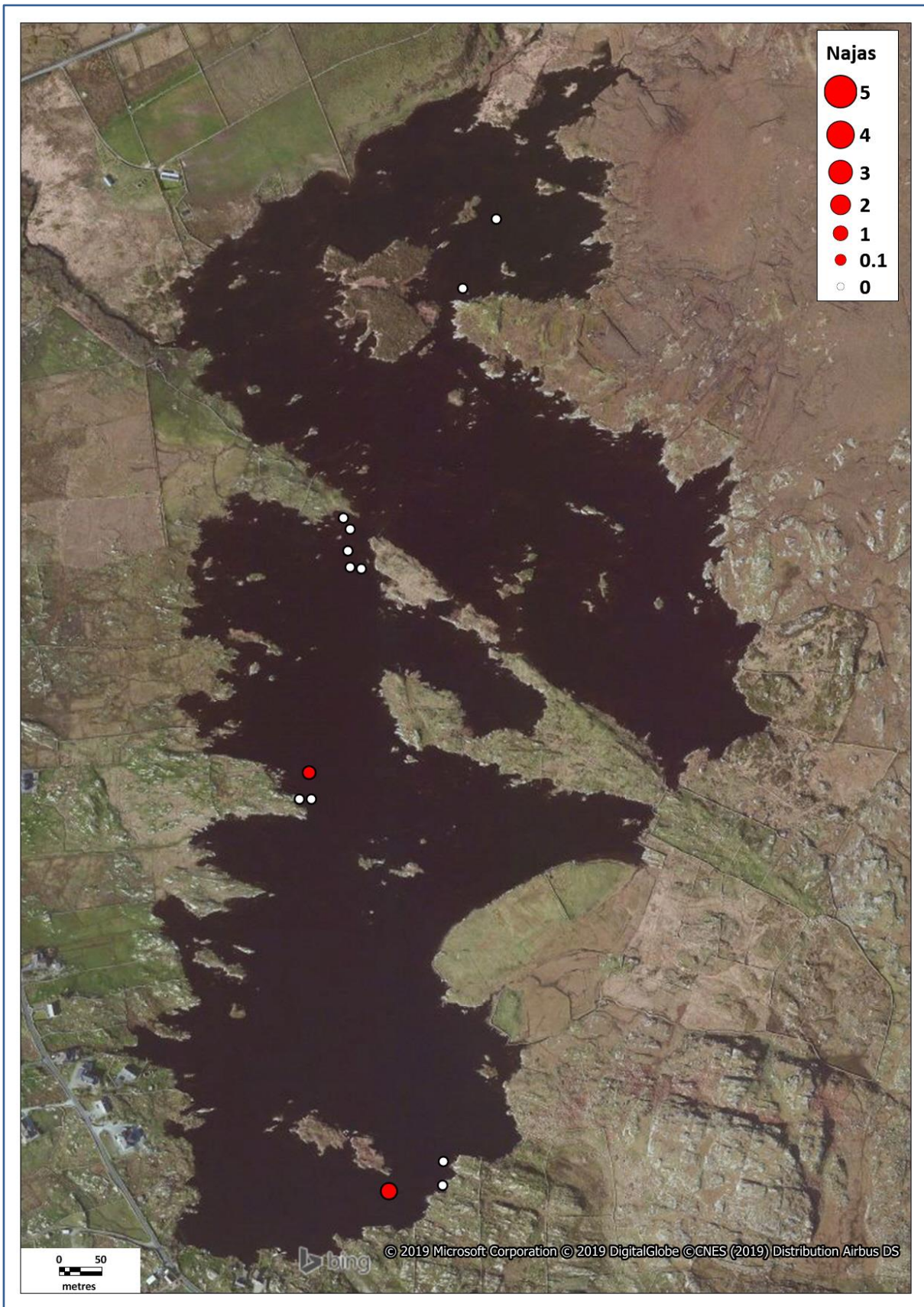


Taxon - Maumeen	Before this survey	In this survey (2016)	Taxon - Maumeen	Before this survey	In this survey (2016)
Charophytes			<i>Isoetes lacustris</i>		1
<i>Chara aspera</i>	1		<i>Juncus bulbosus</i>		
<i>Chara curta</i>			<i>Lemna minor</i>		
<i>Chara globularis</i>			<i>Lemna trisulca</i>		
<i>Chara rudis</i>			<i>Littorella uniflora</i>		1
<i>Chara virgata</i>	1	1	<i>Lobelia dortmanna</i>	1	1
<i>Nitella confervacea</i>			<i>Myriophyllum alterniflorum</i>	1	1
<i>Nitella flexilis</i>			<i>Myriophyllum spicatum</i>		
<i>Nitella gracilis</i>			<i>Najas flexilis</i>	1	1
<i>Nitella opaca</i>			<i>Nuphar lutea</i>		
<i>Nitella translucens</i>	1	1	<i>Nymphaea alba</i>		
<i>Tolypella glomerata</i>			<i>Oenanthe fluviatilis</i>		
<i>Chara cf. muscosa</i>			<i>Phragmites australis</i>		1
Other algae			<i>Pilularia globulifera</i>		
<i>Ophrydium versatile</i>			<i>Potamogeton alpinus</i>		
Bryophytes			<i>Potamogeton berchtoldii</i>	1	1
<i>Fissidens fontanus</i>			<i>Potamogeton crispus</i>		
<i>Fontinalis antipyretica</i>		1	<i>Potamogeton filiformis</i>		
<i>Sphagnum</i> sp.			<i>Potamogeton gramineus</i>		
Vascular Plants			<i>Potamogeton lucens</i>		
<i>Alisma plantago-aquatica</i>			<i>Potamogeton natans</i>		1
<i>Apium inundatum</i>			<i>Potamogeton obtusifolius</i>		
<i>Baldellia ranunculoides</i> subsp. <i>ranunculoides</i>			<i>Potamogeton pectinatus</i>		
<i>Baldellia ranunculoides</i> subsp. <i>repens</i>			<i>Potamogeton perfoliatus</i>	1	1
<i>Callitriche brutia</i> subsp. <i>hamulata</i>			<i>Potamogeton polygonifolius</i>		
<i>Callitriche hermaphroditica</i>	1	1	<i>Potamogeton praelongus</i>		
<i>Carex rostrata</i>			<i>Potamogeton pusillus</i>		
<i>Ceratophyllum demersum</i>			<i>Potamogeton × angustifolius</i>		
<i>Cladium mariscus</i>			<i>Potamogeton × nitens</i>		
<i>Elatine hexandra</i>		1	<i>Ranunculus</i> sp.		
<i>Eleocharis acicularis</i>			<i>Schoenoplectus lacustris</i>		
<i>Eleocharis multicaulis</i>		1	<i>Sparganium angustifolium</i>		
<i>Eleocharis palustris</i>			<i>Sparganium emersum</i>		
<i>Eleogiton fluitans</i>			<i>Sparganium erectum</i>		
<i>Elodea canadensis</i>			<i>Sparganium natans</i>		
<i>Equisetum fluviatile</i>			<i>Subularia aquatica</i>		1
<i>Eriocaulon aquaticum</i>		1	<i>Typha angustifolia</i>		
<i>Hydrilla verticillata</i>			<i>Utricularia</i> sp.		
<i>Isoetes echinospora</i>			<i>Zannichellia palustris</i>		

### *Najas flexilis*

The plant is common in the southern third of the lake and was recorded in two relevés with densities reaching cover values of up to 10%. It is most abundant along the southern shore. The plant occurs from about 1.5 m to the euphotic depth of 3–3.9 m. Substrate is always a reddish silt or mud. Companion species include *Callitriche hermaphroditica*, *Potamogeton berchtoldii* and *P. perfoliatus*. Many plants produce seeds and flowers and appear in good condition (large, much branched unfouled with epiphytes).

The data collected in 2016 was similar to that collected in 2005 and there is no evidence of vegetation change.



## Vegetation

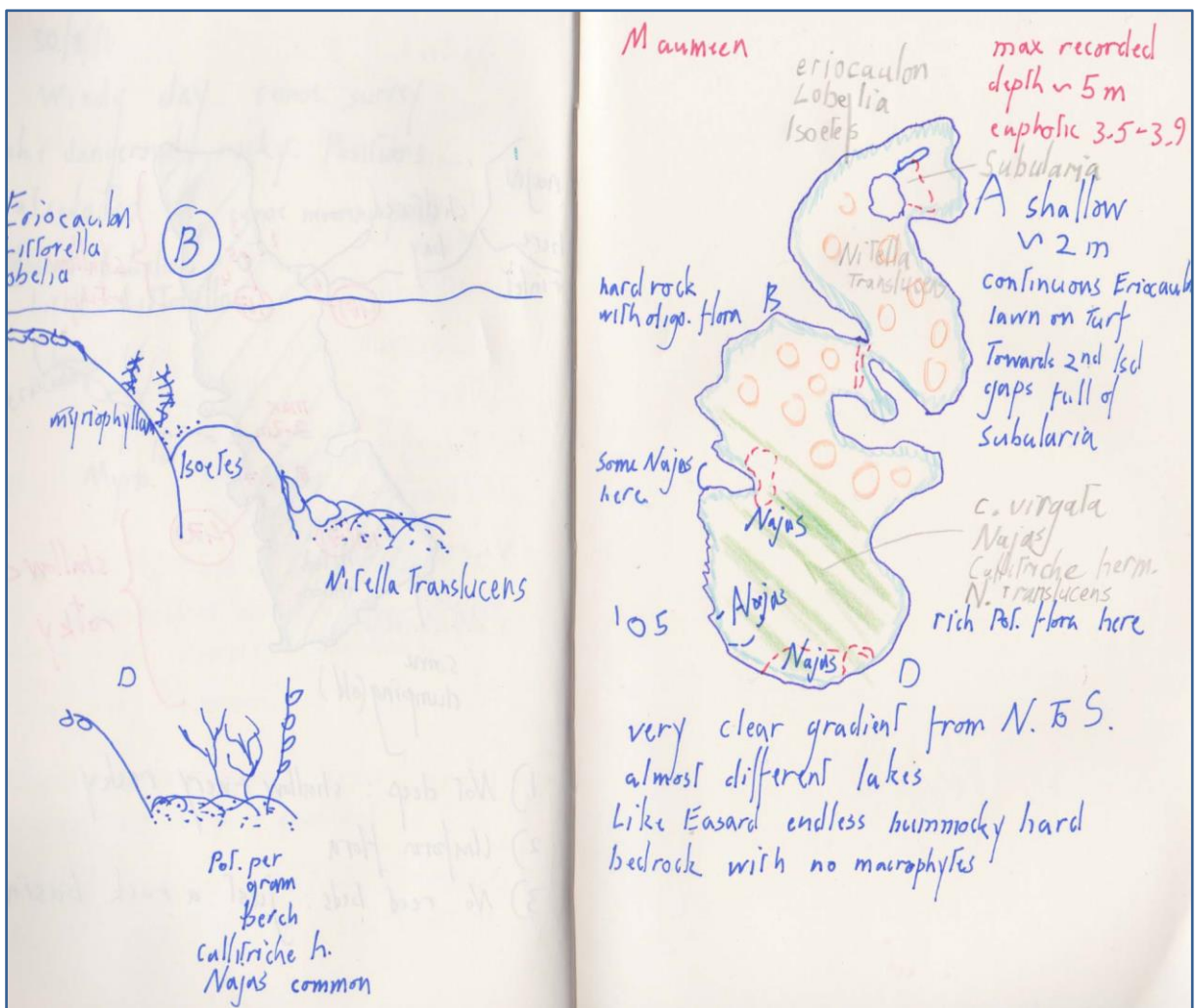
The lake is almost divided in two by a rock ridge. The shallow northern section contains both shore and mid-water *Isoetes* vegetation with locally abundant *Subularia aquatica*, while the deeper southern section contains a good example of the *Najas* deep-water flora. The following communities occur

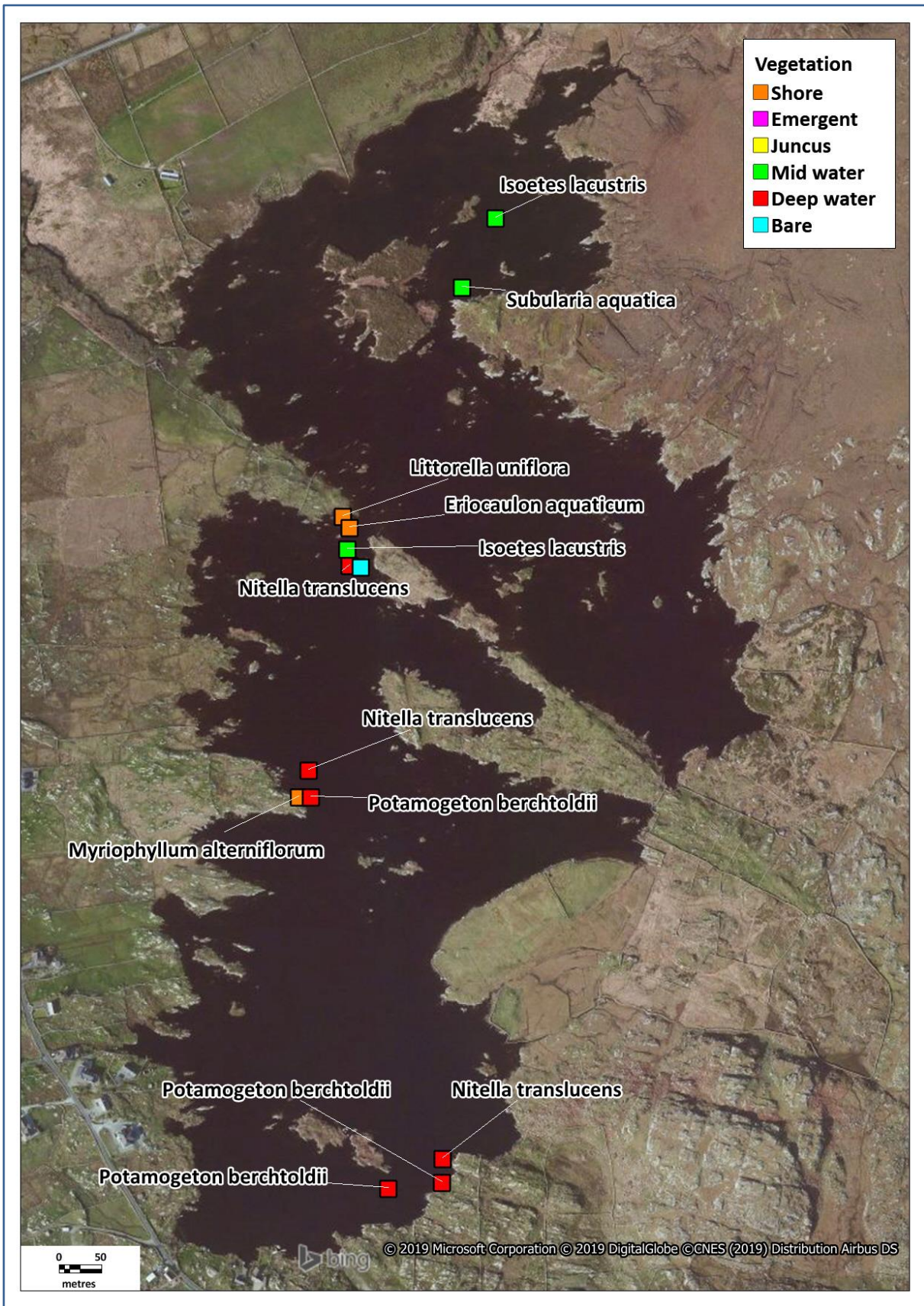
- An *Eriocaulon*—*Lobelia* unit growing in shallow water
- A variant dominated by *Littorella* growing on gravel
- An *Isoetes* unit growing from 1-3 m
- A *Nitella translucens* unit growing at depth
- A *Najas*—*Potamogeton*—*Callitriche* unit growing from about 2 m to the euphotic limit of 3.9 m but only in the southern part of the lake.

Rock type plays a role in this lake as the gabbro bedrock forms hard outcrops which results in much of the shallow water substrate being bare rock, with plants only growing in isolated pockets of finer sediment.

There is a strong north—south vegetation gradient in this lake, with a more oligotrophic flora in the northern section, while the southern part contains both *Najas flexilis* and several *Potamogeton* species.

Sketch map of the vegetation







## Water chemistry data

Water samples were taken on a single occasion on the 18 January 2019 as part of this survey. For comparison, data for the lake in 2002 from Free *et al.* (2006) and in 2005 from C. Roden are presented.

Parameter	Unit	Maumeen This survey	Maumeen Free <i>et al.</i> 2002	Maumeen C. Roden 2005
Alkalinity	mg/l	16.4	12	20
Ammonia	mg/l			0.028
Calcium	mg/l	4.7		2.4
Chloride	mg/l	43.2		46.5
Chlorophyll	µg/l	0.5	14.5	3.46
Colour	Hazen units	38	27	9.1
Conductivity	µS/cm	186.5	215	191.9
Nitrate	mg/l			0.005
Nitrite	mg/l			0.001
pH		7.17	6.81	7.75
Phosphate	mg/l			<0.003
Total phosphorus	mg/l	0.014	0.015	0.018

## Pressures and threats

Since 2000, an additional five houses have been built near the lake. Otherwise there is no evidence from aerial-photos of substantial land use change. The lake is within an SAC. There is no evidence of current environmental threats.

## Conservation condition

The number of species is low. No reason for this is apparent other than the prevalence of bare rock rather than gravel or fine sediment. Some local or rare species occur.

Parameter	Target for Good	Maumeen 2016	Condition
Area of habitat	Stable or increasing	Stable or increasing	Good
Deep-water community	Full development	Full development	Good
Number of species	Stable or increase	Increase (17)	Good
Typical species	≥9 indicator species	12	Good
<i>Najas flexilis</i> population	Stable population	Stable	Good
Introduced species	Not present/not impacting on <i>Najas flexilis</i> / deep-water community	Not present	Good
Euphotic depth (m)	≥3	3.9	Good
Colour (Hazen units)	<40	38	Good
Total phosphorus (TP) (mg/l)	<0.015	0.014	Good
Hydrological regime	<50% <i>Lobelia</i> – <i>Littorella</i> zone exposed in summer	-	Good
<b>Overall assessment</b>			<b>Good</b>

Lough Melvin, 2017			
Name	Melvin		
Alternative name(s)			
Grid reference	G8947653429	Max. depth (m)	45
County	Leitrim & Fermanagh	EPA code	35_160
Area (ha)	2,206	OSi 1:50,000 sheet	16
Maximum length (km)	12.5	Nutrient data	Not examined
Altitude (m)	25	SAC	000428,Lough Melvin SAC
Geology	Carboniferous sandstone and calcareous shale		
Previous survey	Not examined		
Previous <i>Najas flexilis</i> records	There are no records for the species in Lough Melvin		
Snorkel survey date(s)	18/07/2017	Euphotic depth (m)	2.5
Surveyors	PM, CR and JR	Number of species	15
Number of transects	0	Number of relevés	0
<i>Najas flexilis</i>	<i>Najas flexilis</i> was not found		
Deep-water vegetation	None noted		
Noteworthy species	None noted		
Introduced species	None noted		
Substrates	Rock, gravel and silt		

Lough Melvin could be a site for *Najas flexilis*: its rock types include calcareous shale and sandstones, not unlike Lough Leane and its flora contains both *Isoetes lacustris* and *Potamogeton perfoliatus*. A snorkel survey, however, at a sheltered site on the southern shore was disappointing. Euphotic depth was shallow (2.5 m) and water colour dark. In addition, drift *Cladophora* was seen along the shore, an indicator of eutrophication. The vegetation was poorly-developed. *Littorella uniflora* and *Lobelia dortmanna* occur along the shore, with occasional charophytes including *Chara aspera*, *C. virgata* and *Nitella opaca*. Some *Potamogeton* species occurred including *P. perfoliatus*, *P. lucens* and *P. gramineus*. It is very possible that *Najas* communities formerly occurred in Lough Melvin and a thorough survey might find a more diverse flora. The dark water colour and shallow euphotic depth are however discouraging and could indicate a damaged lake. The EPA rate the lake as moderate under the WFD and this assessment would not include water colour data, which may also be bad judging from our observations.

### Species recorded

Taxon - Melvin
Charophytes
<i>Chara aspera</i>
<i>Chara virgata</i>
<i>Nitella opaca</i>
Other algae
<i>Cladophora</i>
Vascular Plants
<i>Isoetes lacustris</i>
<i>Littorella uniflora</i>
<i>Lobelia dortmanna</i>
<i>Myriophyllum alterniflorum</i>
<i>Potamogeton gramineus</i>
<i>Potamogeton lucens</i>
<i>Potamogeton perfoliatus</i>
<i>Potamogeton</i> × <i>angustifolius</i>

Lough Moher, 2017			
Name	Moher	Code	MHR
Alternative name(s)			
Grid reference	L9766376651	Max. depth (m)	>6.4
County	Mayo	EPA code	32_406
Area (ha)	36	OSi 1:50,000 sheet	38
Maximum length (km)	1.1	Nutrient data	EPA 2009-2015
Altitude (m)	87	SAC	-
Geology	Ordovician sandstone slate and conglomerate		
Previous survey	EPA in 2008, 2011, 2014		
Previous <i>Najas flexilis</i> records	EPA 21/07/2008		
Other noteworthy species	<i>Potamogeton obtusifolius</i>		
Snorkel survey date(s)	17/08/2017	Number of species	27
Surveyors	PM, CR, JR	Alkalinity (mg/l CaCO <sub>3</sub> )	17.6
Number of transects	4	Total phosphorus (mg/l TP)	0.013
Number of relevés	20	Colour (Hazen units)	51
Euphotic depth (m)	2.6	Secchi depth (m)	-
<i>Najas flexilis</i>	Occurred in a band around the lake with an estimated area of about 4 ha		
Deep-water vegetation	Partially developed		
Noteworthy species	<i>Isoetes echinospora</i> , <i>Najas flexilis</i> , <i>Nitella confervacea</i> , <i>Potamogeton obtusifolius</i>		
Introduced species	<i>Elodea canadensis</i> present		
Substrates	Sand, peat, mud, some rock		
Summary	A geographically isolated <i>Najas flexilis</i> lake with several rare species to the east of their recorded range. In reasonable conservation condition but possibly damaged by peat stained run off		
Lake score	140	Lake rank	4
CONSERVATION CONDITION	<b>POOR</b>		

### Previous accounts

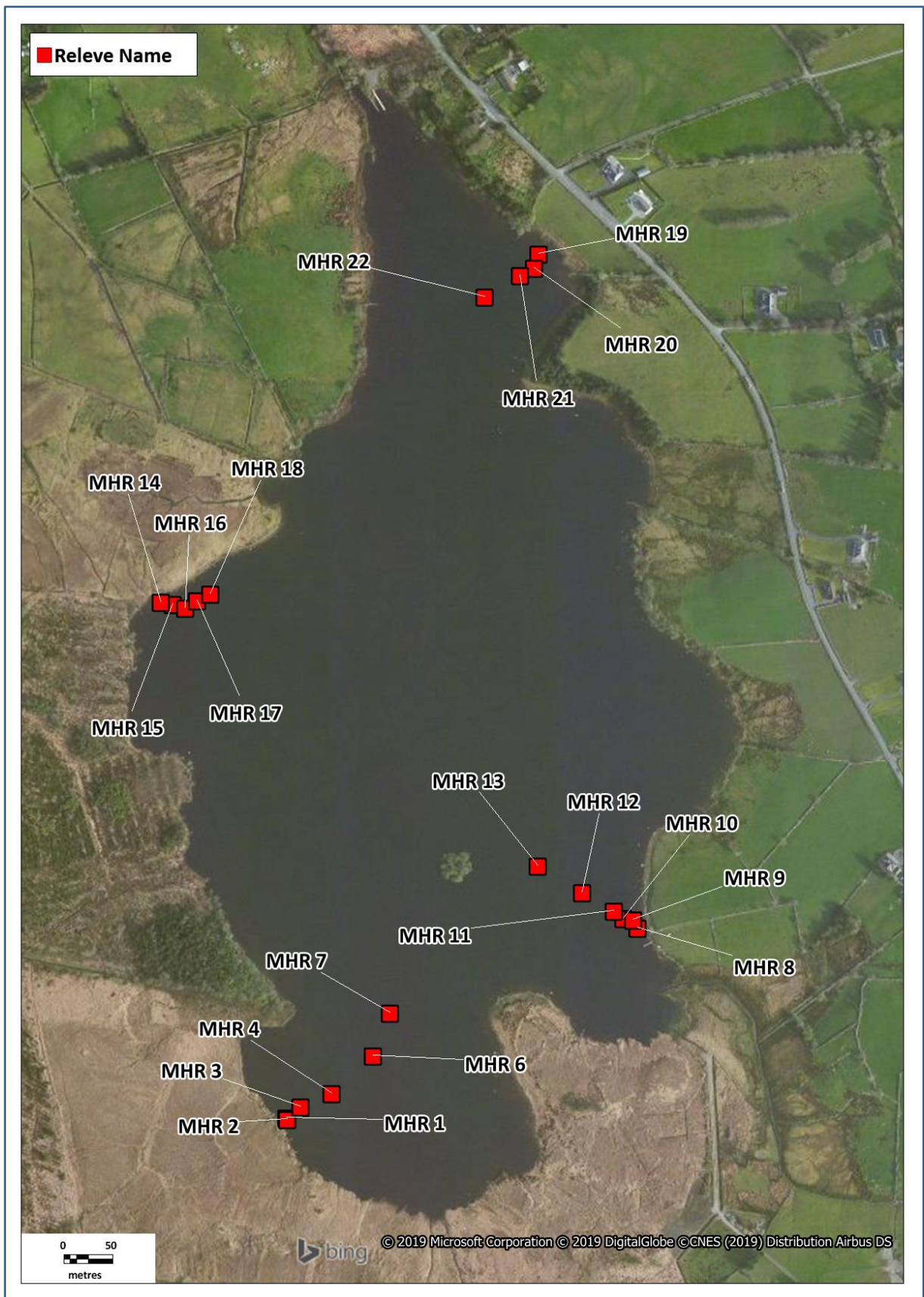
There appear to be no records from Moher Lough before the EPA survey programme began in 2008. *Najas flexilis* was recorded by the EPA in 2008. It was not recorded in 2011 or 2014. The pre-2017 list in the table shows the species recorded by the EPA between 2008 and 2014. In general, similar species were recorded in this survey, but *Myriophyllum spicatum* and *Oenanthe aquatica* were not recorded in 2017.

### Species recorded

In 2017, 27 species were recorded including some unusual taxa. Moher Lough is of interest in that it extends the range of several soft-water species such as *Isoetes echinospora*, *Eriocaulon aquaticum* and, of course, *Najas flexilis*.

- *Potamogeton obtusifolius* is usually a species of more eutrophic lakes but appears to occur in *Najas flexilis* lakes in south Connemara and elsewhere. It had not been recorded near to Moher Lough previously.
- *Isoetes echinospora* is probably under-recorded but the present location is a notable extension of its Irish range. It occurred along two separate transects.
- *Nitella confervacea* known at present from c. 25 hectads. This record is one of two Mayo records. It was only found in one location at a depth of 1.9 m.

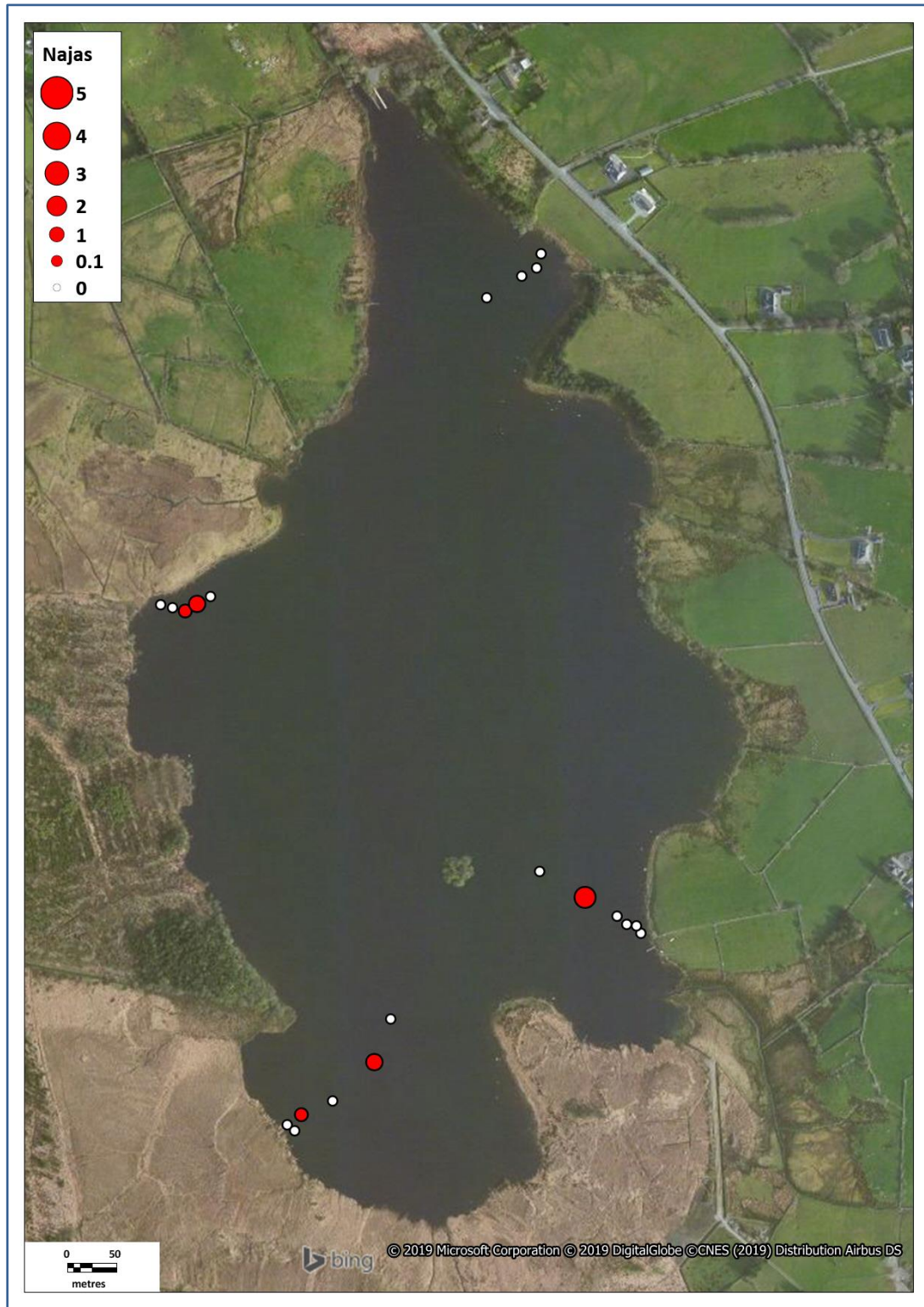
Taxon - Moher	Before this survey	In this survey (2017)	Taxon - Moher	Before this survey	In this survey (2017)
Charophytes			<i>Isoetes lacustris</i>	1	1
<i>Chara aspera</i>			<i>Juncus bulbosus</i>	1	1
<i>Chara curta</i>			<i>Lemna minor</i>		
<i>Chara globularis</i>			<i>Lemna trisulca</i>		
<i>Chara rudis</i>			<i>Littorella uniflora</i>	1	1
<i>Chara virgata</i>	1	1	<i>Lobelia dortmanna</i>	1	1
<i>Nitella confervacea</i>		1	<i>Myriophyllum alterniflorum</i>	1	1
<i>Nitella flexilis</i>			<i>Myriophyllum spicatum</i>	1	
<i>Nitella gracilis</i>			<i>Najas flexilis</i>	1	1
<i>Nitella opaca</i>			<i>Nuphar lutea</i>	1	1
<i>Nitella translucens</i>		1	<i>Nymphaea alba</i>		
<i>Tolypella glomerata</i>			<i>Oenanthe fluviatilis</i>	1	
<i>Chara cf. muscosa</i>			<i>Phragmites australis</i>	1	1
Other algae			<i>Pilularia globulifera</i>		
<i>Ophrydium versatile</i>			<i>Potamogeton alpinus</i>		1
Bryophytes			<i>Potamogeton berchtoldii</i>		1
<i>Fissidens fontanus</i>			<i>Potamogeton crispus</i>		
<i>Fontinalis antipyretica</i>	1	1	<i>Potamogeton filiformis</i>		
<i>Sphagnum</i> sp.			<i>Potamogeton gramineus</i>		
Vascular Plants			<i>Potamogeton lucens</i>		
<i>Alisma plantago-aquatica</i>		1	<i>Potamogeton natans</i>	1	1
<i>Apium inundatum</i>		1	<i>Potamogeton obtusifolius</i>	1	1
<i>Baldellia ranunculoides</i> subsp. <i>ranunculoides</i>		1	<i>Potamogeton pectinatus</i>		
<i>Baldellia ranunculoides</i> subsp. <i>repens</i>			<i>Potamogeton perfoliatus</i>	1	1
<i>Callitriche brutia</i> subsp. <i>hamulata</i>			<i>Potamogeton polygonifolius</i>		
<i>Callitriche hermaphroditica</i>			<i>Potamogeton praelongus</i>		
<i>Carex rostrata</i>		1	<i>Potamogeton pusillus</i>		
<i>Ceratophyllum demersum</i>			<i>Potamogeton × angustifolius</i>		
<i>Cladium mariscus</i>			<i>Potamogeton × nitens</i>		
<i>Elatine hexandra</i>		1	<i>Ranunculus</i> sp.		
<i>Eleocharis acicularis</i>			<i>Schoenoplectus lacustris</i>	1	1
<i>Eleocharis multicaulis</i>			<i>Sparganium angustifolium</i>		
<i>Eleocharis palustris</i>			<i>Sparganium emersum</i>		
<i>Eleogiton fluitans</i>			<i>Sparganium erectum</i>		
<i>Elodea canadensis</i>		1	<i>Sparganium natans</i>		
<i>Equisetum fluviatile</i>	1	1	<i>Subularia aquatica</i>		
<i>Eriocaulon aquaticum</i>	1	1	<i>Typha angustifolia</i>		
<i>Hydrilla verticillata</i>			<i>Utricularia</i> sp.		
<i>Isoetes echinospora</i>		1	<i>Zannichellia palustris</i>		



### *Najas flexilis*

The plant was first recorded from Moher Lough in 2008 by the EPA. In this 2017 survey it was found in six relevés throughout the lake with maximum cover of 20%. It grows between 0.7 m and 2.6 m, or the maximum euphotic depth in the lake. Associates are typical of the deep-water *Najas* community: *Nitella*

*translucens*, *N. confervacea*, *Potamogeton* species and others. It occurs in a band around the lake with an estimated area of about 4 ha.

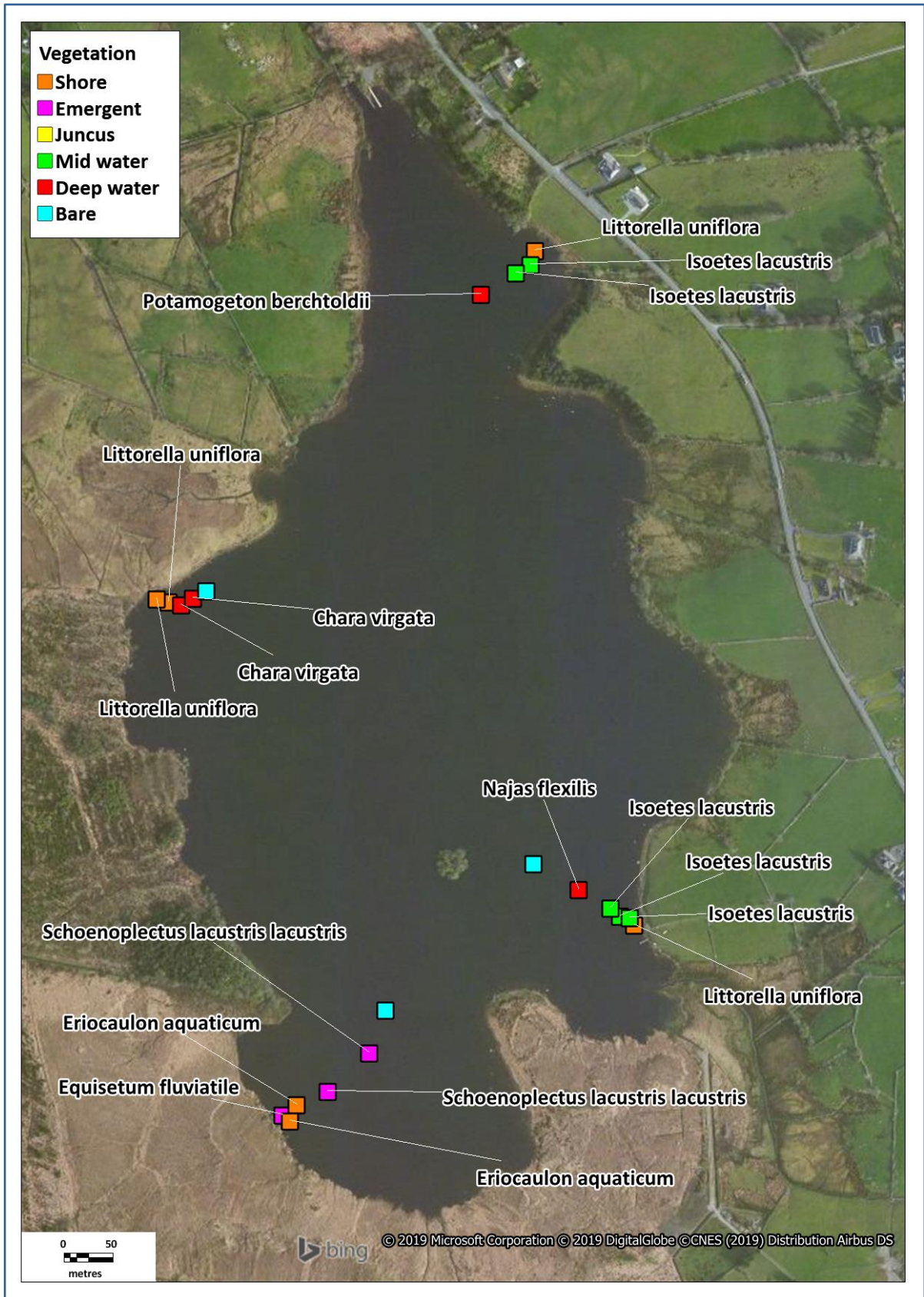


## Vegetation

The lake basin has a recorded depth of at least 6.5 m. The southern shores are peaty, with rock and gravel in the northern part. Deeper sediments are peaty-silt. In the south of the lake, dense beds of *Schoenoplectus* and *Phragmites* in places are followed by *Nuphar* and *Potamogeton natans*. *Eriocaulon* forms dense beds at 0.5-1 m on submerged peat. Below 1.0 m, a *Najas*—*Nitella translucens*—*Potamogeton berchtoldii* community occurs.

Further north, Isoetid communities (*Littorella*, *Lobelia*, *Isoetes* spp.) growing on mineral sediment of sand and cobbles are followed by the *Najas flexilis* community to a depth of 2.1 m on both sides of the lake. There is a greater diversity at the northern end, including *Chara* and *Potamogeton* species.

Maximum euphotic depth is less than 3.0 m, consequently vegetation does not extend across the lake bed but rather forms a band contouring along the lake shore.



## Water chemistry data

Water quality data for the period 2009 to 2015 were made available by the EPA, for many samples from multiple depths. Values presented and used in assessment are averages of all data.

Parameter	Unit	Moher EPA 2009-2015
Alkalinity	mg/l	17.6
Calcium	mg/l	6.8
Chloride	mg/l	20.8
Chlorophyll	µg/l	3.95
Colour	Hazen units	50.9
Conductivity	µS/cm	121
Magnesium	mg/l	2.1
pH		7.32
Potassium	mg/l	0.9
Secchi	m	2.3
Sulphate	mg/l	3.99
Total oxidised nitrogen	mg/l	0.18
Total phosphorus	mg/l	0.013

## Pressures and threats

The lake achieved good WFD status in 2008, 2011 and 2014 EPA surveys. However there are extensive conifer plantations on blanket bog close to the lake shore and water transparency is low. It is possible that a deeper euphotic depth occurred prior to these developments. Logging or nutrient run off from adjacent farm land are possible future threats.

## Conservation condition

Several parameters (euphotic depth, deep-water community, colour) are in the *Poor* range, probably due to peat runoff.

Parameter	Target for Good	Moher 2017	Condition
Area of habitat	Stable or increasing	Stable or increasing	Good
Deep-water community	Full development	Partial	Poor
Number of species	Stable or increase	Increase (27)	Good
Typical species	≥9 indicator species	12	Good
<i>Najas flexilis</i> population	Stable population	Assumed stable*	Good
Introduced species	Not present/not impacting on <i>Najas flexilis</i> / deep-water community	Not impacting	Good
Euphotic depth (m)	≥3	2.6	Poor
Colour (Hazen units)	<40	51	Poor
Total phosphorus (TP) (mg/l)	<0.015	0.013	Good
Hydrological regime	<50% <i>Lobelia – Littorella</i> zone exposed in summer	-	Good
<b>Overall assessment</b>			<b>Poor</b>

\* *Najas flexilis* occurs to base of euphotic zone, so a decrease in the euphotic depth would have reduced the population size



Lough Mullaghderg, 2017			
Name	Mullaghderg	Code	MDG
Alternative name(s)	Mullaghderg West		
Grid reference	B7619819733	Max. depth (m)	2
County	Donegal	EPA code	38_85
Area (ha)	54	OSi 1:50,000 sheet	1
Maximum length (km)	1.4	Nutrient data	This survey 05/02/2019, Heuff (1984) 1977
Altitude (m)	3	SAC	001141, Gweedore Bay And Islands SAC
Geology	Granite and blown sand		
Previous survey	Bullock-Webster (1920), Heuff (1984), C.D. Preston in 1989, Roden (1999, 2004, 2007), Wingfield <i>et al.</i> (2004)		
Previous <i>Najas flexilis</i> records	Bullock-Webster August 1919, J.P.M. Brenan and N.D. Simpson 10/08/1938, W.A. Sledge 1939, H. Heuff and J. Ryan 21/09/1977, N.F. Stewart and others 23/08/1989, 06/06/1990, C. Roden 15/09/1999, 30/07/2002, R.A. Wingfield 15/08/2000 (note records are for both Mullaghderg East and West)		
Other noteworthy species	<i>Chara muscosa</i>		
Snorkel survey date(s)	25/07/2017	Number of species	26
Surveyors	PM, CR, JR	Alkalinity (mg/l CaCO <sub>3</sub> )	35
Number of transects	4	Total phosphorus (mg/l TP)	0.044
Number of relevés	16	Colour (Hazen units)	172
Euphotic depth (m)	>1.2/max depth	Secchi depth (m)	-
<i>Najas flexilis</i>	Occurs at low density scattered over the lake bed		
Deep-water vegetation	Partial development		
Noteworthy species	<i>Isoetes echinospora</i> , <i>Najas flexilis</i> , <i>Nitella confervacea</i> , <i>Potamogeton × griffithsii</i> (requires verification)		
Introduced species	None noted		
Substrates	Largely sand with some rock and silt		
Summary	A shallow lake close to the sea with <i>Najas flexilis</i> but damaged by historic drainage and high water colour		
Lake score	91	Lake rank	5
CONSERVATION CONDITION	<b>POOR</b>		

### Previous accounts

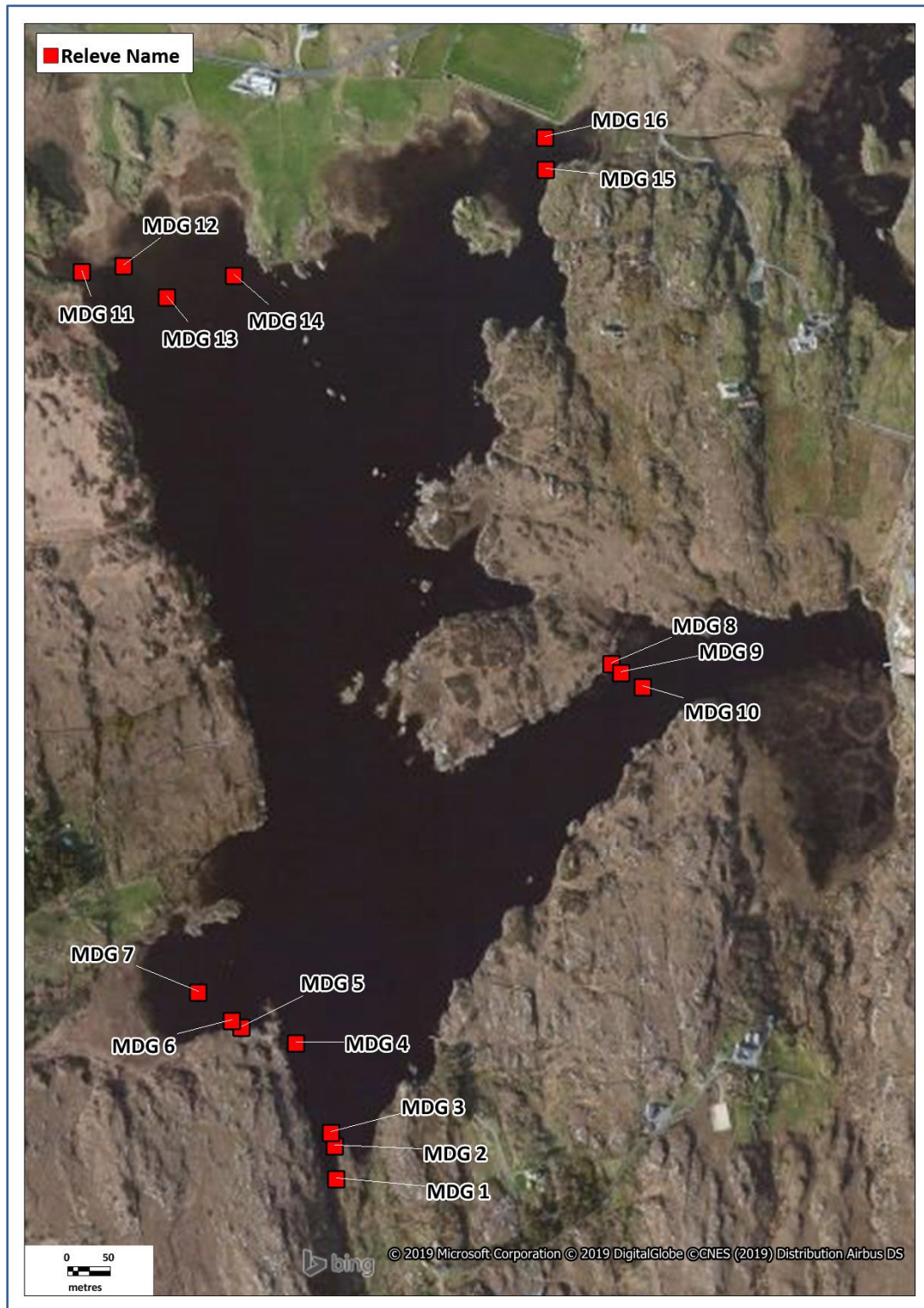
1. Bullock-Webster visited the lake in 1917 and 1919 (Bullock-Webster, 1918, 1920; Groves & Bullock-Webster, 1924b). He recorded *Chara aspera*, *Chara virgata*, *Chara curta*, *Nitella opaca* and *Chara muscosa*, as well as *Najas flexilis* on his second visit (Bullock-Webster, 1920; Groves & Bullock-Webster, 1924a, b).
2. Brenan and Simpson collected both *Najas flexilis* and *Chara muscosa* during their surveys in 1938 and 1939, reported in Brenan & Simpson (1949), however both species' records arise from later determination of museum specimens.
3. H. Heuff and J. Ryan conducted a snorkel survey on 21/09/1977 (Heuff, 1984). Their description is reproduced below.
4. C. Roden snorkelled in part of the lake in 1999 and gave the following description:

*This lake is noted as the original location for the rare Chara muscosa. However it has not been seen here since 1939 (Stewart & Church, 1992). The northern end of the lake is separated from the sea by a line of sand dunes but most of the lakeshore consists of high rocky granite scarps. However the whole floor of the northern basin is sandy. The plant communities suggest oligotrophic water and calcium content is less than 6 mg/l. An unusual feature of the sand shelf is that it has been invaded in places by a dense growth of the Common Reed Phragmites australis, a feature not seen elsewhere. Bullock-Webster*

does not mention this feature in his report of 1917. But his observation that *Chara aspera* grows in abundance on the sand shelf remains the case. It is abundant at depths less than 1.5 m and unusually persists in diminished quantity to depths of 2.5 m. *Najas flexilis* is occasional on the sandy bottom but in general plant life is much poorer in this lake than in Aughrusbeg or Kiltorris. It is possible that a more diverse community occurs in the southern basin but it was not possible to reach this area without the use of a boat

(Roden, 1999).

See also Gweedore Bay and Islands SAC conservation objectives supporting document for *Najas flexilis* (NPWS, 2015a, b).



## Description of Mullaghderg by H. Heuff and J. Ryan (Heuff, 1984).

*Shallow lake behind dunes with moderately soft-water and sandy bottom. Sparse emergent fringe. Submerged vegetation dominated by Littorella uniflora, Eriocaulon aquaticum or at northern shore, Chara aspera. Najas flexilis found in this lake. Much of the bottom covered in flocculated algal material.*

### *Emergent zone*

*Sparse fringe of Carex rostrata and Phragmites australis.*

### *Submergent zone*

*Littorella, Chara aspera and Eriocaulon dominated areas occur at about 1 m depth. At 1.5 m Potamogeton praelongus, P. gramineus, Najas flexilis and Nitella flexilis were found together on soft silt overlying sand.*

## Species recorded

In 2017, 26 species were recorded from Mullaghderg. A total of 32 or more species has been recorded over all surveys. Several unusual species occurred or still occur.

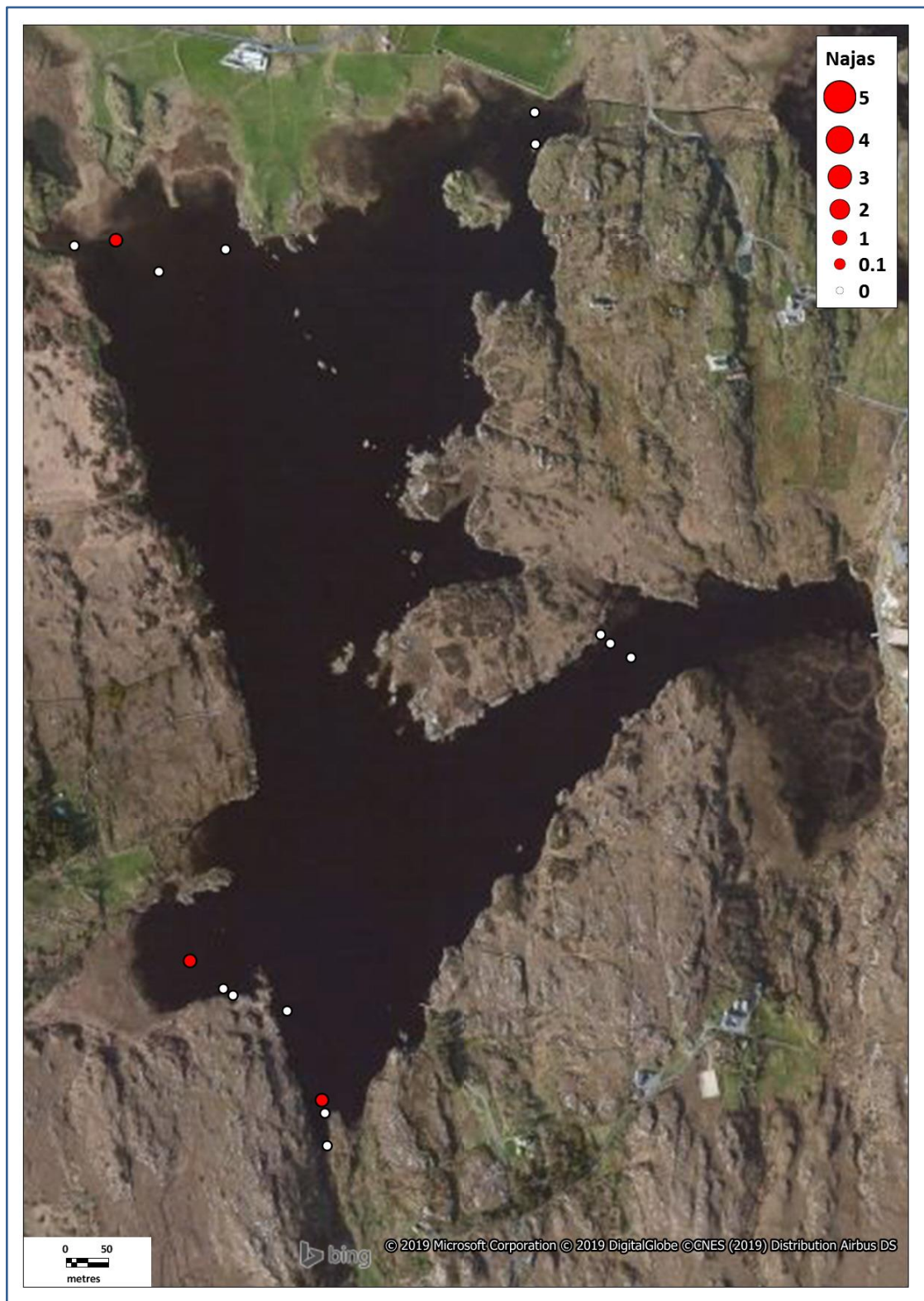
- *Chara muscosa*, a little known taxon was described from this lake by Groves and Bullock-Webster (Groves & Bullock-Webster, 1924a, b) however it has not been seen for many years despite several searches using snorkel. A possible reason is the partial drainage of the lake in the early 20<sup>th</sup> century.
- *Nitella confervacea*, though known from the adjoining lake Mullaghderg East, was first recorded in this survey. It grows at 1-1.5 m in soft silt in the northern part of the lake.
- *Isoetes echinospora* is an under-recorded taxon which occurs in several other lakes examined in the 2016-2018 survey. It is found scattered amongst *Isoetes lacustris* plants, and neither species is very abundant in the lake.
- *Potamogeton × griffithsii* (*P. praelongus* × *P. alpinus*) is a very rare hybrid in Ireland being only known from a lake in Fanad. Similar material was also gathered during the survey at Lough Anure. These new localities have yet to be confirmed, but have been included in the tables and species counts as the taxon is known to occur in Donegal. *Potamogeton × griffithsii* occurs at several locations in the Mullaghderg with cover values of 10%.

## *Najas flexilis*

The plant occurs scattered over the floor throughout the lake. Density is low, like most macrophytes in Mullaghderg, due perhaps to the shallow depth and mobile bottom deposits. The plant was first noted in 1919 and has been recorded in every subsequent survey despite the impact of drainage lowering the lake level. The area of suitable habitat is large (>50 ha.) due to the shallow nature of the lake, but as noted cover value is very low, <1%.

Taxon - Mullaghderg	Before this survey	In this survey (2017)	Taxon - Mullaghderg	Before this survey	In this survey (2017)
Charophytes			<i>Juncus bulbosus</i>	1	1
<i>Chara aspera</i>	1	1	<i>Lemna minor</i>		
<i>Chara curta</i>	1		<i>Lemna trisulca</i>		
<i>Chara globularis</i>			<i>Littorella uniflora</i>	1	1
<i>Chara rudis</i>			<i>Lobelia dortmanna</i>	1	1
<i>Chara virgata</i>	1	1	<i>Myriophyllum alterniflorum</i>		
<i>Nitella confervacea</i>		1	<i>Myriophyllum spicatum</i>	1	1
<i>Nitella flexilis</i>	1	1	<i>Najas flexilis</i>	1	1
<i>Nitella gracilis</i>			<i>Nuphar lutea</i>		
<i>Nitella opaca</i>	1		<i>Nymphaea alba</i>		
<i>Nitella translucens</i>	1	1	<i>Oenanthe fluviatilis</i>		
<i>Tolypella glomerata</i>			<i>Phragmites australis</i>	1	1
<i>Chara cf. muscosa</i>	1		<i>Pilularia globulifera</i>		
Other algae			<i>Potamogeton alpinus</i>	1	
<i>Ophrydium versatile</i>			<i>Potamogeton berchtoldii</i>		1
Bryophytes			<i>Potamogeton crispus</i>		
<i>Fissidens fontanus</i>			<i>Potamogeton filiformis</i>		
<i>Fontinalis antipyretica</i>	1		<i>Potamogeton gramineus</i>	1	1
<i>Sphagnum</i> sp.			<i>Potamogeton lucens</i>		
Vascular Plants			<i>Potamogeton natans</i>	1	1
<i>Alisma plantago-aquatica</i>			<i>Potamogeton obtusifolius</i>		
<i>Apium inundatum</i>			<i>Potamogeton pectinatus</i>		
<i>Baldellia ranunculoides</i> subsp. <i>ranunculoides</i>			<i>Potamogeton perfoliatus</i>	1	1
<i>Baldellia ranunculoides</i> subsp. <i>repens</i>			<i>Potamogeton polygonifolius</i>		
<i>Callitriche brutia</i> subsp. <i>hamulata</i>			<i>Potamogeton praelongus</i>	1	1
<i>Callitriche hermaphroditica</i>			<i>Potamogeton pusillus</i>		
<i>Carex rostrata</i>	1		<i>Potamogeton × angustifolius</i>		
<i>Ceratophyllum demersum</i>			<i>Potamogeton × griffithsii</i>		1*
<i>Cladium mariscus</i>			<i>Potamogeton × nitens</i>		
<i>Elatine hexandra</i>		1	<i>Ranunculus</i> sp.		
<i>Eleocharis acicularis</i>			<i>Schoenoplectus lacustris</i>		
<i>Eleocharis multicaulis</i>		1	<i>Sparganium angustifolium</i>	1	1
<i>Eleocharis palustris</i>			<i>Sparganium emersum</i>		
<i>Eleogiton fluitans</i>			<i>Sparganium erectum</i>		
<i>Elodea canadensis</i>			<i>Sparganium natans</i>		1
<i>Equisetum fluviatile</i>	1	1	<i>Subularia aquatica</i>		
<i>Eriocaulon aquaticum</i>	1	1	<i>Typha angustifolia</i>		
<i>Hydrilla verticillata</i>			<i>Utricularia</i> sp.	1	1
<i>Isoetes echinospora</i>		1	<i>Zannichellia palustris</i>		
<i>Isoetes lacustris</i>	1	1			

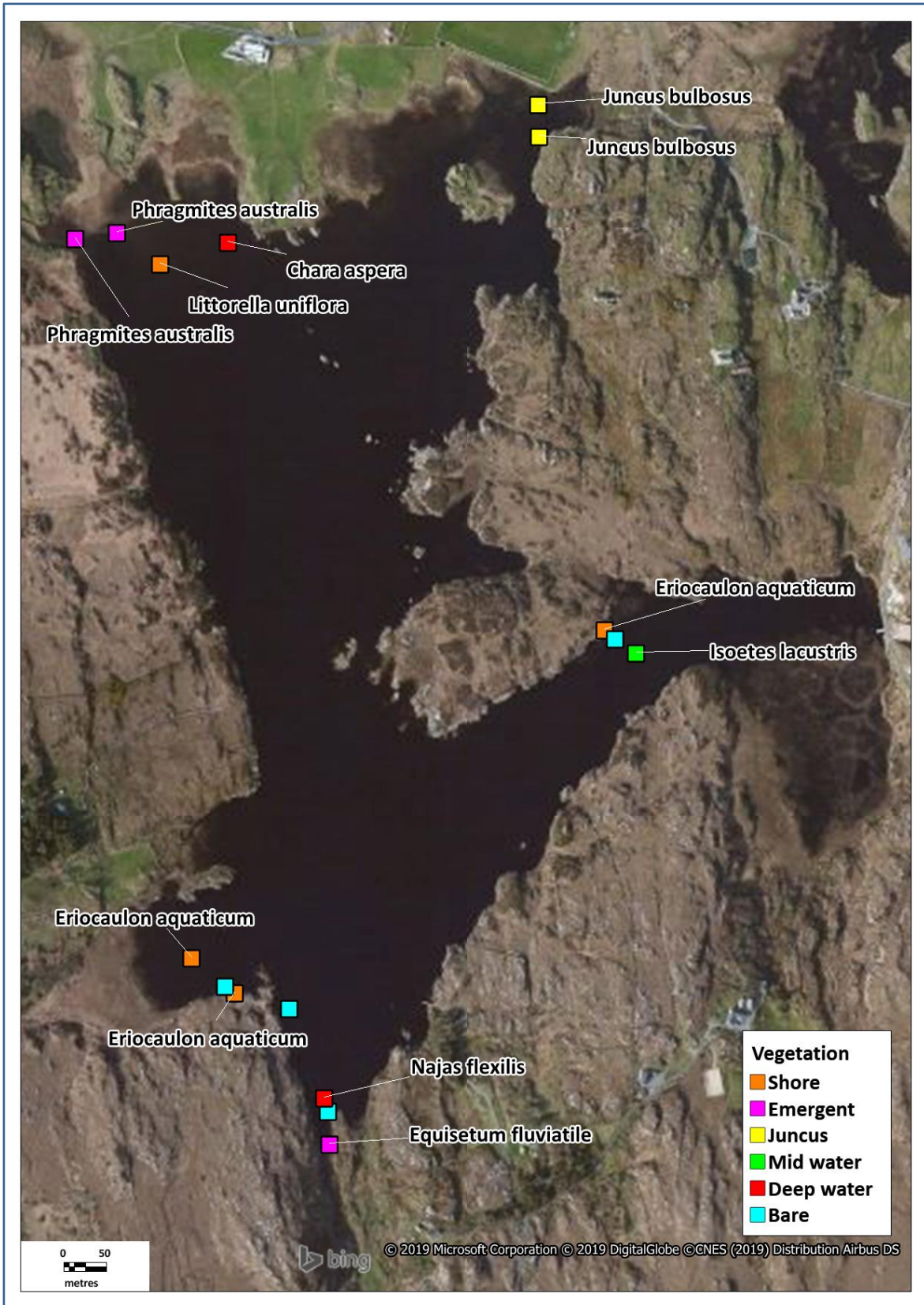
\* requires verification



## Vegetation

Mullaghderg Lough was partly drained by the early 20<sup>th</sup> century. This resulted in the lake being divided into two lakes: Mullaghderg east and west. Furthermore, a north-western arm has now become fen or swamp. The lake is separated from the sea by extensive sand dunes and much of the lake bottom is sand or a loose sandy sediment, noted both in this survey and by H. Heuff and J. Ryan in 1977 (Heuff, 1984). The lake is very shallow (1.5 m) and wave action appears to disturb the bottom so that large areas are bare of vegetation and have a semi-liquid composition. In areas close to rocky shores more solid bottom sediment occurs which supports benthic vegetation.

Shoreline vegetation consists of *Eriocaulon* or *Littorella* swards with some *Lobelia* and *Isoetes*. In sheltered areas, *Potamogeton natans*, *Phragmites australis* and *Equisetum fluviatile* grow. On the northern shore, an extensive sand shelf of about 0.8-1.0 m supports very abundant *Chara aspera* and *Phragmites*. In slightly deeper water (>1.0 m), *Nitella translucens*, *Nitella confervoacea*, *Nitella flexilis* and rare *Najas flexilis* occur. At similar depths, large *Potamogeton* species and *Myriophyllum spicatum* can occur in other parts of the lake bed. Tow ards the southern end, large areas of semi-liquid silt with little vegetation occurs. The lake is so shallow that euphotic depth is greater than lake maximum depth.



## Water chemistry data

Water samples were taken on a single occasion on the 05 February 2019 as part of this survey. Data are also available from 21 September 1977 (Heuff, 1984) are reproduced in the table.

Parameter	Unit	Mullaghderg This survey	Mullaghderg Heuff 1977
Alkalinity	mg/l	34.8	8
Calcium	mg/l	13	
Chloride	mg/l	36.3	13.1
Chlorophyll	µg/l	1.07	
Colour	Hazen units	172	
Conductivity	µS/cm	187	250
pH		7.4	
Potassium	mg/l		0.28
Total phosphorus	mg/l	0.044	

## Pressures and threats

There are no immediate threats to the lake but past damage in the form of lowering lake level and splitting the lake in two was substantial, possibly resulting in the extinction of *Chara muscosa*. The outlet from Mullaghderg Lough to Kincas Lough was drained in the late 19<sup>th</sup> or early 20<sup>th</sup> century (between the First Edition (1830s) and Second Edition (1902) six-inch maps) (NPWS, 2015).

## Conservation condition

Mullaghderg is a very shallow sandy-bottomed lake. The limited nutrient data suggest high total phosphorus and colour levels. The lack of extensive bottom vegetation is unexplained but is not compatible with *Good* conservation condition.

Parameter	Target for Good	Mullaghderg 2017	Condition
Area of habitat	Stable or increasing	Reduced	Poor
Deep-water community	Full development	Partial development	Poor
Number of species	Stable or increase	Stable (26)	Good
Typical species	≥9 indicator species	11	Good
<i>Najas flexilis</i> population	Stable population	Appears stable	Good
Introduced species	Not present/not impacting on <i>Najas flexilis</i> / deep-water community	Not present	Good
Euphotic depth (m)	≥3	>1.2	n/a
Colour (Hazen units)	<40	172	Bad
Total phosphorus (TP) (mg/l)	<0.015	0.044	Poor
Hydrological regime	<50% <i>Lobelia</i> – <i>Littorella</i> zone exposed in summer	-	Good
<b>Overall assessment</b>			<b>Poor</b>

Loch na Creibhinne, 2016				
Name	na Creibhinne		Code	CRE
Alternative name(s)	Creibhinne, Nagravín			
Grid reference	L9906621559	Max. depth (m)	2.2	
County	Galway	EPA code	31_212	
Area (ha)	56	OSi 1:50,000 sheet	45	
Maximum length (km)	1.4	Nutrient data	This survey 18/01/2019, C. Roden in 2005	
Altitude (m)	14	SAC	-	
Geology	Galway granite			
Previous survey	C. Roden for NPWS in 2005			
Previous <i>Najas flexilis</i> records	C. Roden 29/08/2005, U. King 2010			
Other noteworthy species	<i>Potamogeton obtusifolius</i>			
Snorkel survey date(s)	30/08/2016	Number of species	20	
Surveyors	PM, CR	Alkalinity (mg/l CaCO <sub>3</sub> )	16.4	
Number of transects	4	Total phosphorus (mg/l TP)	0.0185	
Number of relevés	10	Colour (Hazen units)	64	
Euphotic depth (m)	>1.5/max depth	Secchi depth (m)	-	
<i>Najas flexilis</i>	Large population throughout the lake			
Deep-water vegetation	Very shallow lake with an unusual shallow water <i>Najas flexilis</i> population, occurring with other members of the normally deep-water community			
Noteworthy species	<i>Najas flexilis</i> , <i>Potamogeton obtusifolius</i>			
Introduced species	<i>Elodea canadensis</i> present			
Substrates	Fine mud, sand, cobbles, rock			
Summary	A shallow coastal lake on granite in good conservation condition. <i>Najas</i> vegetation occurs in a mosaic along with <i>Isoetes lacustris</i> at a relatively shallow depth			
Lake score	154	Lake rank	3	
CONSERVATION CONDITION	<b>GOOD</b>			

### Previous accounts

1. The initial account of this lake was provided by C. Roden who sampled on 29/08/2005 (Roden, 2005). The site and vegetation were briefly described based on a short examination by snorkelling the south-western section. The area examined was shallow (1-1.5 m) with numerous granite glacial erratics, both in the lake and along the shore. There was little developed shore vegetation other than an *Eriocaulon* band. Most of the bottom was dominated by *Isoetes lacustris* or *Eriocaulon*, with gaps occupied by *Najas flexilis* and *Potamogeton* species with *Najas flexilis* growing in unusually shallow water (1.0 m).
2. The population was confirmed in 2010 by Ursula King (King pers. comm.).

### Species recorded

Despite the lake's size, the species list is relatively short: 20 species were recorded in 2016 and a total of 21 from all surveys. This is probably due to the nature of the lake's topography. It consists of a shallow granite rock basin no deeper than 2.2 m with many protruding rocks. As there are no large inflowing rivers, there is little sediment, instead rocky ground is common. Deep-water communities cannot occur.

*Najas flexilis* is the only species of conservation significance, but *Potamogeton obtusifolius* is very local in Connemara.



Taxon - Creibhinne	Before this survey	In this survey (2016)	Taxon - Creibhinne	Before this survey	In this survey (2016)
Charophytes			<i>Isoetes lacustris</i>	1	1
<i>Chara aspera</i>			<i>Juncus bulbosus</i>		
<i>Chara curta</i>			<i>Lemna minor</i>		
<i>Chara globularis</i>			<i>Lemna trisulca</i>		
<i>Chara rudis</i>			<i>Littorella uniflora</i>		1
<i>Chara virgata</i>		1	<i>Lobelia dortmanna</i>	1	1
<i>Nitella confervacea</i>			<i>Myriophyllum alterniflorum</i>	1	1
<i>Nitella flexilis</i>			<i>Myriophyllum spicatum</i>		
<i>Nitella gracilis</i>			<i>Najas flexilis</i>	1	1
<i>Nitella opaca</i>			<i>Nuphar lutea</i>		
<i>Nitella translucens</i>	1	1	<i>Nymphaea alba</i>		
<i>Tolypella glomerata</i>			<i>Oenanthe fluviatilis</i>		
<i>Chara cf. muscosa</i>			<i>Phragmites australis</i>		
Other algae			<i>Pilularia globulifera</i>		
<i>Ophrydium versatile</i>		1	<i>Potamogeton alpinus</i>		
Bryophytes			<i>Potamogeton berchtoldii</i>	1	1
<i>Fissidens fontanus</i>			<i>Potamogeton crispus</i>		
<i>Fontinalis antipyretica</i>			<i>Potamogeton filiformis</i>		
<i>Sphagnum</i> sp.			<i>Potamogeton gramineus</i>		1
Vascular Plants			<i>Potamogeton lucens</i>		
<i>Alisma plantago-aquatica</i>	1	1	<i>Potamogeton natans</i>		1
<i>Apium inundatum</i>			<i>Potamogeton obtusifolius</i>	1	1
<i>Baldellia ranunculoides</i> subsp. <i>ranunculoides</i>	1		<i>Potamogeton pectinatus</i>		
<i>Baldellia ranunculoides</i> subsp. <i>repens</i>			<i>Potamogeton perfoliatus</i>	1	1
<i>Callitriche brutia</i> subsp. <i>hamulata</i>			<i>Potamogeton polygonifolius</i>		
<i>Callitriche hermaphrodita</i>			<i>Potamogeton praelongus</i>		
<i>Carex rostrata</i>			<i>Potamogeton pusillus</i>		
<i>Ceratophyllum demersum</i>			<i>Potamogeton × angustifolius</i>		
<i>Cladium mariscus</i>			<i>Potamogeton × nitens</i>		
<i>Elatine hexandra</i>	1	1	<i>Ranunculus</i> sp.		
<i>Eleocharis acicularis</i>			<i>Schoenoplectus lacustris</i>		
<i>Eleocharis multicaulis</i>			<i>Sparganium angustifolium</i>		
<i>Eleocharis palustris</i>			<i>Sparganium emersum</i>		
<i>Eleogiton fluitans</i>			<i>Sparganium erectum</i>		
<i>Elodea canadensis</i>		1	<i>Sparganium natans</i>	1	1
<i>Equisetum fluviatile</i>			<i>Subularia aquatica</i>		
<i>Eriocaulon aquaticum</i>	1	1	<i>Typha angustifolia</i>		1
<i>Hydrilla verticillata</i>			<i>Utricularia</i> sp.		1
<i>Isoetes echinospora</i>			<i>Zannichellia palustris</i>		



### *Najas flexilis*

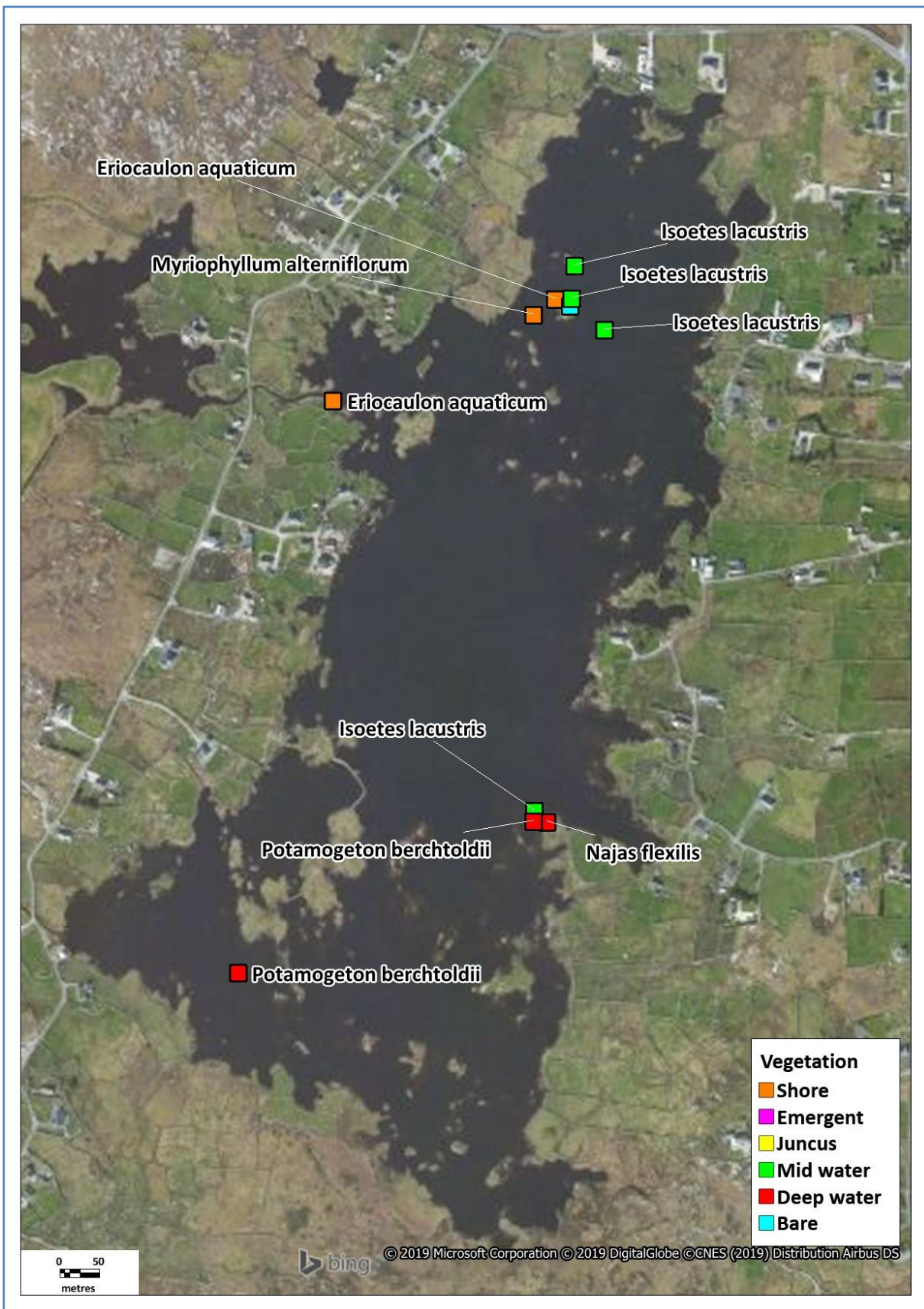
The plant is abundant in the lake and was recorded in five relevés out of 10 sampled, but at low densities. The plant occurs from about 1.0 m to 2.2 m. It occurs throughout the lake. Substrate is always silt or mud, often in pockets among rocks and boulders. Companion species include *Potamogeton*

*berchtoldii*, *P. obtusifolius* and *P. perfoliatus*. Many plants produce seeds and flowers and appear in good condition (large, much branched unfouled with epiphytes).

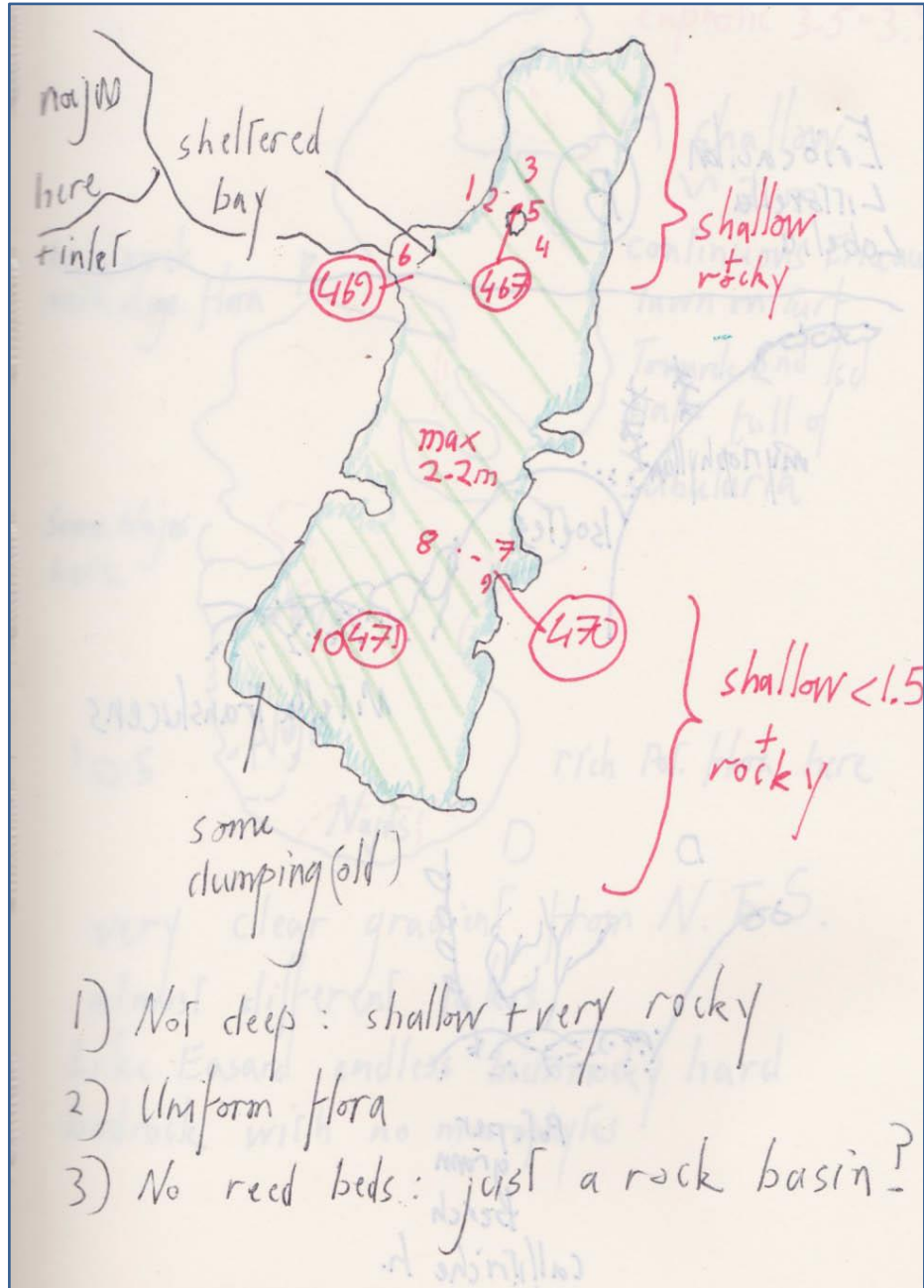


## Vegetation

There is little variation in the vegetation which reflects the lake's uniform substrate and depth. Most of the lake is dominated by an *Isoetes*—*Potamogeton berchtoldii* community with many scattered plants of *Najas flexilis* and *Chara virgata*. The vegetation appears to be a combination of deep-water vegetation interspersed with the mid-water *Isoetes* vegetation in relatively shallow water.



## Sketch map



## Water chemistry data

Water samples were taken on a single occasion on the 18 January 2019 as part of this survey. Data are also available from samples taken by C. Roden on 22 September 2005.

Parameter	Unit	Creibhinne This survey	Creibhinne C. Roden 2005
Ammonia	mg/l		0.020
Alkalinity	mg/l	16.4	18
Calcium	mg/l	6.4	6.8
Chloride	mg/l	35.7	43.5
Chlorophyll	µg/l	4.53	3.46
Colour	Hazen units	63.5	-
Conductivity	µS/cm	145	163.2
Magnesium	mg/l	2.4	2.4
Nitrate	mg/l		0.004
Nitrite	mg/l		0.001
pH		7.08	7.14
Phosphate	mg/l		<0.003
Total phosphorus	mg/l	0.0185	0.0152

## Pressures and threats

Some minor dumping was noted at the south end of the lake. While the number of surrounding houses is high (50 or more), only three new houses have appeared since 2005 (GEOHIVE website). No striking changes in land-use can be detected in this time. An administrative problem is that the lake has no nature conservation designation as an NHA or SAC, though *Najas flexilis* is protected by the Flora Protection Order and is a Habitats Directive Annex II species.

## Conservation condition

An unusual lake due to its shallow depth and the large *Najas flexilis* population growing close to the surface. Total phosphorus levels are higher than in many *Najas flexilis* lakes. The absence of a deep-water community is discounted as an unusual shallow water *Najas flexilis* population occurs and appears to be in good condition.

Parameter	Target for Good	Creibhinne 2016	Condition
Area of habitat	Stable or increasing	Stable or increasing	Good
Deep-water community	Full development	replaced by shallow water population	n/a
Number of species	Stable or increase	Increase (20)	Good
Typical species	≥9 indicator species	10	Good
<i>Najas flexilis</i> population	Stable population	Appears stable	Good
Introduced species	Not present/not impacting on <i>Najas flexilis</i> / deep-water community	Not impacting on <i>Najas flexilis</i>	Good
Euphotic depth (m)	≥3	>1.5/max depth	n/a
Colour (Hazen units)	<40	64	Poor
Total phosphorus (TP) (mg/l)	<0.015	0.0185	Poor
Hydrological regime	<50% <i>Lobelia – Littorella</i> zone exposed in summer	-	Good
<b>Overall assessment</b>			<b>Good</b>

Loch na gCaor, 2017			
Name	na gCaor	Code	NCR
Alternative name(s)	Nageeron		
Grid reference	L7511231586	Max. depth (m)	3
County	Galway	EPA code	31_142
Area (ha)	9	OSi 1:50,000 sheet	44
Maximum length (km)	0.5	Nutrient data	This survey 18/01/2019, C. Roden 2004
Altitude (m)	5	SAC	002119, Lough Nageeron SAC
Geology	Galway granite		
Previous survey	M. Scannell in 1974, R. FitzGerald and A.C. Leslie in 1991, M. Wyse Jackson in 1997, Roden (2004)		
Previous <i>Najas flexilis</i> records	M.J.P. Scannell 23/09/1974, R. FitzGerald and A.C. Leslie 08/08/1991, M.B. Wyse Jackson 20/08/1997, C. Roden 04/08/2004		
Other noteworthy species	-		
Snorkel survey date(s)	21/09/2017	Number of species	14
Surveyors	PM, CR	Alkalinity (mg/l CaCO <sub>3</sub> )	28.8
Number of transects	4	Total phosphorus (mg/l TP)	0.02
Number of relevés	15	Colour (Hazen units)	97
Euphotic depth (m)	2.1	Secchi depth (m)	-
<i>Najas flexilis</i>	Scattered plants at low densities on south and east sides of the lake		
Deep-water vegetation	Partial development		
Noteworthy species	<i>Najas flexilis</i> , <i>Potamogeton obtusifolius</i>		
Introduced species	None noted		
Substrates	Silt and rock		
Summary	A small shallow lake in south Connemara. <i>Najas flexilis</i> is present but vegetation and flora is very sparse possibly due to shallow depth and wind exposure		
Lake score	96	Lake rank	5
CONSERVATION CONDITION	<b>POOR</b>		

### Previous accounts

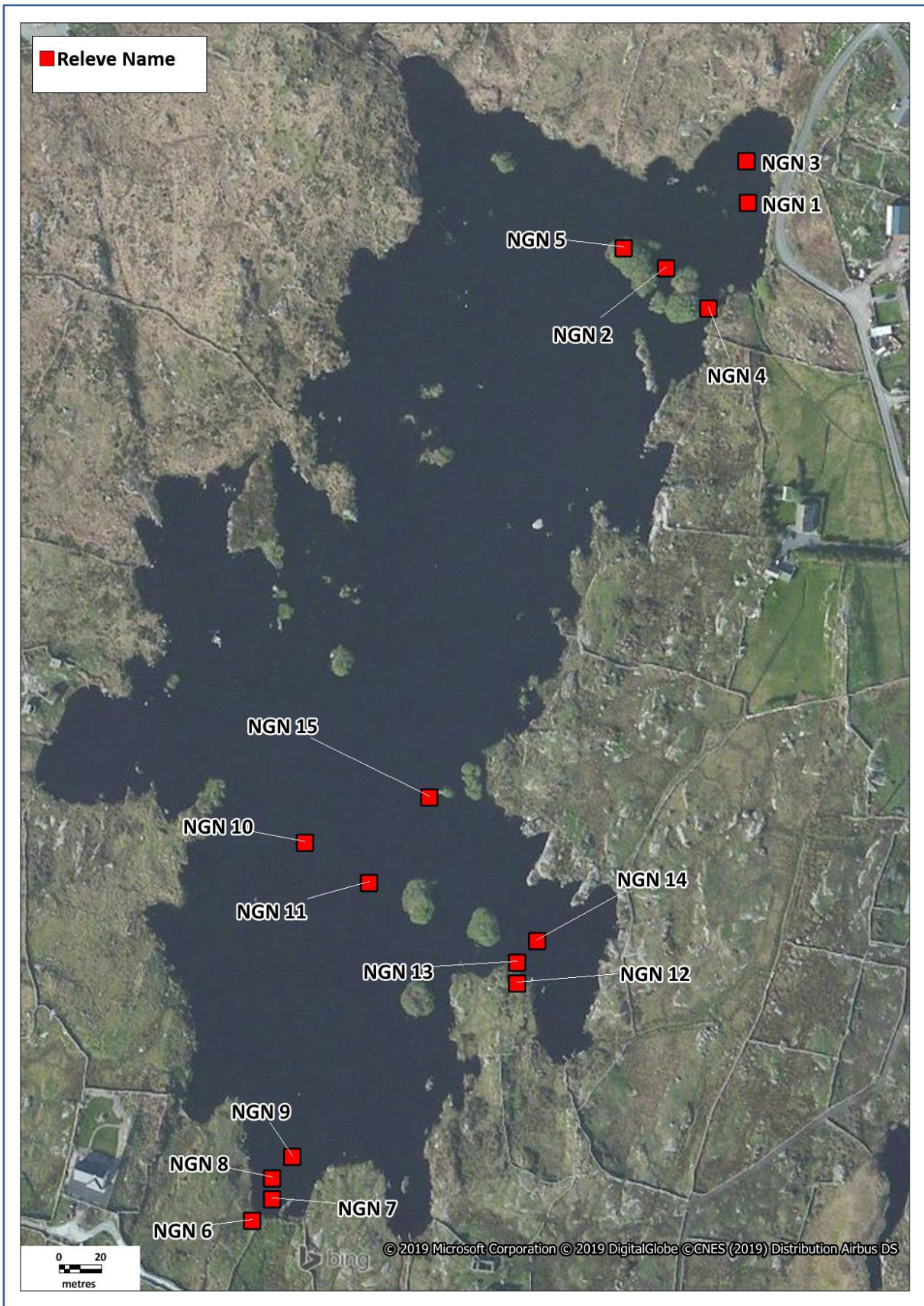
1. *Najas flexilis* was recorded as drift material by Maura Scannell in 1974.
2. R. FitzGerald also recorded drift material in 1991.
3. M. Wyse Jackson also noted drift material in 1997, a large quantity was noted.
4. C. Roden snorkelled in the north-eastern corner of the lake on 04/08/2004 and recorded *Najas* and associated flora (Roden, 2004). He noted clear water and a rocky cobble shore but did not distinguish vegetation zones. Species present are shown in the table below. Other than *Najas flexilis*, no unusual species were noted. The plant grew at 2.0 m with *Callitriche hamulata*, *Potamogeton perfoliatus*, *P. berchtoldii* and *M. alterniflorum*. Roden (2004) commented that *Najas* was not very abundant (maximum cover value 10%). A water chemistry sample was also taken and data are given below.

See also NPWS (2021c).

### Species recorded

Only 14 species were recorded from Lough na gCaor in 2017. All but *Najas flexilis* are widespread in soft-water lakes. Across all surveys only 16 species have been recorded. A possible reason is that the lake is both very shallow and most shores are of cobble and rock.

*Potamogeton obtusifolius* is usually a species of more eutrophic lakes but appears to occur in *Najas flexilis* lakes in south Connemara.

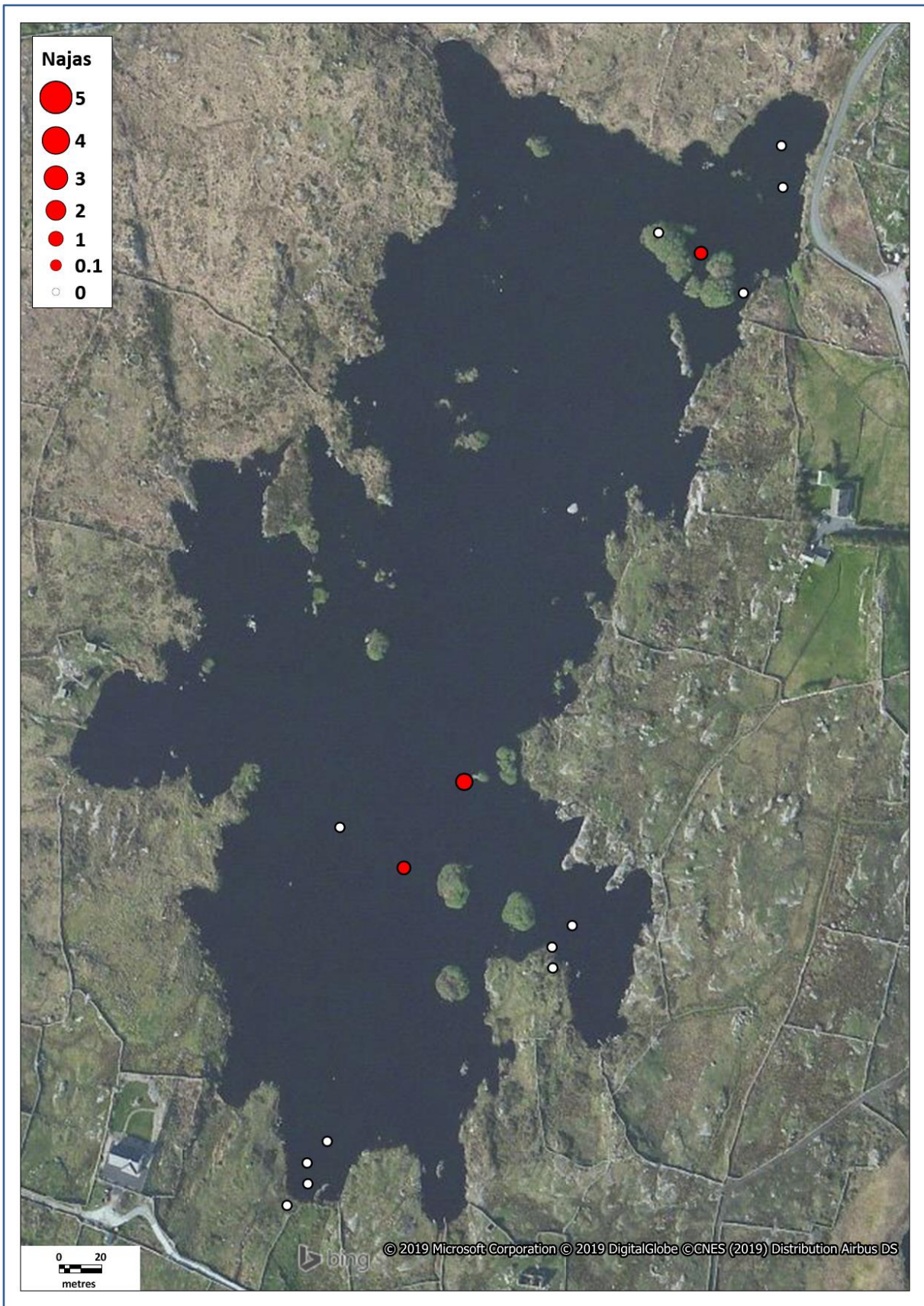




Taxon - na gCaor	Before this survey	In this survey (2017)	Taxon - na gCaor	Before this survey	In this survey (2017)
Charophytes			<i>Isoetes lacustris</i>	1	1
<i>Chara aspera</i>			<i>Juncus bulbosus</i>		
<i>Chara curta</i>			<i>Lemna minor</i>		
<i>Chara globularis</i>			<i>Lemna trisulca</i>		
<i>Chara rudis</i>			<i>Littorella uniflora</i>	1	1
<i>Chara virgata</i>	1	1	<i>Lobelia dortmanna</i>		
<i>Nitella confervacea</i>			<i>Myriophyllum alterniflorum</i>	1	1
<i>Nitella flexilis</i>	1		<i>Myriophyllum spicatum</i>		
<i>Nitella gracilis</i>			<i>Najas flexilis</i>	1	1
<i>Nitella opaca</i>			<i>Nuphar lutea</i>		
<i>Nitella translucens</i>	1	1	<i>Nymphaea alba</i>		1
<i>Tolypella glomerata</i>			<i>Oenanthe fluviatilis</i>		
<i>Chara cf. muscosa</i>			<i>Phragmites australis</i>		1
Other algae			<i>Pilularia globulifera</i>		
<i>Ophrydium versatile</i>			<i>Potamogeton alpinus</i>		
Bryophytes			<i>Potamogeton berchtoldii</i>	1	1
<i>Fissidens fontanus</i>			<i>Potamogeton crispus</i>		
<i>Fontinalis antipyretica</i>			<i>Potamogeton filiformis</i>		
<i>Sphagnum</i> sp.			<i>Potamogeton gramineus</i>		
Vascular Plants			<i>Potamogeton lucens</i>		
<i>Alisma plantago-aquatica</i>			<i>Potamogeton natans</i>		
<i>Apium inundatum</i>	1	1	<i>Potamogeton obtusifolius</i>		1
<i>Baldellia ranunculoides</i> subsp. <i>ranunculoides</i>			<i>Potamogeton pectinatus</i>		
<i>Baldellia ranunculoides</i> subsp. <i>repens</i>			<i>Potamogeton perfoliatus</i>	1	1
<i>Callitriche brutia</i> subsp. <i>hamulata</i>	1		<i>Potamogeton polygonifolius</i>		
<i>Callitriche hermaphrodita</i>			<i>Potamogeton praelongus</i>		
<i>Carex rostrata</i>			<i>Potamogeton pusillus</i>		
<i>Ceratophyllum demersum</i>			<i>Potamogeton × angustifolius</i>		
<i>Cladium mariscus</i>			<i>Potamogeton × nitens</i>		
<i>Elatine hexandra</i>	1	1	<i>Ranunculus</i> sp.		
<i>Eleocharis acicularis</i>			<i>Schoenoplectus lacustris</i>		
<i>Eleocharis multicaulis</i>			<i>Sparganium angustifolium</i>		
<i>Eleocharis palustris</i>			<i>Sparganium emersum</i>		1
<i>Eleogiton fluitans</i>			<i>Sparganium erectum</i>		
<i>Elodea canadensis</i>			<i>Sparganium natans</i>		
<i>Equisetum fluviatile</i>			<i>Subularia aquatica</i>		
<i>Eriocaulon aquaticum</i>			<i>Typha angustifolia</i>		
<i>Hydrilla verticillata</i>			<i>Utricularia</i> sp.		
<i>Isoetes echinospora</i>			<i>Zannichellia palustris</i>		

### *Najas flexilis*

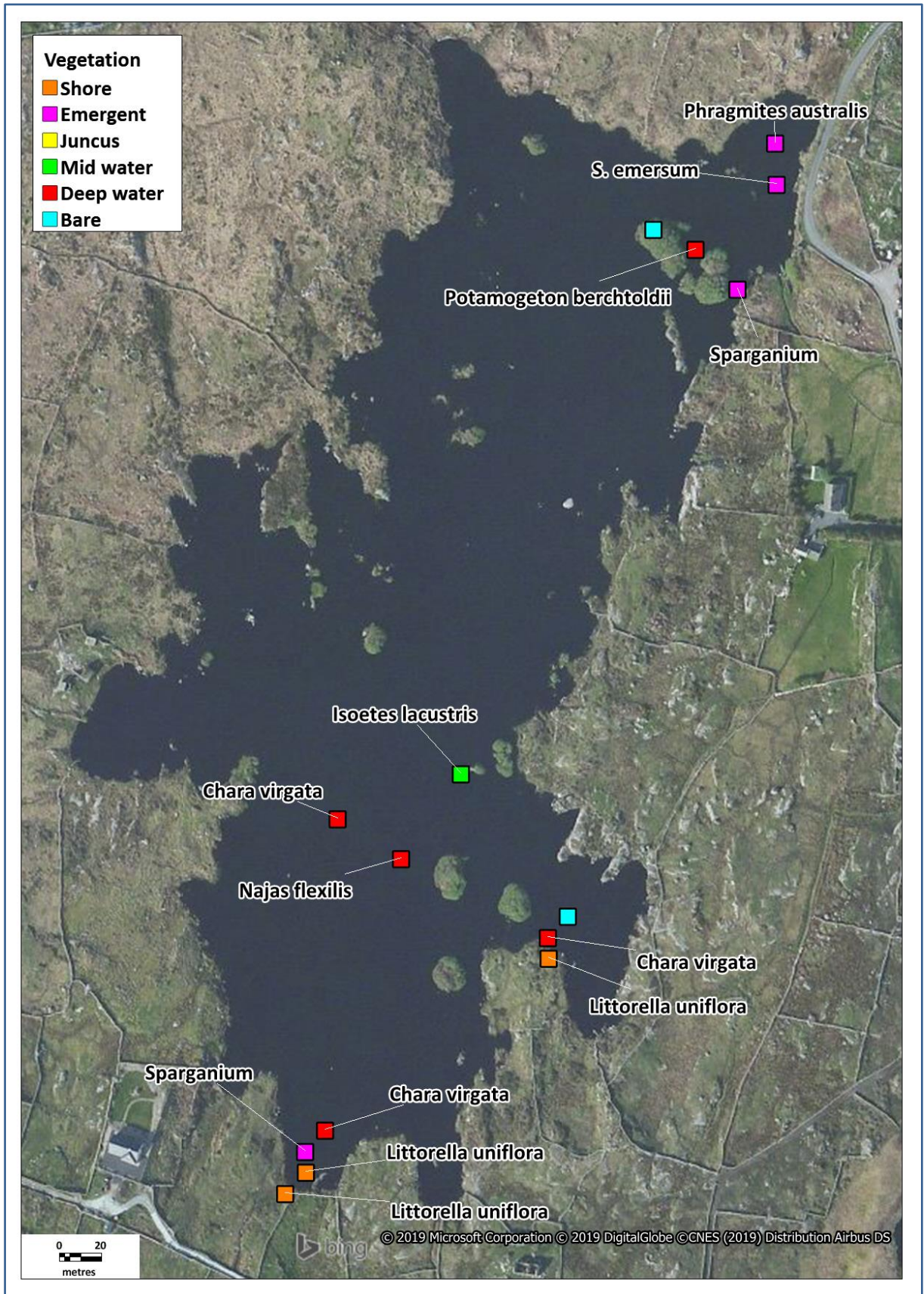
The plant was recorded on the southern and eastern sides of the lake, but only as scattered patches at a depth range from 0.5-1.5 m and densities up to 10% cover. It grows on silt and, surprisingly, on thin silt over bedrock. In 2004 the plant grew in a more usual community of *Potamogeton berchtoldii*, *P. perfoliatus* and *Callitriche brutia* subsp. *hamulata*. As the centre of the lake seems to lack vegetation, the habitat available appears confined to the eastern side, covering an area less than a hectare. However earlier records suggests an abundance of drift material so the population may vary from year to year.



## Vegetation

The vegetation of Loch na gCaor is very patchy, with large areas of either bare rock and boulder or wide expanses of bare silt in 1-2 m of water. At the southern end, a *Littorella* zone gives way to *Sparganium emersum* and then a *Potamogeton—Chara virgata* community at 1.5 m. Patches of *Isoetes* occur in this

community with some *Najas* in the south-eastern part of the lake. In the north-east, a mixture of floating species such as *Nymphaea* and *Sparganium* occur, along with *Potamogeton* species, as well as *Najas* and *Chara*. However few species have cover values greater than 10%.



## Water chemistry data

Water samples were taken on a single occasion on the 18 January 2019 as part of this survey. Data are also available from samples taken by C. Roden in 2004, analysed by Glan Uisce Teo.

Parameter	Unit	na gCaor This survey	na gCaor 2004
Alkalinity	mg/l	28.8	36
Calcium	mg/l	9.3	7.6
Chloride	mg/l	60.4	64.5
Chlorophyll	µg/l	1.5	1
Colour	Hazen units	97	45
Conductivity	µS/cm	249.5	263
Magnesium	mg/l		1.7
pH		7.45	7.7
Total phosphorus	mg/l	0.02	0.02

## Pressures and threats

There are no current threats to Loch na gCaor. An old water pumping station is now derelict and there are no agricultural inputs. However four houses with septic tanks occur within 100 m of the lake shore, but these were built over 20 years ago.

## Conservation condition

Several of the parameters are within the *Poor* range. Colour and total phosphorus, based on limited data, are high.

Parameter	Target for Good	Loch na gCaor 2017	Condition
Area of habitat	Stable or increasing	Stable or increasing	Good
Deep-water community	Full development	Partial	Poor
Number of species	Stable or increase	Stable/increase (14)	Good
Typical species	≥9 indicator species	8	Poor
<i>Najas flexilis</i> population	Stable population	Assumed stable*	Good
Introduced species	Not present/not impacting on <i>Najas flexilis</i> / deep-water community	Not present	Good
Euphotic depth (m)	≥3	2.1	Poor
Colour (Hazen units)	<40	97	Bad
Total phosphorus (TP) (mg/l)	<0.015	0.02	Poor
Hydrological regime	<50% <i>Lobelia</i> – <i>Littorella</i> zone exposed in summer	-	Good
<b>Overall assessment</b>			<b>Poor</b>

\* some indication of fluctuations in population, which may be natural or the result of impacts on water quality

Lough Nageltia, 2016, 2018			
Name	Nageltia		
Alternative name(s)			
Grid reference	M1106579027	Max. depth (m)	?25
County	Mayo	EPA code	30_337
Area (ha)	35	OSi 1:50,000 sheet	38
Maximum length (km)	1.5	Nutrient data	This survey 05/02/2019
Altitude (m)	29	SAC	-
Geology	Carboniferous sandstone		
Previous survey	Roden (2004)		
Previous <i>Najas flexilis</i> records	C. Roden 12/08/2004		
Other noteworthy species	<i>Isoetes echinospora</i> , <i>Nitella confervacea</i> , <i>Pilularia globulifera</i>		
Snorkel survey date(s)	27/07/2016, 25/08/2018	Number of species	18
Surveyors	PM, CR, JR	Alkalinity (mg/l CaCO <sub>3</sub> )	18
Number of transects	0	Total phosphorus (mg/l TP)	0.034
Number of relevés	0	Colour (Hazen units)	122
Euphotic depth (m)	-	Secchi depth (m)	1.8
<i>Najas flexilis</i>	<i>Najas flexilis</i> was not seen in 2016 or 2018		
Deep-water vegetation	Partial development		
Noteworthy species	<i>Nitella confervacea</i> , <i>Pilularia globulifera</i>		
Introduced species	<i>Elodea canadensis</i> present (first record this survey, occurred abundantly)		
Substrates	Silt, mud, sand, cobbles, rock		
Summary	A lake on the edge of the central plain with several scarce species such as <i>Pilularia globulifera</i> , but damaged recently by the loss of a population of <i>Najas flexilis</i>		
Lake score	87	Lake rank	5
CONSERVATION CONDITION	<b>BAD</b>		

### Previous accounts

1. The initial account of this lake was provided by Roden (2004) and is reproduced below. The site and vegetation were briefly described based on a short examination by snorkel of central section.
2. Ursula King (pers. comm.) failed to find *Najas flexilis* in 2010.

## Account of Lough Nageltia from Roden (2004)

<b><i>Najas flexilis</i></b>	<b>Discovery series map:</b> 38	<b>Grid reference:</b> M785114
<b>Locality:</b> Lough Nageltia	<b>Vice county:</b> H27	<b>SAC/NHA name &amp; no:</b> n/a
<b>Date:</b> 12/08/2004	<b>Recorder:</b> Cilian Roden	<b>Altitude:</b> 29 m
<p><b>Site description:</b> One of a group of lakes on basal Carboniferous sandstone north of Lough Mask. The lake is surrounded by wet heath growing on glacial moraines. The lake shore is stony and the lake bottom shelves slowly to a depth of 2 m. Visibility is fair and the lake bottom is a soft reddish silt. The lake is fed by several small streams. Shells of bivalves are common.</p>		
<p><b>Population:</b> The south end of the lake was examined. There is a scattered population of <i>Najas</i> in the centre of the lake at a depth of 1.5 m growing with <i>Nitella confervacea</i>, <i>Potamogeton obtusifolius</i>, <i>P. berchtoldii</i>, <i>P. perfoliatus</i> and <i>Chara virgata</i>.</p>		
<p><b>Vegetation:</b> Poorly-developed Isoetid communities near shore, followed by <i>Potamogeton</i> sp., <i>Nitella</i> and <i>Najas</i>. Drift specimens of the fern <i>Pilularia globulifera</i> were found at one place.</p>		
<p><b>Threats:</b> No obvious threats</p>		
<p><b>Access:</b> By track from the Westport-Partry road and then walking 300 m.</p>		
<p><b>Conservation:</b> The lake is notable for several reasons: it extends the eastern limit of <i>Eriocaulon</i> to the edge of the central plain; the populations of <i>Najas</i> and <i>Potamogeton obtusifolius</i> are many kilometres from known stations; and <i>Pilularia globulifera</i> has not been recently recorded in this area.</p>		
<p><b>Remarks:</b> Other <i>Najas</i> stations may exist in this area although the neighbouring Lough Nacorrelea was visited, without success.</p>		

### 2016 and 2018 surveys

As noted above, Lough Nageltia is an unusual lake situated 10 km east of the nearest known station for *Najas flexilis*. It is therefore very disappointing that the species was not relocated in 2016. It should, however, be noted that it still holds one of the most easterly populations of *Eriocaulon aquaticum* and a large population of *Pilularia globulifera*.

In 2016 the lake water was extremely turbid with much poorer visibility than in 2004. Consequently, the benthic flora was very poorly-developed and not easily seen. For this reason it was decided not to attempt a full survey. However a four-man-hour snorkel survey was conducted in the eastern basin and a species list prepared.

A second snorkel by C. Roden in the eastern basin in 2018 showed clearer water but *Najas flexilis* was not located. The clearer water, however, allowed a better interpretation of the vegetation. A sketch map of that visit is included below.

### Species recorded

The species list of 18 species in 2016-2018 was similar to 2004 except that *Najas flexilis* and *Potamogeton obtusifolius* were not seen, and *Isoetes echinospora* was not confirmed. However, a large population of *Pilularia globulifera* was noted along the south-western shore. The introduced species *Elodea canadensis* was a new record and occurred abundantly.

- *Isoetes echinospora* is probably still present amongst plants of *I. lacustris*.
- *Nitella confervacea* was present in isolated patches at 1-2 m depth.
- *Pilularia globulifera* was occasional in 0-1 m depth, common along south-western shore.

Taxon - Nageltia	Before this survey	In this survey (2016/8)	Taxon - Nageltia	Before this survey	In this survey (2016/8)
Charophytes			<i>Isoetes lacustris</i>	1	1
<i>Chara aspera</i>			<i>Juncus bulbosus</i>	1	1
<i>Chara curta</i>			<i>Lemna minor</i>		
<i>Chara globularis</i>			<i>Lemna trisulca</i>		
<i>Chara rudis</i>			<i>Littorella uniflora</i>	1	1
<i>Chara virgata</i>	1	1	<i>Lobelia dortmanna</i>	1	1
<i>Nitella confervacea</i>	1	1	<i>Myriophyllum alterniflorum</i>	1	1
<i>Nitella flexilis</i>	1	1	<i>Myriophyllum spicatum</i>		
<i>Nitella gracilis</i>			<i>Najas flexilis</i>	1	
<i>Nitella opaca</i>			<i>Nuphar lutea</i>		1
<i>Nitella translucens</i>		1	<i>Nymphaea alba</i>		
<i>Tolypella glomerata</i>			<i>Oenanthe fluviatilis</i>		
<i>Chara cf. muscosa</i>			<i>Phragmites australis</i>		
Other algae			<i>Pilularia globulifera</i>	1	1
<i>Ophrydium versatile</i>			<i>Potamogeton alpinus</i>		
Bryophytes			<i>Potamogeton berchtoldii</i>	1	1
<i>Fissidens fontanus</i>			<i>Potamogeton crispus</i>		
<i>Fontinalis antipyretica</i>			<i>Potamogeton filiformis</i>		
<i>Sphagnum</i> sp.			<i>Potamogeton gramineus</i>		
Vascular Plants			<i>Potamogeton lucens</i>		
<i>Alisma plantago-aquatica</i>		1	<i>Potamogeton natans</i>		
<i>Apium inundatum</i>			<i>Potamogeton obtusifolius</i>	1	
<i>Baldellia ranunculoides</i> subsp. <i>ranunculoides</i>		1	<i>Potamogeton pectinatus</i>		
<i>Baldellia ranunculoides</i> subsp. <i>repens</i>			<i>Potamogeton perfoliatus</i>	1	1
<i>Callitriche brutia</i> subsp. <i>hamulata</i>			<i>Potamogeton polygonifolius</i>		
<i>Callitriche hermaphrodita</i>			<i>Potamogeton praelongus</i>		
<i>Carex rostrata</i>			<i>Potamogeton pusillus</i>		
<i>Ceratophyllum demersum</i>			<i>Potamogeton × angustifolius</i>		
<i>Cladium mariscus</i>			<i>Potamogeton × nitens</i>		
<i>Elatine hexandra</i>		1	<i>Ranunculus</i> sp.		
<i>Eleocharis acicularis</i>			<i>Schoenoplectus lacustris</i>		
<i>Eleocharis multicaulis</i>			<i>Sparganium angustifolium</i>		
<i>Eleocharis palustris</i>			<i>Sparganium emersum</i>		
<i>Eleogiton fluitans</i>			<i>Sparganium erectum</i>		
<i>Elodea canadensis</i>		1	<i>Sparganium natans</i>		
<i>Equisetum fluviatile</i>			<i>Subularia aquatica</i>		
<i>Eriocaulon aquaticum</i>	1	1	<i>Typha angustifolia</i>		
<i>Hydrilla verticillata</i>			<i>Utricularia</i> sp.		
<i>Isoetes echinospora</i>	1		<i>Zannichellia palustris</i>		

### *Najas flexilis*

The species has not been seen since 2004 despite three subsequent searches in 2010, 2016 and 2018. Its habitat has declined in quality as a result of greatly decreased water transparency and the spread of the introduced species *Elodea canadensis*. Whether *Najas flexilis* would reappear from seed deposits if lake water quality improves is unknown.

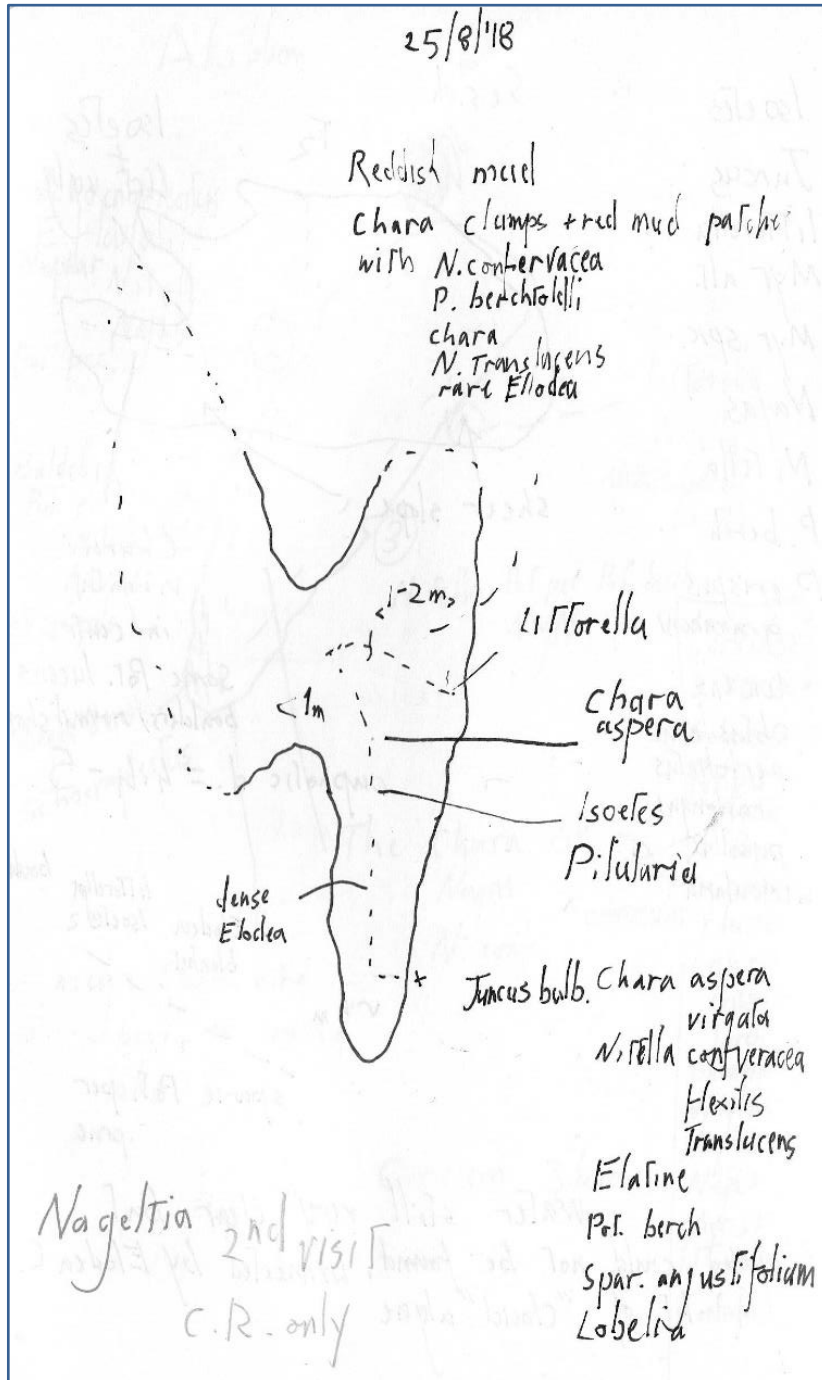
The western basin of this lake is difficult to access when encumbered with equipment, but before it is concluded that *Najas flexilis* is extinct, the western basin should be examined by snorkelling.

## Vegetation

While the near-surface *Eriocaulon*—*Lobelia* community persists, the deeper water community described in 2004 has declined to scattered plants on the lake bottom. Conversely, *Elodea canadensis* has now become one of the commonest species.

The original lake vegetation was extensive as the lake is shallow (<2.5 m) and appears to have been a species-rich variant of the *Najas flexilis* community.

No map was prepared due to very poor water transparency in 2016, but a sketch map of the 2018 visit is presented below.





## Water chemistry data

Water samples were taken on a single occasion on the 05 February 2019 as part of this survey.

Parameter	Unit	Nageltia This survey
Alkalinity	mg/l	18.1
Calcium	mg/l	7
Chloride	mg/l	17.9
Chlorophyll	µg/l	1.6
Colour	Hazen units	122
Conductivity	µS/cm	101
pH		7.3
Total phosphorus	mg/l	0.034

## Pressures and threats

Given that the same surveyor (CR) examined the lake in 2004, 2016 and 2018, there can be little doubt that the recorded decline in conservation condition is real rather than observer error or bias. The observed decline includes

- greatly increased water turbidity. In 2004, the shallow lake bottom was easily examined from the surface, while in 2016 bottom vegetation could only be examined by duck diving and the water was noticeably dark
- the disappearance of *Najas flexilis* and *Potamogeton obtusifolius*
- replacement of *Najas* community by bare mud or large *Elodea canadensis* plants
- The appearance of *Elodea canadensis*.

The reason for the decline is not obvious. A comparison of 2005 and 2013 aerial images show a small increase in machine peat extraction but no major changes in landscape.

## Conservation condition

This shallow lake was in good condition in 2004 but, since then, *Najas flexilis* has disappeared and *Elodea canadensis* now occurs, possibly the latter displacing the former. The euphotic depth could not be determined because the lake is shallow, 1.8-2.0m deep, and at the maximum depth there were many empty patches, but also colonies of some macrophytes. Limited nutrient data suggest colour and total phosphorus are high. Nevertheless, as the lake contains a large population of a protected species *Pilularia globulifera* and the scarce charophyte *Nitella confervacea*, it remains of conservation value.

Parameter	Target for Good	Nageltia 2016 & 2018	Condition
Area of habitat	Stable or increasing	Declining	Poor
Deep-water community	Full development	Near absence	Poor/Bad
Number of species	Stable or increase	Increase(18)	Good
Typical species	≥9 indicator species	11	Good
<i>Najas flexilis</i> population	Stable population	Extinct/near extinct	Bad
Introduced species	Not present/not impacting on <i>Najas flexilis</i> / deep-water community	<i>Najas flexilis</i> and deep-water community almost replaced by <i>Elodea</i>	Bad
Euphotic depth (m)	≥3	Not determined	n/a
Colour (Hazen units)	<40	122	Bad
Total phosphorus (TP) (mg/l)	<0.015	0.034	Poor
Hydrological regime	<50% <i>Lobelia – Littorella</i> zone exposed in summer	-	Good
<b>Overall assessment</b>			<b>Bad</b>

Lough Nahaltora, 2017			
Name	Nahaltora	Code	NLA
Alternative name(s)	Altora, na hAltora		
Grid reference	L7919774281	Max. depth (m)	>4
County	Mayo	EPA code	32_472
Area (ha)	15	OSi 1:50,000 sheet	37
Maximum length (km)	0.6	Nutrient data	This survey 05/02/2019
Altitude (m)	54	SAC	001932, Mweelrea/Sheeffry/Erriff Complex SAC
Geology	Silurian calcareous siltstone and sandstone		
Previous survey	Roden (2004)		
Previous <i>Najas flexilis</i> records	C. Roden 12/08/2004		
Other noteworthy species	-		
Snorkel survey date(s)	18/08/2017	Number of species	24
Surveyors	PM, CR, JR	Alkalinity (mg/l CaCO <sub>3</sub> )	10
Number of transects	4	Total phosphorus (mg/l TP)	0.034
Number of relevés	12	Colour (Hazen units)	67
Euphotic depth (m)	2.0	Secchi depth (m)	4.5
<i>Najas flexilis</i>	Small population in the north-east		
Deep-water vegetation	Partial development		
Noteworthy species	<i>Najas flexilis</i> , <i>Pilularia globulifera</i>		
Introduced species	<i>Elodea canadensis</i> recorded in an earlier survey		
Substrates	Fine mud, sand, rock		
Summary	A lake with low alkalinity but populations of <i>Pilularia globulifera</i> and <i>Najas flexilis</i> . Water is dark possibly due to peat run off		
Lake score	109	Lake rank	4
CONSERVATION CONDITION	<b>POOR</b>		

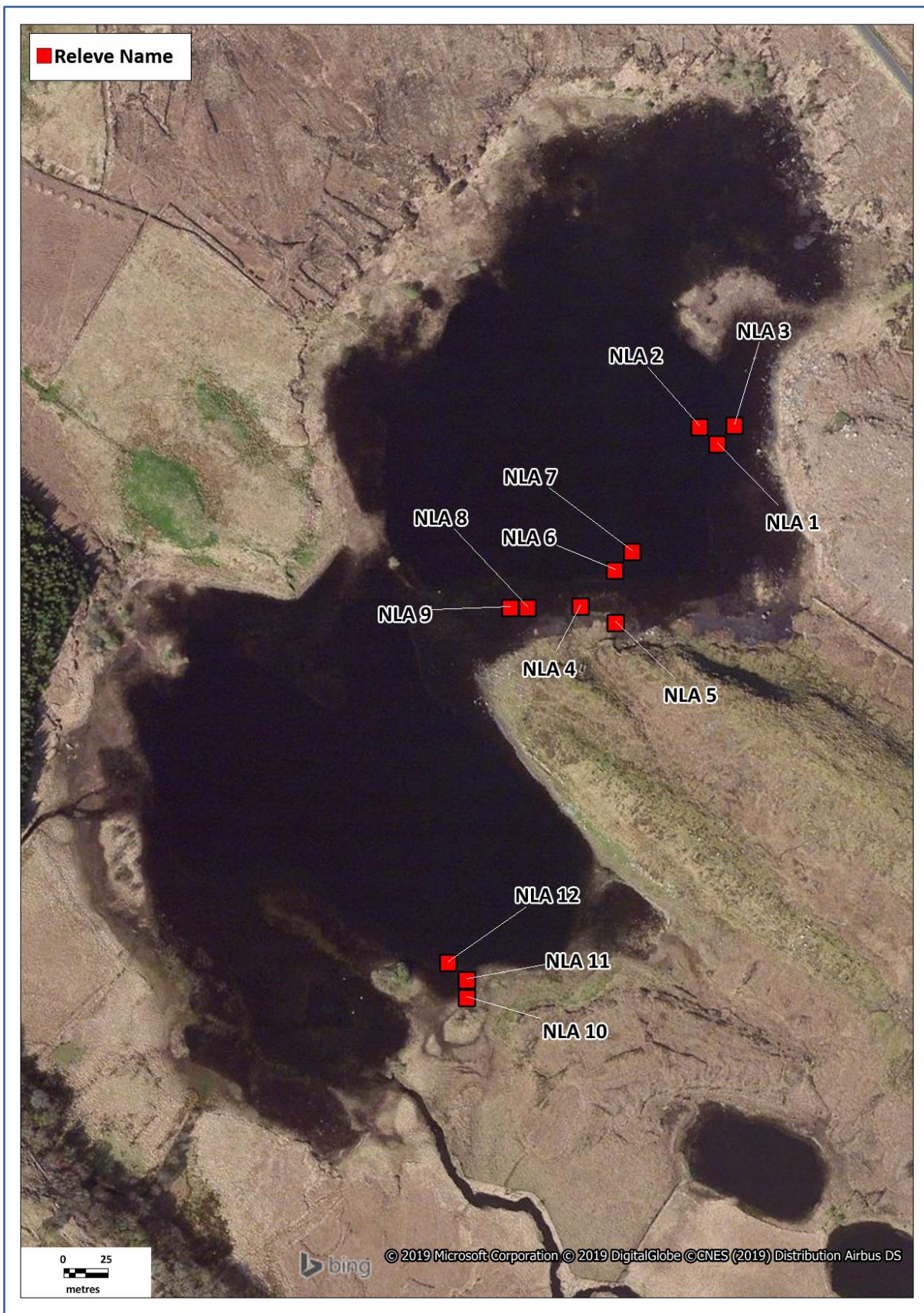
### Previous accounts

The lake appears to have been overlooked by most Irish botanists and was only visited by C. Roden in 2004. He undertook a short snorkel dive to see if *Najas flexilis* occurred on the basis that both *Potamogeton perfoliatus* and *Isoetes* co-occurred. He examined the north-eastern section where he noted a rocky, steeply-sloping shore giving way to peaty sediment at about 1 m and dark coloured water. He noted Isoetid vegetation followed by *Nitella translucens*, *Schoenoplectus lacustris*, *Apium inundatum*, *Elodea canadensis* and *Nuphar lutea*. *Najas flexilis*, *Potamogeton berchtoldii* and *Nitella translucens* occurred at about 2 m. See also NPWS (2017c, f).

### Species recorded

In 2017, 24 species were recorded from Lough Nahaltora, but most are widespread in soft-water lakes.

- *Pilularia globulifera* was recorded in three relevés in water less than 1 m depth. It occurred both in open Isoetid vegetation on rock and gravel, and taller *Schoenoplectus* and *Phragmites* stands on sandy-peat. High cover values of 50% were noted. The plant, while rare in Ireland, does occur in other south-west Mayo lakes (Finn Lough, Mask and Nageltia).

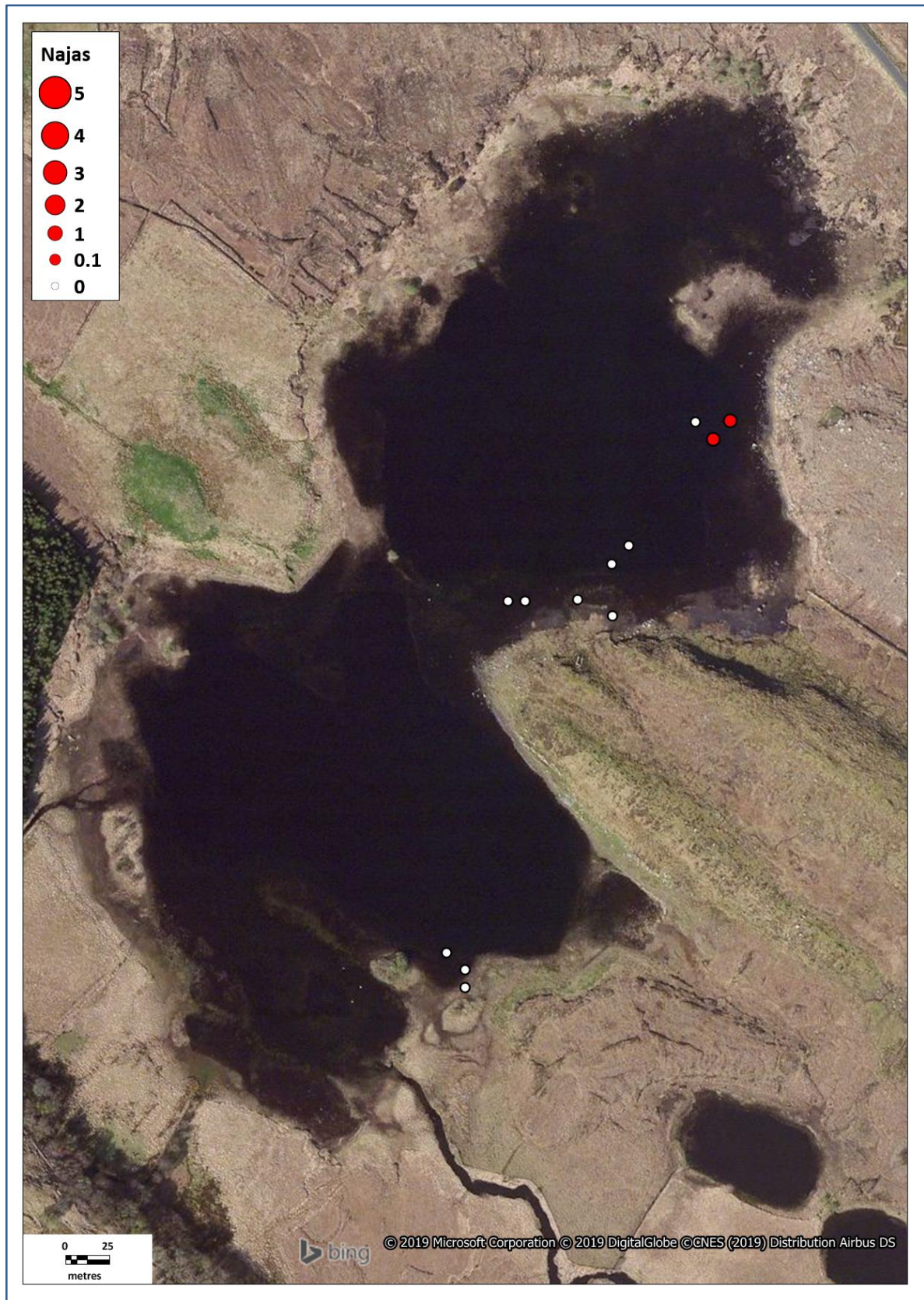


Taxon - Nahaltora	Before this survey	In this survey (2017)	Taxon - Nahaltora	Before this survey	In this survey (2017)
Charophytes			<i>Isoetes lacustris</i>	1	1
<i>Chara aspera</i>			<i>Juncus bulbosus</i>		1
<i>Chara curta</i>			<i>Lemna minor</i>		
<i>Chara globularis</i>			<i>Lemna trisulca</i>		
<i>Chara rudis</i>			<i>Littorella uniflora</i>		
<i>Chara virgata</i>	1	1	<i>Lobelia dortmanna</i>	1	1
<i>Nitella confervacea</i>			<i>Myriophyllum alterniflorum</i>	1	1
<i>Nitella flexilis</i>			<i>Myriophyllum spicatum</i>		
<i>Nitella gracilis</i>			<i>Najas flexilis</i>	1	1
<i>Nitella opaca</i>			<i>Nuphar lutea</i>	1	1
<i>Nitella translucens</i>	1	1	<i>Nymphaea alba</i>		1
<i>Tolypella glomerata</i>			<i>Oenanthe fluviatilis</i>		
<i>Chara cf. muscosa</i>			<i>Phragmites australis</i>		1
Other algae			<i>Pilularia globulifera</i>		1
<i>Ophrydium versatile</i>			<i>Potamogeton alpinus</i>		
Bryophytes			<i>Potamogeton berchtoldii</i>	1	1
<i>Fissidens fontanus</i>			<i>Potamogeton crispus</i>		
<i>Fontinalis antipyretica</i>			<i>Potamogeton filiformis</i>		
<i>Sphagnum</i> sp.	1		<i>Potamogeton gramineus</i>		
Vascular Plants			<i>Potamogeton lucens</i>		
<i>Alisma plantago-aquatica</i>			<i>Potamogeton natans</i>		1
<i>Apium inundatum</i>	1	1	<i>Potamogeton obtusifolius</i>		
<i>Baldellia ranunculoides</i> subsp. <i>ranunculoides</i>	1	1	<i>Potamogeton pectinatus</i>		
<i>Baldellia ranunculoides</i> subsp. <i>repens</i>			<i>Potamogeton perfoliatus</i>	1	1
<i>Callitriche brutia</i> subsp. <i>hamulata</i>			<i>Potamogeton polygonifolius</i>		
<i>Callitriche hermaphroditica</i>			<i>Potamogeton praelongus</i>		
<i>Carex rostrata</i>			<i>Potamogeton pusillus</i>		
<i>Ceratophyllum demersum</i>			<i>Potamogeton × angustifolius</i>		
<i>Cladium mariscus</i>			<i>Potamogeton × nitens</i>		
<i>Elatine hexandra</i>	1	1	<i>Ranunculus</i> sp.		
<i>Eleocharis acicularis</i>			<i>Schoenoplectus lacustris</i>	1	1
<i>Eleocharis multicaulis</i>	1	1	<i>Sparganium angustifolium</i>		
<i>Eleocharis palustris</i>		1	<i>Sparganium emersum</i>		
<i>Eleogiton fluitans</i>		1	<i>Sparganium erectum</i>		
<i>Elodea canadensis</i>	1		<i>Sparganium natans</i>		
<i>Equisetum fluviatile</i>		1	<i>Subularia aquatica</i>		
<i>Eriocaulon aquaticum</i>	1	1	<i>Typha angustifolia</i>		
<i>Hydrilla verticillata</i>			<i>Utricularia</i> sp.		1
<i>Isoetes echinospora</i>			<i>Zannichellia palustris</i>		

### *Najas flexilis*

The plant was recorded on only one transect in the northern basin, with cover less than 5%. It grows on gravel with peaty silt between 0.4 m and 1.5 m. The species' habitat appears less than 1 ha in area, due to the steeply-sloping lake bed, shallow euphotic zone and restricted distribution within the lake.

Companion species included *Isoetes lacustris*, *Nitella translucens* and *Chara virgata*. In 2004, C. Roden noted the plant in the same part of the lake but at the slightly deeper depth of 2-2.5 m growing with *Nitella translucens*, *Potamogeton berchtoldii* and *P. perfoliatus* (Roden, 2004). There are no obvious threats to the plant at present except possibly increasing peat erosion restricting light availability.

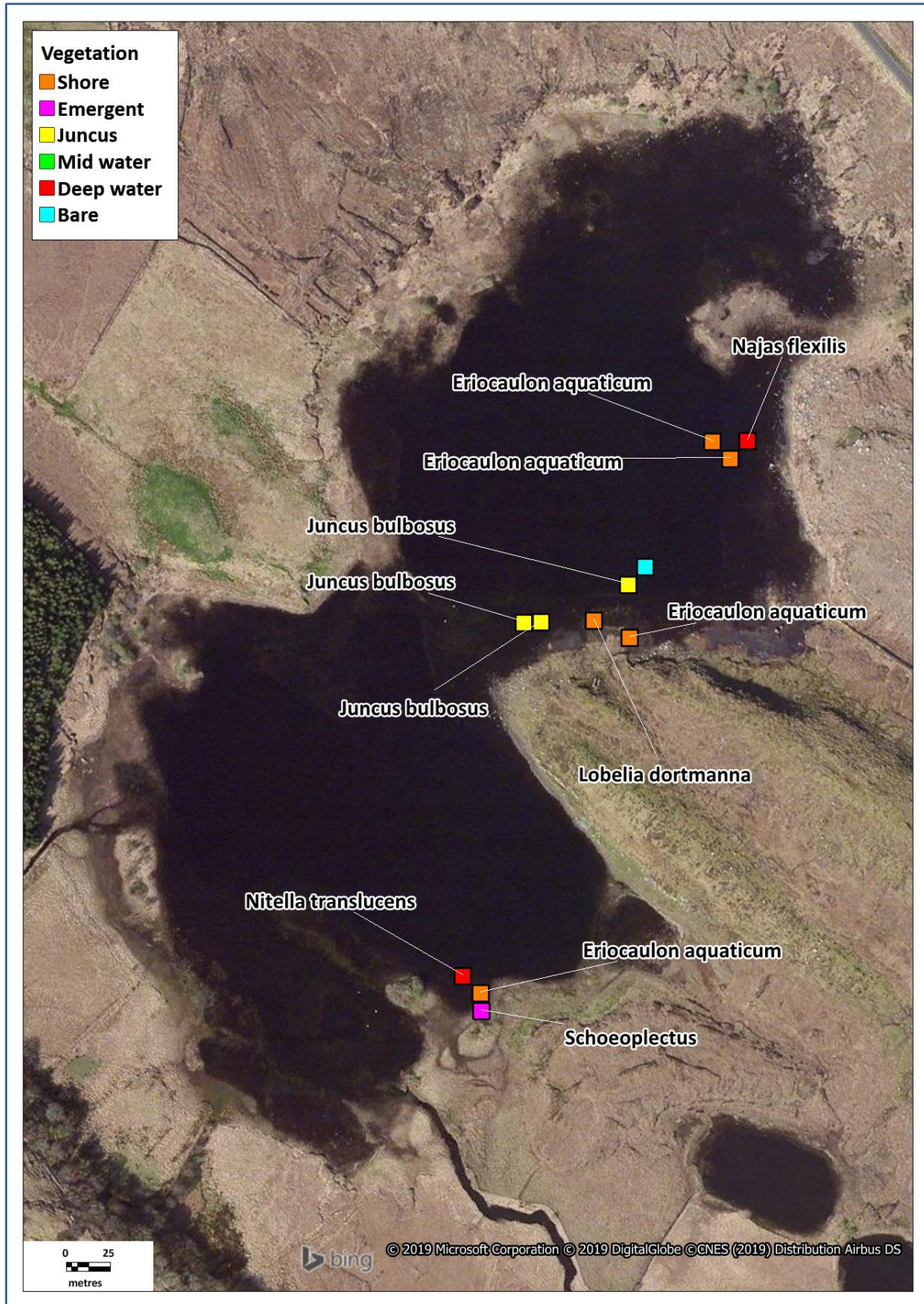


## Vegetation

Lough Nahaltora occurs partly on Silurian silt and sandstone which is slightly calcareous. The southern part lies on Silurian quartzite. The shore is a mixture of cobbles, rock outcrop and soft peaty material, and slopes steeply. At depth, peat sediment occurs. Water is very coloured with a shallow euphotic depth of 2.0 m. Consequently, deeper water vegetation is not extensive.

Rocky areas in the northern basin have an Isoetid vegetation and *Eriocaulon* occurs. Emergents (*Schoenoplectus*) are very common in the southern basin, but also occur sparsely on rocky shores (possibly due to the lake's small size and sheltered location). In water of 1-2 m depth *Potamogeton perfoliatus*, *P. berchtoldii* and *Nitella translucens* occur, along with a little *Najas flexilis*.

The southern basin is less rocky and surrounded by *Equisetum fluviatile*, *Schoenoplectus* and *Phragmites*. Because the shore slopes very steeply there is little submerged vegetation, but *Pilularia* is abundant at the base of the emergents.



## Water chemistry data

Water samples were taken on a single occasion on the 5 February 2019 as part of this survey.

Parameter	Unit	Nahaltora This survey
Alkalinity	mg/l	10
Calcium	mg/l	33
Chloride	mg/l	20.7
Chlorophyll	µg/l	1
Colour	Hazen units	66.7
Conductivity	µS/cm	86.6
pH		6.9
Total phosphorus	mg/l	0.0335

## Pressures and threats

Lough Nahaltora is not monitored by the EPA. It does not appear to be under severe pressure. It is surrounded by blanket peat or heath, and one area of coniferous forestry to the south. There are no obvious differences in aerial photos taken in 2000 and 2013. However peat runoff may be an issue, judging from the shallow euphotic depth.

## Conservation condition

The measurements for several parameters are within the *Poor* range and colour and total phosphorus, based on limited data, are high. Peat runoff may be a pressure.

Parameter	Target for Good	Nahaltora 2017	Condition
Area of habitat	Stable or increasing	Stable or increasing	Good
Deep-water community	Full development	Partial development	Poor
Number of species	Stable or increase	Increase (24)	Good
Typical species	≥9 indicator species	10	Good
<i>Najas flexilis</i> population	Stable population	Reduced depth distribution	Poor
Introduced species	Not present/not impacting on <i>Najas flexilis</i> / deep-water community	Not impacting	Good
Euphotic depth (m)	≥3	2.0	Poor
Colour (Hazen units)	<40	67	Poor
Total phosphorus (TP) (mg/l)	<0.015	0.034	Poor
Hydrological regime	<50% <i>Lobelia – Littorella</i> zone exposed in summer	-	Good
<b>Overall assessment</b>			<b>Poor</b>

Port Lough, 2016			
Name	Port	Code	PRT
Alternative name(s)	an Phoirt		
Grid reference	C0113934714	Max. depth (m)	>5
County	Donegal	EPA code	38_637
Area (ha)	20	OSi 1:50,000 sheet	2
Maximum length (km)	0.8	Nutrient data	This survey 05/02/2019
Altitude (m)	67	SAC	00147, HornHead And Rinclevan SAC
Geology	Dalradian marble and schist		
Previous survey	N.F. Stewart and C.D. Preston in 1989, Roden (2004)		
Previous <i>Najas flexilis</i> records	N.F. Stewart and C.D. Preston 26/08/1989, C. Roden 31/07/2002		
Other noteworthy species	<i>Callitriche hermaphroditica</i> , <i>Chara curta</i> , <i>Nitella confervacea</i>		
Snorkel survey date(s)	18/08/2016	Number of species	31
Surveyors	PM, CR, JR	Alkalinity (mg/l CaCO <sub>3</sub> )	35.5
Number of transects	3	Total phosphorus (mg/l TP)	0.028
Number of relevés	15	Colour (Hazen units)	68
Euphotic depth (m)	5.0	Secchi depth (m)	3
<i>Najas flexilis</i>	Large population in the lake		
Deep-water vegetation	Full development		
Noteworthy species	<i>Callitriche hermaphroditica</i> , <i>Chara curta</i> , <i>Najas flexilis</i> , <i>Nitella confervacea</i>		
Introduced species	<i>Elodea canadensis</i> was first recorded during this survey		
Substrates	Gravel, fine mud, bedrock		
Summary	An exceptionally valuable site with unusual charophyte and <i>Najas flexilis</i> populations and higher alkalinity than most surveyed sites. It may be threatened by the recent introduction of <i>Elodea canadensis</i>		
Lake score	270	Lake rank	1
CONSERVATION CONDITION	GOOD		



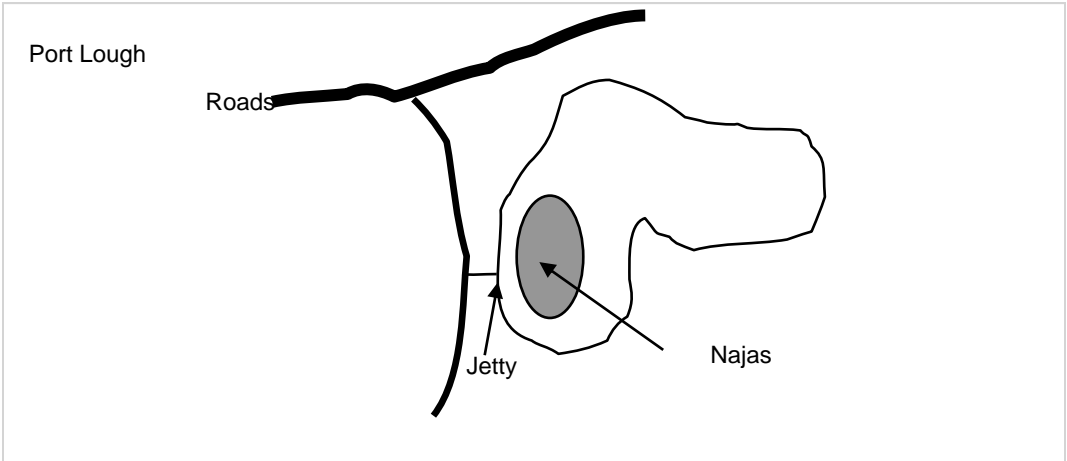


## Previous accounts

1. N.F. Stewart and C.D. Preston visited this lake in 1989 and discovered *Najas flexilis*. They also recorded *Chara curta*, *Chara virgata*, *Nitella flexilis*, *Nitella translucens*, *Nitella confervacea*, *Apium inundatum*, *Baldellia ranunculoides*, *Callitriche hermaphroditica*, *Juncus bulbosus*, *Littorella uniflora*, *Lobelia dortmanna*, *Myriophyllum alterniflorum*, *Potamogeton berchtoldii*, *P. crispus*, *P. gramineus*, *P. praelongus*, *P. pusillus*, *P. × nitens* and *Schoenoplectus lacustris*.
2. C. Roden visited Port Lough in 2004 and his description is reproduced below.

See also NPWS (2014c, d).

Account of Port Lough from Roden (2004)

<b><i>Najas flexilis</i></b>	<b>Discovery series map:</b> 2	<b>Grid reference:</b> C010347
<b>Locality:</b> Loch an Phoirt or Port Lough	<b>Vice county:</b> H35	<b>SAC/NHA name &amp;no:</b> 000147
<b>Date:</b> 31/07/2002	<b>Recorder:</b> Cilian Roden	<b>Altitude:</b>
<b>Site description:</b> Port Lough is a rock basin Lough situated partly in Dalriadan limestone, consequently the water is clear. The bottom is a fine reddish mud with some stones along the shore. Maximum depth recorded was 3m but it is reputedly deeper in some places.		
<b>Population:</b> A very large population is present growing in clearings between carpets of <i>Chara globularis</i> . In places high cover values (20%) are reached.		
<b>Vegetation:</b> <i>Najas flexilis</i> is accompanied by <i>Nitella batrachosperma</i> , <i>Nitella flexilis</i> , <i>Potamogeton berchtoldii</i> and <i>Callitriche hermaphroditica</i> . This grouping grows in clearings in a dense carpet of <i>Chara globularis</i> .		
<b>Management:</b> The lake is managed for trout fishing by a local angling club, who monitor it for signs of eutrophication.		
<b>Threats:</b> No serious threats at present, although cattle feeders have been placed in two lakeside fields.		
<b>Access:</b> A lane at Western end leads to jetty used by anglers.		
<b>Conservation:</b> The lake has a diverse flora.		
<b>Remarks:</b> A very fine example of a meso/oligotrophic clear water lough which is not affected by peat bog drainage.		
		

## Species recorded

The most interesting aspect of the lake's flora is its diversity with many species more typical of base rich water rather than meso-oligotrophic lakes. In 2016, 31 species were recorded at Port Lough.

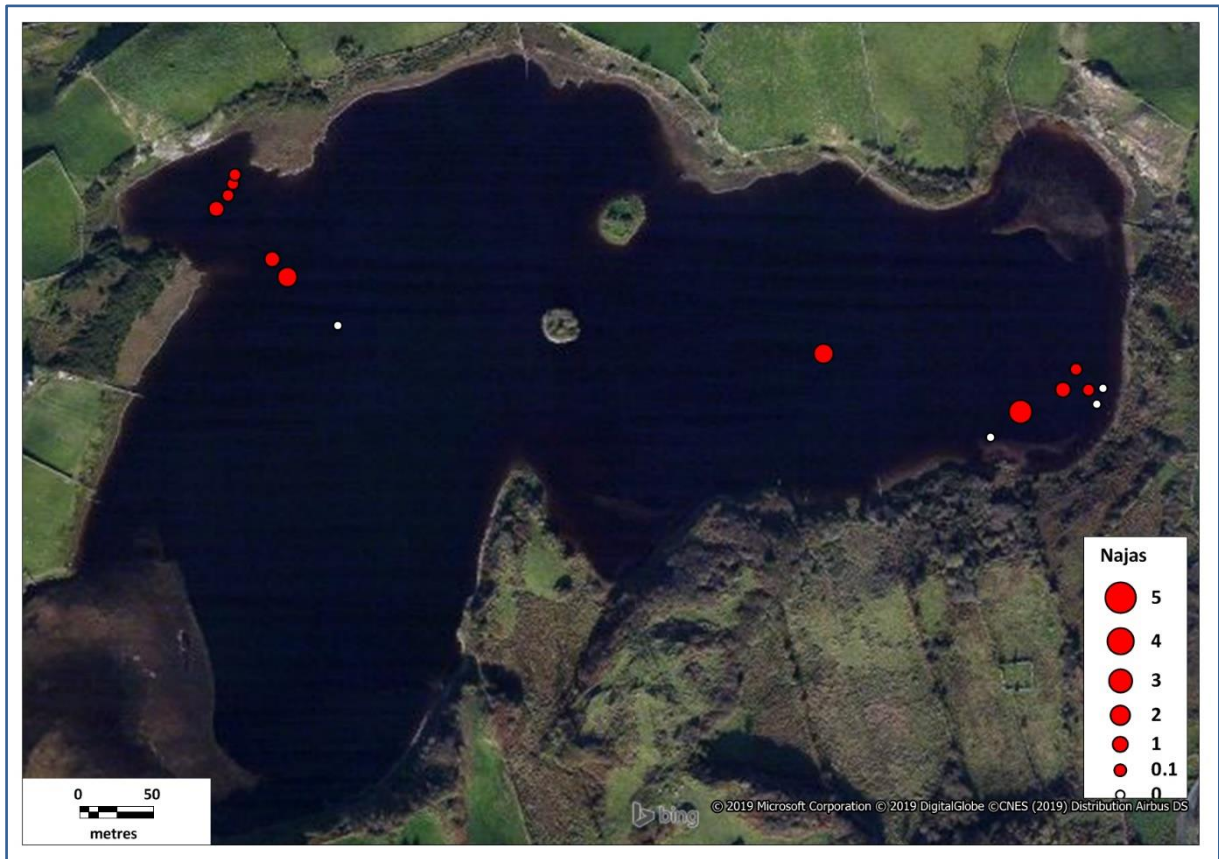
- *Chara curta* and *Chara aspera* are common in marl lakes, and the presence of these two charophytes in a *Najas flexilis*-type lake is unusual. The *Chara curta* plants are striking as they lack the usual calcification seen in more calcium rich waters.
- *Najas flexilis* is common in the lake.
- *Nitella confervacea* is noteworthy as it is recorded infrequently.

*Elodea canadensis* is very abundant and reaches great size, although it was not recorded in 2004 nor in 1989. Its abundance suggests a recent introduction and rapid growth.

Taxon - Port	Before this survey	In this survey (2016)	Taxon - Port	Before this survey	In this survey (2016)
Charophytes			<i>Isoetes lacustris</i>	1	1
<i>Chara aspera</i>	1	1	<i>Juncus bulbosus</i>	1	1
<i>Chara curta</i>	1	1	<i>Lemna minor</i>		
<i>Chara globularis</i>	1	1	<i>Lemna trisulca</i>		
<i>Chara rudis</i>			<i>Littorella uniflora</i>	1	1
<i>Chara virgata</i>	1	1	<i>Lobelia dortmanna</i>	1	1
<i>Nitella confervacea</i>	1	1	<i>Myriophyllum alterniflorum</i>	1	1
<i>Nitella flexilis</i>	1	1	<i>Myriophyllum spicatum</i>		
<i>Nitella gracilis</i>			<i>Najas flexilis</i>	1	1
<i>Nitella opaca</i>		1	<i>Nuphar lutea</i>		
<i>Nitella translucens</i>	1	1	<i>Nymphaea alba</i>		
<i>Tolypella glomerata</i>			<i>Oenanthes fluviatilis</i>		
<i>Chara cf. muscosa</i>			<i>Phragmites australis</i>		
Other algae			<i>Pilularia globulifera</i>		
<i>Ophrydium versatile</i>			<i>Potamogeton alpinus</i>		
Bryophytes			<i>Potamogeton berchtoldii</i>	1	1
<i>Fissidens fontanus</i>			<i>Potamogeton crispus</i>	1	1
<i>Fontinalis antipyretica</i>	1	1	<i>Potamogeton filiformis</i>	1	
<i>Sphagnum</i> sp.			<i>Potamogeton gramineus</i>	1	1
Vascular Plants			<i>Potamogeton lucens</i>	1	
<i>Alisma plantago-aquatica</i>			<i>Potamogeton natans</i>		
<i>Apium inundatum</i>	1	1	<i>Potamogeton obtusifolius</i>		
<i>Baldellia ranunculoides</i> subsp. <i>ranunculoides</i>	1	1	<i>Potamogeton pectinatus</i>		
<i>Baldellia ranunculoides</i> subsp. <i>repens</i>			<i>Potamogeton perfoliatus</i>	1	1
<i>Callitriche brutia</i> subsp. <i>hamulata</i>		1	<i>Potamogeton polygonifolius</i>		
<i>Callitriche hermaphroditica</i>	1	1	<i>Potamogeton praelongus</i>	1	1
<i>Carex rostrata</i>			<i>Potamogeton pusillus</i>	1	1
<i>Ceratophyllum demersum</i>			<i>Potamogeton × angustifolius</i>		
<i>Cladium mariscus</i>			<i>Potamogeton × nitens</i>	1	1
<i>Elatine hexandra</i>		1	<i>Ranunculus</i> sp.		
<i>Eleocharis acicularis</i>			<i>Schoenoplectus lacustris</i>	1	1
<i>Eleocharis multicaulis</i>			<i>Sparganium angustifolium</i>		
<i>Eleocharis palustris</i>			<i>Sparganium emersum</i>		
<i>Eleogiton fluitans</i>			<i>Sparganium erectum</i>		
<i>Elodea canadensis</i>		1	<i>Sparganium natans</i>		
<i>Equisetum fluviatile</i>		1	<i>Subularia aquatica</i>		
<i>Eriocaulon aquaticum</i>			<i>Typha angustifolia</i>		
<i>Hydrilla verticillata</i>			<i>Utricularia</i> sp.	1	1
<i>Isoetes echinospora</i>			<i>Zannichellia palustris</i>		

### *Najas flexilis*

The plant is very abundant, almost from the shore to the base of the euphotic zone. It grows in a variety of communities almost throughout the lake, being recorded in 11 relevés. This unusually wide niche may indicate that *Najas flexilis* is most abundant in lakes with higher alkalinities (>25 mg/l) rather than the more base-poor lakes frequently assumed to be its preferred habitat.



### Vegetation

Much of the shoreline is bedrock or large boulders with sparse vegetation, although a very dense *Phragmites* bed occurs in the southern arm. While the widespread *Lobelia* – *Littorella* community occurs, it is enriched by several charophyte species such as *Chara curta* and, occasionally, *Najas flexilis*.

Below about 1.0 m, silt is dominant with a very diverse vegetation including *Isoetes lacustris*, *Elodea canadensis*, *Potamogeton* spp., *Najas flexilis* and a very diverse array of charophytes including *Nitella opaca*. At the base of the euphotic zone at 5 m, *Najas*, *Potamogeton* spp., *Nitella* spp. and *Elodea canadensis* are common.

As the lake is largely shallower than the euphotic depth, the benthic macroflora is abundant.

In 2004, C. Roden noted *Chara globularis/virgata* forming large hummocks, with *Najas flexilis* and *Callitriche* growing in gaps between the charophytes (Roden, 2004). In 2016, however, this vegetation was largely replaced by *Elodea canadensis*, although *Najas flexilis* persisted. In 2016, large patches of blackened dead charophytes were found at depth, possibly the remains of an early summer flora.



### Water chemistry data

Water samples were taken on a single occasion on the 5 February 2019 as part of this survey.

Parameter	Unit	Port Lough This survey
Alkalinity	mg/l	35.5
Calcium	mg/l	11
Chloride	mg/l	23.2
Chlorophyll	µg/l	0.9
Colour	Hazen units	68.3
Conductivity	µS/cm	152
pH		7.5
Total phosphorus	mg/l	0.028

### Pressures and threats

In a sense, the lake is in good ecological condition but changes since 2004 may be significant. *Elodea canadensis* has appeared in the lake in great abundance and has suppressed some very unusual *Najas flexilis* – *Chara virgata* vegetation. At depth, blackened remains of charophytes form a noticeable deposit. It is not clear why the charophytes are dead; it may be a seasonal feature in late summer but could indicate an environmental problem. No other threats or problems were noted and no significant differences can be seen between 2005 and 2013 aerial photos.

*Elodea canadensis* was very abundant and reached great size, although it was not recorded in 2004 nor in 1989. Its abundance suggests a recent introduction and rapid growth. It is possible that, as in Sessiagh, it will gradually suppress other species. However, unlike Sessiagh, there is no obvious source of additional nutrients at present. Port Lough should be revisited in the future to determine if *Elodea canadensis* has an increasing impact on the lake. See also the site account for the nearby Sessiagh Lough.

### Conservation condition

The lake remains of exceptional conservation value, however the impact of *Elodea canadensis* is of some concern. Continued monitoring is necessary as *Elodea canadensis* may continue to spread and eradicate the existing vegetation, as has happened in Sessiagh Lough. Only two comparable lakes are known at present, Kindrum and Sessiagh, and neither is in good conservation condition. Colour and total phosphorus are high, but only single measurements are available.

Parameter	Target for Good	Port Lough 2016	Condition
Area of habitat	Stable or increasing	Stable or increasing	Good
Deep-water community	Full development	Full development	Good
Number of species	Stable or increase	Increase (31)	Good
Typical species	≥9 indicator species	11	Good
<i>Najas flexilis</i> population	Stable population	Stable	Good
Introduced species	Not present/not impacting on <i>Najas flexilis</i> / deep-water community	<i>Elodea canadensis</i> impacting on deep-water vegetation	Poor
Euphotic depth (m)	≥3	5.0	Good
Colour (Hazen units)	<40	68	Poor
Total phosphorus (TP) (mg/l)	<0.015	0.028	Poor
Hydrological regime	<50% <i>Lobelia – Littorella</i> zone exposed in summer	-	Good
<b>Overall assessment</b>			<b>Good</b>

Sessiagh Lough, 2018			
Name	Sessiagh		
Alternative name(s)	an tSeisigh/Lochan tSeisigh		
Grid reference	C0427836149	Max. depth (m)	22
County	Donegal	EPA code	38_61
Area (ha)	24	OSi 1:50,000 sheet	2
Maximum length (km)	0.8	Nutrient data	EPA 2009-2015, NRFB 1999-2001
Altitude (m)	28	SAC	000185, Sessiagh Lough SAC
Geology	Schist, marble, quartzite		
Previous survey	J. Ryan in 1981, C. Preston in 1989, Roden (2004), EPA in 2009, 2012 and 2015		
Previous <i>Najas flexilis</i> records	J. Ryan 1981, C.D. Preston and N.F. Stewart 26/08/1989, C. Roden 31/07/2003, EPA 28/07/2009, 2012		
Other noteworthy species	<i>Tolypella glomerata</i> , <i>Zannichella palustris</i>		
Snorkel survey date(s)	23/08/2018	Number of species	22
Surveyors	PM, CR, JR	Alkalinity (mg/l CaCO <sub>3</sub> )	53
Number of transects	2	Total phosphorus (mg/l TP)	0.008
Number of relevés	7	Colour (Hazen units)	18
Euphotic depth (m)	5.4	Secchi depth (m)	-
<i>Najas flexilis</i>	May be extinct		
Deep-water vegetation	Absent – replaced by <i>Elodea canadensis</i>		
Noteworthy species	-		
Introduced species	<i>Elodea canadensis</i> present and abundant – first recorded in 2015		
Substrates	Rock, silt, gravel		
Summary	A formerly very important site for <i>Najas flexilis</i> , now severely damaged by the introduction of <i>Elodea canadensis</i> and possible eutrophication		
Lake score	165	Lake rank	3
CONSERVATION CONDITION	<b>BAD</b>		

### Previous accounts

1. *Najas flexilis* was recorded by Jim Ryan in 1981.
2. Chris Preston briefly visited the site in August 1989. He noted very clear water and confirmed the presence of *Najas flexilis*. He also noted a diverse *Potamogeton* flora and recorded *Zannichella palustris*.
3. C. Roden snorkelled the lake on 31/07/2003. He noted huge populations of *Najas* growing to a depth of 5 m. He again recorded very clear water. He noted an Isoetid flora (*Littorella*, *Lobelia*, *Isoetes*) in shallow water. In deeper water, he noted a variety of *Potamogeton* species and *Callitriche hermaphroditica* with many areas of short vegetation with *Najas flexilis*, *Zannichella*, *Nitella flexilis*, *Tolypella glomerata* and *Chara* sp. Below 3 m, *Najas flexilis* was abundant (60% cover) to the euphotic depth of about 5 m.
4. The EPA surveyed the lake in 2009, 2012 and 2015. Their species list resembles those of C.D. Preston and C. Roden, and again they recorded a euphotic depth of 5 m. Their 2015 survey was the first occasion when *Elodea canadensis* was recorded. It occurred from 2.3-4.0 m and was abundant at some stations. In 2009 and 2012, they recorded *Najas flexilis* between 0.5 m and 4.6 m, and recorded it as abundant in places. They made no records of *Najas flexilis* in 2015. Given that a similar methodology was used on all three surveys, these results suggest the invasion of Sessiagh by *Elodea canadensis* between 2012 and 2015 and the possible extinction of *Najas flexilis* in the same period.

See also NPWS (2021a).

## Species recorded

A total of 28 species has been recorded from Sessiagh, with only 22 found in 2018. The species list is rather different from many *Najas flexilis* lakes, with a diverse *Potamogeton* flora but fewer soft-water species such as *Elatine* or *Juncus bulbosus*. *Zannichella palustris* is recorded from no other lake in this survey.

- *Tolypella glomerata* is rarely found in coastal lakes such as Sessiagh or Aughrusbeg, but is commoner in other habitats. It was not seen in 2018, but may reappear in the future.
- *Zannichella palustris* is widespread in Ireland but usually in more eutrophic or calcareous habitats than *Najas flexilis*-type lakes (Preston and Croft, 1997). Again, it was not seen in 2018.
- *Najas flexilis* occurred until 2015 and may be re-found (see below).

Taxon - Sessiagh	Before this survey	In this survey (2018)	Taxon - Sessiagh	Before this survey	In this survey (2018)
Charophytes			<i>Isoetes lacustris</i>	1	1
<i>Chara aspera</i>		1	<i>Juncus bulbosus</i>		
<i>Chara curta</i>			<i>Lemna minor</i>		
<i>Chara globularis</i>			<i>Lemna trisulca</i>		
<i>Chara rudis</i>			<i>Littorella uniflora</i>	1	1
<i>Chara virgata</i>	1	1	<i>Lobelia dortmanna</i>		1
<i>Nitella confervacea</i>			<i>Myriophyllum alterniflorum</i>	1	1
<i>Nitella flexilis</i>	1	1	<i>Myriophyllum spicatum</i>	1	1
<i>Nitella gracilis</i>			<i>Najas flexilis</i>	1	
<i>Nitella opaca</i>			<i>Nuphar lutea</i>		
<i>Nitella translucens</i>		1	<i>Nymphaea alba</i>		
<i>Tolypella glomerata</i>	1		<i>Oenanthe fluviatilis</i>		
<i>Chara cf. muscosa</i>			<i>Phragmites australis</i>		
Other algae			<i>Pilularia globulifera</i>		
<i>Ophrydium versatile</i>			<i>Potamogeton alpinus</i>		
Bryophytes			<i>Potamogeton berchtoldii</i>		
<i>Fissidens fontanus</i>			<i>Potamogeton crispus</i>	1	1
<i>Fontinalis antipyretica</i>	1	1	<i>Potamogeton filiformis</i>		
<i>Sphagnum</i> sp.	1		<i>Potamogeton gramineus</i>	1	1
Vascular Plants			<i>Potamogeton lucens</i>	1	1
<i>Alisma plantago-aquatica</i>			<i>Potamogeton natans</i>		
<i>Apium inundatum</i>			<i>Potamogeton obtusifolius</i>	1	
<i>Baldellia ranunculoides</i> subsp. <i>ranunculoides</i>		1	<i>Potamogeton pectinatus</i>		
<i>Baldellia ranunculoides</i> subsp. <i>repens</i>			<i>Potamogeton perfoliatus</i>	1	1
<i>Callitriche brutia</i> subsp. <i>hamulata</i>			<i>Potamogeton polygonifolius</i>		
<i>Callitriche hermaphrodita</i>	1	1	<i>Potamogeton praelongus</i>	1	1
<i>Carex rostrata</i>			<i>Potamogeton pusillus</i>	1	1
<i>Ceratophyllum demersum</i>			<i>Potamogeton × angustifolius</i>	1	
<i>Cladium mariscus</i>			<i>Potamogeton × nitens</i>		
<i>Elatine hexandra</i>			<i>Ranunculus</i> sp.		
<i>Eleocharis acicularis</i>			<i>Schoenoplectus lacustris</i>		
<i>Eleocharis multicaulis</i>	1	1	<i>Sparganium angustifolium</i>		
<i>Eleocharis palustris</i>			<i>Sparganium emersum</i>		
<i>Eleogiton fluitans</i>			<i>Sparganium erectum</i>		
<i>Elodea canadensis</i>	1	1	<i>Sparganium natans</i>		
<i>Equisetum fluviatile</i>	1	1	<i>Subularia aquatica</i>		
<i>Eriocaulon aquaticum</i>			<i>Typha angustifolia</i>		
<i>Hydrilla verticillata</i>			<i>Utricularia</i> sp.	1	1
<i>Isoetes echinospora</i>			<i>Zannichella palustris</i>	1	



### *Najas flexilis*

The failure to locate *Najas flexilis* in Sessiagh in 2018 was one of the greatest surprises in the survey. In 2002, C. Roden thought Sessiagh held the largest population of *Najas flexilis* in Donegal (Roden, 2002, 2004) and it had been noted in five separate surveys up to 2015, but surveys in 2015 and 2018 failed to locate the plant. The most obvious difference between C. Roden's 2002 survey and the 2018 survey is the much denser growth of large macrophytes (*Potamogeton* species, *Myriophyllum spicatum* and *Elodea canadensis*) below 1.5 m in 2018 compared to 2002. This growth of perennial plants has removed former areas of lower and less bulky species (*Najas flexilis*, *Tolypella glomerata*, *Zannichella palustris* and *Callitriche hermaphroditica*) that previously grew at depth in the lake.

Whether these changes reflect eutrophication allowing larger macrophyte growth and/or the recent invasion of *Elodea canadensis* is uncertain. Only future survey will establish if *Najas flexilis* is permanently lost from Sessiagh.

### Vegetation

Sessiagh is a small but deep lake on Dalradian bedrock of marble, schist and quartzite. The water is unusually clear with a euphotic depth of 5.4 m. Since 2012, the vegetation appears to have changed greatly due to the appearance of *Elodea canadensis*. At present the rocky shores support an Isoetid vegetation of *Littorella*, *Lobelia*, *Isoetes lacustris*, as well as *Fontinalis*, *Potamogeton gramineus* and *Myriophyllum alterniflorum*. At slightly greater depth (0.5 m), *Chara aspera* is abundant. Below 1.5 m a dense vegetation of *Elodea canadensis*, *Myriophyllum spicatum* and several large *Potamogeton* species is dominant, reaching cover values of 80-100%. Some *Nitella translucens* occurs as a lower layer at the base of the larger macrophytes. At the eastern end, some *Chara virgata* grows amongst the *Isoetes lacustris* at 2 m depth.





### Water chemistry data

Water quality data for the period 2009 to 2015 were made available by the EPA, for many samples from multiple depths. Values presented and used in assessment are averages of all data. Data for the lake for 1999-2001 from the Northern Regional Fisheries Board are given for comparison (data provided to C. Roden).

Parameter	Unit	Sessiagh	
		EPA 2009-2015	Northern Regional Fisheries Board 1999-2001
Alkalinity	mg/l	52.5	50
Calcium	mg/l	17.2	
Chlorophyll	µg/l	3.8	9.5
Colour	Hazen units	18	
Conductivity	µS/cm	245	
Magnesium	mg/l	6.1	
pH		7.84	8.4
Potassium	mg/l	1.95	
Sulphate	mg/l	10.8	
Total oxidised nitrogen	mg/l	0.10	0.0135
Total phosphorus	mg/l	0.008	0.046

### Pressures and threats

EPA surveys in 2009, 2012 and 2015 rate Sessiagh as being of good WFD status. The 2005-2010 NPWS conservation plan for the site however notes a history of algal blooms around the year 2000 due to leakages from septic tanks in house along the northern shore of the lake. The recent loss of *Najas flexilis* suggests strongly that the lake is under ecological threat.

### Conservation condition

Sessiagh, until 2015, was one of the most interesting *Najas flexilis* lakes in Ireland. It combined an abundant *Najas flexilis* population with a flora rich in *Potamogeton* species and several charophytes. The replacement of the deep-water flora by *Elodea canadensis* has removed both the former deep-water flora and the lake's conservation importance. The possible role of eutrophication from nearby houses should be investigated.

Parameter	Target for Good	Sessiagh 2018	Condition
Area of habitat	Stable or increasing	Declining	Bad
Deep-water community	Full development	Absent – replaced by <i>Elodea canadensis</i>	Bad
Number of species	Stable or increase	8% decrease (22)	Poor
Typical species	≥9 indicator species	8	Poor
<i>Najas flexilis</i> population	Stable population	Extinct/near extinct	Bad
Introduced species	Not present/not impacting on <i>Najas flexilis</i> / deep-water community	Deep-water community replaced by <i>Elodea canadensis</i>	Bad
Euphotic depth (m)	≥3	5.4	Good
Colour (Hazen units)	<40	18	Good
Total phosphorus (TP) (mg/l)	<0.015	0.008	Good
Hydrological regime	<50% <i>Lobelia – Littorella</i> zone exposed in summer	-	Good
<b>Overall assessment</b>			<b>Bad</b>

Lough Shannagh, 2017			
Name	Shannagh	Code	SNH
Alternative name(s)	An Slodán Mór		
Grid reference	C213664532	Max. depth (m)	>16
County	Donegal	EPA code	38_678
Area (ha)	27	OSi 1:50,000 sheet	2
Maximum length (km)	0.9	Nutrient data	EPA 2009-2015
Altitude (m)	18	SAC	001975, Ballyhoorisky Point To Fanad Head SAC
Geology	Quartzite		
Previous survey	Multiple surveys including Bullock-Webster (1917, 1919) (see also Groves & Bullock-Webster 1920, 1924b), C.D. Preston and N.F. Stewart in 1989 and 1990, Roden (2004), Wingfield <i>et al.</i> (2004), EPA in 2009, 2012 and 2015		
Previous <i>Najas flexilis</i> records	C.D. Preston and N.F. Stewart 25/08/1989, 08/06/1990, S.L. Bell 1991, C. Roden 30/08/1999, R.A. Wingfield 14/08/2000		
Other noteworthy species	<i>Nitella spanioclema</i>		
Snorkel survey date(s)	28/08/2017	Number of species	20
Surveyors	PM, CR, JR	Alkalinity (mg/l CaCO <sub>3</sub> )	33.1
Number of transects	6	Total phosphorus (mg/l TP)	0.019
Number of relevés	14	Colour (Hazen units)	77
Euphotic depth (m)	2.0	Secchi depth (m)	-
<i>Najas flexilis</i>	Present in small quantities		
Deep-water vegetation	Partial development		
Noteworthy species	<i>Najas flexilis</i> , <i>Nitella spanioclema</i>		
Introduced species	None noted		
Substrates	Rock, gravel, silt		
Summary	A lake of some importance as the type site for <i>Nitella spanioclema</i> , which still occurs. A small population of <i>Najas flexilis</i> is present but water quality may be deteriorating		
Lake score	107	Lake rank	4
CONSERVATION CONDITION	<b>POOR</b>		

### Previous accounts

1. Lough Shannagh was first examined by Bullock-Webster in 1916 (Bullock-Webster, 1917). He recorded *Nitella translucens*, *Chara aspera* and *Chara fragilis* (the present day *Chara virgata*). He also recorded a new taxon, *Nitella spanioclema*, along the western shore of the lake (Bullock-Webster, 1917, 1919; Groves & Bullock-Webster, 1920).
2. C.D. Preston, N.F. Stewart and others visited the lake on at least two occasions in 1989-1990, and made a detailed species list which is shown in the table. They recorded *Najas flexilis* along the western shore in August 1989, the first record of the species from the lake.
3. C. Roden snorkelled the northern part of the lake in 1999 and gave the following account

*This lake is notable as the type site for the little known Nitella spanioclema where it was first collected in 1917. Although a small sandy area occurs in the north-western corner, the lake is almost enclosed by rocky ground and probably occupies a rocky basin on granite bedrock [incorrect-quartzite] rather than being a true sand barrier lough. For this reason, it was not completely surveyed, instead only the western and northern shore was examined. Most of the shoreline consists of rocky ground, which slopes downward to a sediment of silty-sand.*

*The communities are typical of calcium-poor water, although Chara aspera occurs on sand. The wide expanse of the lake bed is largely bare mud or sand, although Najas flexilis also occurs. As described, below plants close to Nitella spanioclema were found during the survey, in the location given by Bullock-Webster (1917).*

C. Roden also noted very clear water with *Najas flexilis* growing at 4 m (Roden, 2004).

- The EPA surveyed the lake on three occasions, 2009, 2012 and 2015. Species lists, though less comprehensive than that of previous surveys, agree with these, except for a record for *Myriophyllum spicatum*. Maximum euphotic depth was measured as between 3.7 m and 2.4 m. *Najas flexilis* was not recorded in 2012 or 2015.

See also NPWS (2017a, b).



### Species recorded

A total of 27 species has been recorded from Lough Shannagh across all surveys, although only 20 were recorded in 2017, possibly because very heavy recent rainfall made the lake water very dark and turbid.

- Nitella spanioclema* is an obscure taxon only known from several lakes in the Fanad peninsula. It was described in the 1920s by Groves and Bullock-Webster (1920, see also Bullock-Webster, 1919) but, even today its exact status is not clear. Some material was found in 2017 but it was not fruiting.
- Najas flexilis* occurs (see below).

Taxon - Shannagh	Before this survey	In this survey (2017)	Taxon - Shannagh	Before this survey	In this survey (2017)
Charophytes			<i>Isoetes lacustris</i>	1	1
<i>Chara aspera</i>	1	1	<i>Juncus bulbosus</i>		1
<i>Chara curta</i>			<i>Lemna minor</i>		
<i>Chara globularis</i>			<i>Lemna trisulca</i>		
<i>Chara rudis</i>			<i>Littorella uniflora</i>	1	1
<i>Chara virgata</i>	1	1	<i>Lobelia dortmanna</i>	1	1
<i>Nitella confervacea</i>			<i>Myriophyllum alterniflorum</i>	1	1
<i>Nitella flexilis</i>			<i>Myriophyllum spicatum</i>	1	
<i>Nitella gracilis</i>			<i>Najas flexilis</i>	1	1
<i>Nitella opaca</i>			<i>Nuphar lutea</i>		
<i>Nitella spanioclema</i>	1	1	<i>Nymphaea alba</i>		
<i>Nitella translucens</i>	1	1	<i>Oenanthe fluviatilis</i>		
<i>Tolypella glomerata</i>			<i>Phragmites australis</i>		
<i>Chara cf. muscosa</i>			<i>Pilularia globulifera</i>		
Other algae			<i>Potamogeton alpinus</i>		
<i>Ophrydium versatile</i>			<i>Potamogeton berchtoldii</i>	1	1
Bryophytes			<i>Potamogeton crispus</i>	1	
<i>Fissidens fontanus</i>			<i>Potamogeton filiformis</i>		
<i>Fontinalis antipyretica</i>	1	1	<i>Potamogeton gramineus</i>	1	1
<i>Sphagnum</i> sp.			<i>Potamogeton lucens</i>		
Vascular Plants			<i>Potamogeton natans</i>	1	
<i>Alisma plantago-aquatica</i>	1	1	<i>Potamogeton obtusifolius</i>		
<i>Apium inundatum</i>			<i>Potamogeton pectinatus</i>		
<i>Baldellia ranunculoides</i> subsp. <i>ranunculoides</i>	1	1	<i>Potamogeton perfoliatus</i>	1	1
<i>Baldellia ranunculoides</i> subsp. <i>repens</i>			<i>Potamogeton polygonifolius</i>		
<i>Callitriche brutia</i> subsp. <i>hamulata</i>	1	1	<i>Potamogeton praelongus</i>		
<i>Callitriche hermaphroditica</i>	1		<i>Potamogeton pusillus</i>		
<i>Carex rostrata</i>		1	<i>Potamogeton × angustifolius</i>		
<i>Ceratophyllum demersum</i>			<i>Potamogeton × nitens</i>	1	1
<i>Cladium mariscus</i>			<i>Ranunculus</i> sp.		
<i>Elatine hexandra</i>	1		<i>Schoenoplectus lacustris</i>		
<i>Eleocharis acicularis</i>			<i>Sparganium angustifolium</i>	1	
<i>Eleocharis multicaulis</i>		1	<i>Sparganium emersum</i>	1	
<i>Eleocharis palustris</i>			<i>Sparganium erectum</i>		
<i>Eleogiton fluitans</i>			<i>Sparganium natans</i>		
<i>Elodea canadensis</i>			<i>Subularia aquatica</i>		
<i>Equisetum fluviatile</i>			<i>Typha angustifolia</i>		
<i>Eriocaulon aquaticum</i>			<i>Utricularia</i> sp.		
<i>Hydrilla verticillata</i>			<i>Zannichellia palustris</i>		
<i>Isoetes echinospora</i>					

### *Najas flexilis*

*Najas flexilis* only occurs in the north-western corner where it is found at 2 m with *Nitella translucens* and *Potamogeton perfoliatus*. Only a small area is colonised. The plant was first found by C.D. Preston in 1989 on the western shore and was again noted by C. Roden in 1999 in the north-western corner of the lake (Roden, 2002, 2004). Roden (2002, 2004) recorded *Callitriche hermaphroditica*, *Potamogeton berchtoldii*, *P. perfoliatus* and *Fontinalis antipyretica*, as companion species.



## Vegetation

Lough Shannagh has an oval basin of at least 16 m depth on a bedrock of quartzite rock. This hard bedrock results in shores of big cobbles and stone rather than fine sediment, though some sandy ground occurs along the western shore. Shorelines slope steeply and the euphotic depth is about 2.0 m.



In shallow water, a type of Isoetid vegetation occurs with *Littorella* and *Isoetes* in scattered patches. At about 1.0 m, *Potamogeton gramineus* occurs as does *Fontinalis* and *Nitella translucens*. In the north-western corner, a sandy area has a dense covering of *Chara aspera* and *Potamogeton* species. Close by at 2 m, an area of *Najas flexilis* and *Nitella translucens* also occurs. Much of the eastern shore is very rocky with little vegetation.

### Water chemistry data

Water quality data for the period 2009 to 2015 were made available by the EPA, for many samples from multiple depths. Values presented and used in assessment are averages of all data.

Parameter	Unit	Shannagh EPA 2009-2015
Alkalinity	mg/l	33.1
Chlorophyll	µg/l	9.2
Colour	Hazen units	76.9
Conductivity	µS/cm	203.2
pH		7.54
Total oxidised nitrogen	mg/l	0.24
Total phosphorus	mg/l	0.019

### Pressures and threats

The EPA rated Shannagh as in good WFD status in 2009, but only moderate in 2012 and 2015. In the 2017 survey, water transparency was poor and the euphotic depth only 2 m. This contrasts with C. Roden's 1999 description where he noted clear water and estimated that *Najas flexilis* grew at about 4 m. He recorded several species not seen in 2017, e.g. *C. hermaphroditica*, *Elatine hexandra*, *Potamogeton crispus*, also noted by C.D. Preston and N.F. Stewart in 1989. The lake is used as a water reservoir and in 2017 it was thought that recent heavy rain had darkened the water. Nevertheless, the facts presented here do suggest that the lake may be suffering a decline in water quality.

### Conservation condition

The measurements for several parameters are within the *Poor* range and colour and total phosphorus are high.

Parameter	Target for Good	Shannagh 2017	Condition
Area of habitat	Stable or increasing	Stable or increasing	Good
Deep-water community	Full development	Partial development	Poor
Number of species	Stable or increase	17% decrease (20)	Bad
Typical species	≥9 indicator species	9	Good
<i>Najas flexilis</i> population	Stable population	Reduced depth distribution	Poor
Introduced species	Not present/not impacting on <i>Najas flexilis</i> / deep-water community	Not present	Good
Euphotic depth (m)	≥3	2.0	Poor
Colour (Hazen units)	<40	77	Poor
Total phosphorus (TP) (mg/l)	<0.015	0.19	Poor
Hydrological regime	<50% <i>Lobelia</i> – <i>Littorella</i> zone exposed in summer	-	Good
<b>Overall assessment</b>			<b>Poor</b>

Sheskinmore Lough, 2018			
Name	Sheskinmore	Code	SEK
Alternative name(s)			
Grid reference	G6999295803	Max. depth (m)	1
County	Donegal	EPA code	38_545
Area (ha)	31	OSi 1:50,000 sheet	10
Maximum length (km)	0.8	Nutrient data	This survey 05/02/2019
Altitude (m)	3	SAC	000197, West Of Ardara/Maas Road SAC
Geology	Blown sand over Palaeozoic schist and granite		
Previous survey	J. Ryan in 1981, C.D. Preston and N.F. Stewart in 1989, Roden (2004)		
Previous <i>Najas flexilis</i> records	J. Ryan 1981, C. Roden 29/07/2002		
Other noteworthy species	-		
Snorkel survey date(s)	19/07/2018	Number of species	26
Surveyors	PM, JR	Alkalinity (mg/l CaCO <sub>3</sub> )	16.6
Number of transects	1	Total phosphorus (mg/l TP)	0.026
Number of relevés	8	Colour (Hazen units)	149
Euphotic depth (m)	>1.5/max depth	Secchi depth (m)	-
<i>Najas flexilis</i>	At high cover (75%) with <i>Potamogeton</i> spp. and <i>Sparganium angustifolium</i> , sparsely distributed amongst <i>Chara</i> swards		
Deep-water vegetation	Does not occur in this very shallow lake		
Noteworthy species	<i>Isoetes echinospora</i> , <i>Najas flexilis</i>		
Introduced species	None noted		
Substrates	Sand, rock		
Summary	An atypical site which is extremely shallow (1 m) but contains a <i>Najas flexilis</i> population in good conservation condition		
Lake score	142	Lake rank	4
CONSERVATION CONDITION	<b>GOOD</b>		

### Previous accounts

1. *Najas flexilis* was recorded by Jim Ryan in 1981.
2. C.D. Preston and N.F. Stewart visited the site in 1989 but did not record *Najas flexilis*.
3. C. Roden briefly snorkelled the lake in 2002 and made the following notes

**Site description:** *Sheskinmore is a shallow circular lough formed between machair and outcropping rock. Maximum depth is less than 2 m. The bottom is mainly sandy-mud. Vegetation is dominated by Chara spp.*

***Najas flexilis* population:** *The population exceeds 1,000 plants scattered amongst Chara throughout and under leaves of Sparganium in the south-east corner of the lough. Only under Sparganium does the species attain high cover values.*

A species list was prepared and is included in the table ('Before this survey' column). Most species were rare or occasional, but *Chara* spp., *Littorella* and *Nitella translucens* were common. The north-western sector is dominated by emergent species and there is slightly deeper water in the south-east where the *Najas flexilis* population occurred. *Najas* was sparsely distributed amongst *Chara* swards growing on sand and more abundantly under *Sparganium* leaves.

See also NPWS (2015c, d).

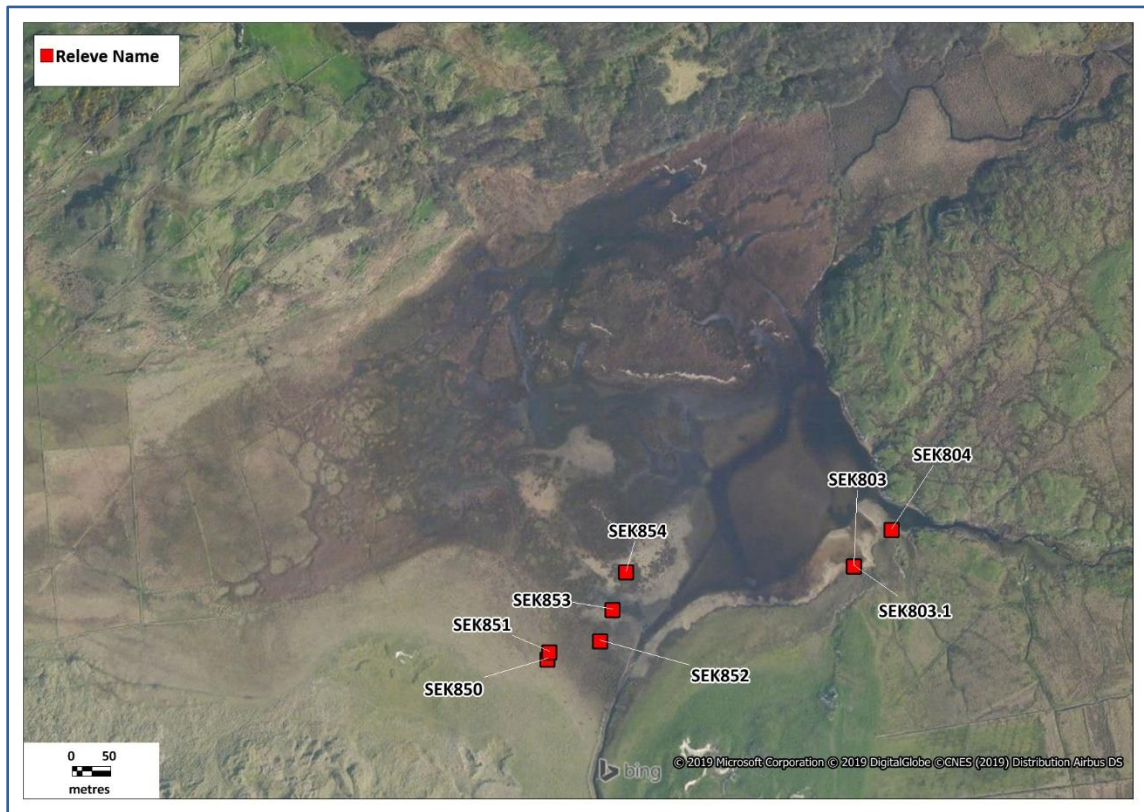


## Species recorded

In 2018, 26 species were recorded in Sheskinmore, and a total of 29 species across all surveys.

- *Isoetes echinospora* is under-recorded in Irish lakes. It is more abundant than *I. lacustris* in Sheskinmore but neither species is common.
- *Najas flexilis* occurs (see below).

Taxon - Sheskinmore	Before this survey	In this survey (2018)	Taxon - Sheskinmore	Before this survey	In this survey (2018)
Charophytes			<i>Isoetes lacustris</i>	1	1
<i>Chara aspera</i>	1	1	<i>Juncus bulbosus</i>	1	1
<i>Chara curta</i>			<i>Lemna minor</i>		
<i>Chara globularis</i>			<i>Lemna trisulca</i>		
<i>Chara rudis</i>			<i>Littorella uniflora</i>	1	1
<i>Chara virgata</i>	1	1	<i>Lobelia dortmanna</i>	1	1
<i>Nitella confervacea</i>			<i>Myriophyllum alterniflorum</i>	1	1
<i>Nitella flexilis</i>			<i>Myriophyllum spicatum</i>		1
<i>Nitella gracilis</i>			<i>Najas flexilis</i>	1	1
<i>Nitella opaca</i>			<i>Nuphar lutea</i>		
<i>Nitella translucens</i>	1	1	<i>Nymphaea alba</i>	1	
<i>Tolypella glomerata</i>			<i>Oenanthe fluviatilis</i>		
<i>Chara cf. muscosa</i>			<i>Phragmites australis</i>		1
Other algae			<i>Pilularia globulifera</i>		
<i>Ophrydium versatile</i>			<i>Potamogeton alpinus</i>		
Bryophytes			<i>Potamogeton berchtoldii</i>	1	1
<i>Fissidens fontanus</i>			<i>Potamogeton crispus</i>		
<i>Fontinalis antipyretica</i>	1		<i>Potamogeton filiformis</i>		1
<i>Sphagnum</i> sp.			<i>Potamogeton gramineus</i>	1	1
Vascular Plants			<i>Potamogeton lucens</i>		
<i>Alisma plantago-aquatica</i>		1	<i>Potamogeton natans</i>	1	1
<i>Apium inundatum</i>			<i>Potamogeton obtusifolius</i>		
<i>Baldellia ranunculoides</i> subsp. <i>ranunculoides</i>		1	<i>Potamogeton pectinatus</i>		
<i>Baldellia ranunculoides</i> subsp. <i>repens</i>			<i>Potamogeton perfoliatus</i>	1	1
<i>Callitriche brutia</i> subsp. <i>hamulata</i>			<i>Potamogeton polygonifolius</i>		
<i>Callitriche hermaphrodita</i>	1		<i>Potamogeton praelongus</i>		
<i>Carex rostrata</i>		1	<i>Potamogeton pusillus</i>		
<i>Ceratophyllum demersum</i>			<i>Potamogeton × angustifolius</i>		1
<i>Cladium mariscus</i>			<i>Potamogeton × nitens</i>		
<i>Elatine hexandra</i>			<i>Ranunculus</i> sp.		
<i>Eleocharis acicularis</i>			<i>Schoenoplectus lacustris</i>		
<i>Eleocharis multicaulis</i>	1	1	<i>Sparganium angustifolium</i>	1	1
<i>Eleocharis palustris</i>		1	<i>Sparganium emersum</i>		
<i>Eleogiton fluitans</i>			<i>Sparganium erectum</i>		
<i>Elodea canadensis</i>			<i>Sparganium natans</i>		
<i>Equisetum fluviatile</i>		1	<i>Subularia aquatica</i>		
<i>Eriocaulon aquaticum</i>			<i>Typha angustifolia</i>		
<i>Hydrilla verticillata</i>			<i>Utricularia</i> sp.	1	1
<i>Isoetes echinospora</i>		1	<i>Zannichellia palustris</i>		



### *Najas flexilis*

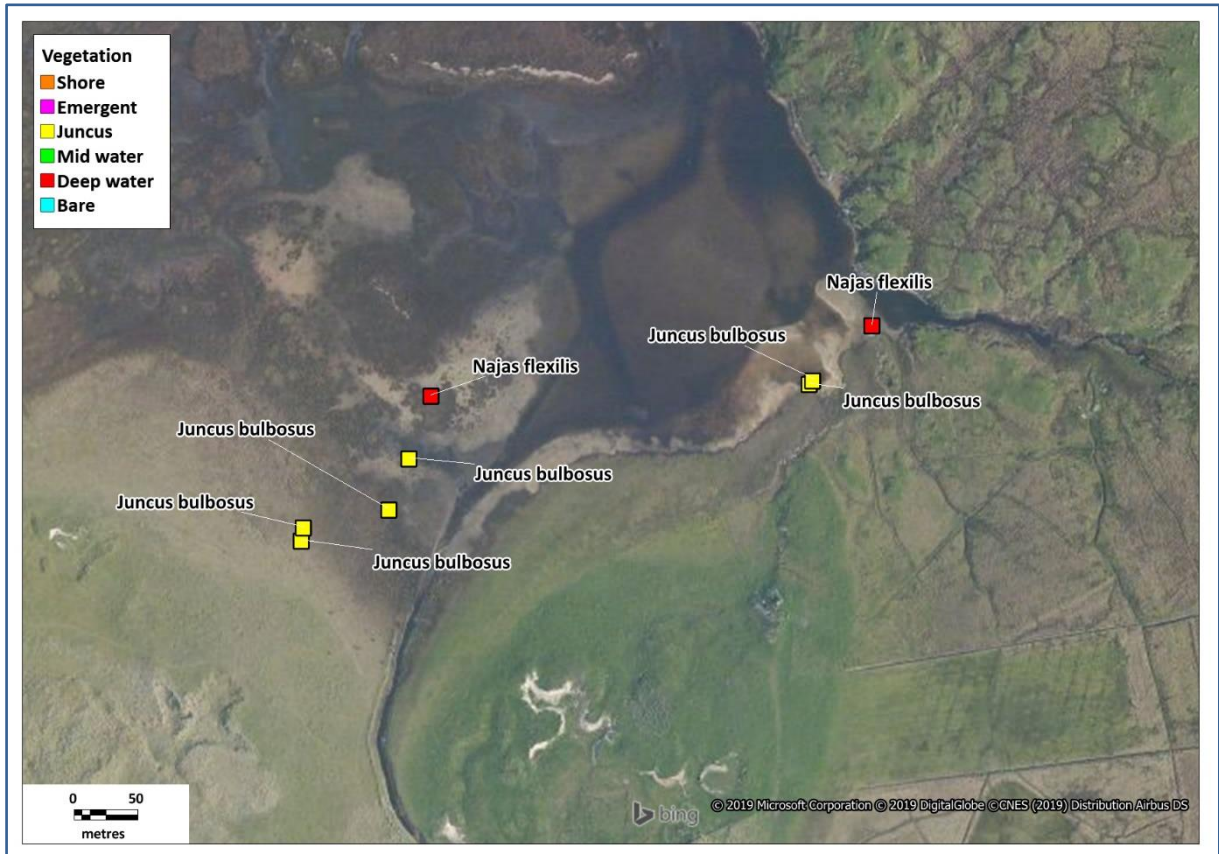
The plant is sparsely distributed amongst *Chara* swards and at much higher cover values (75%) with *Potamogeton* spp. and *Sparganium angustifolium*. It was first noted by Jim Ryan in 1981 and again by C. Roden in 2002. C. Roden's distribution data (Roden, 2002, 2004) matches that of the present survey. It is calculated that about 2 ha of habitat exists in Sheskinmore. There are no obvious threats to the population.



## Vegetation

Sheskinmore is not a typical *Najas flexilis* lake in terms of geomorphology. It is a very shallow (<1 m) sandy lake, separated from the sea by extensive sand dunes. Much of the lake is filled with emergents such as *Phragmites*. In the south-east more open water occurs, and it is in this area where *Najas* occurs. Vegetation cover values range from 40- 95%.

In very shallow water (<0.5 m), *Chara aspera* is dominant with much *Juncus bulbosus* and some *Potamogeton gramineus*. In deeper water (0.5-1 m), *Sparganium angustifolium*, *Nitella translucens*, *Potamogeton perfoliatus* and *Najas flexilis* are dominant.



## Water chemistry data

Water samples were taken on a single occasion on the 5 February 2019 as part of this survey.

Parameter	Unit	Sheskinmore This survey
Alkalinity	mg/l	16.6
Calcium	mg/l	6
Chloride	mg/l	23.5
Chlorophyll	µg/l	1.0
Colour	Hazen units	149
Conductivity	µS/cm	111
pH		7.1
Total phosphorus	mg/l	0.026

## Pressures and threats

Sheskinmore is a state nature reserve and there are no immediate threats to the site.

## Conservation condition

A very unusual lake which is not under threat but difficult to classify using the scheme proposed. The nearby very shallow Clooney Lough also contains a sward of *Chara* spp. with some *Najas flexilis*, but it was not visited in the present survey.

Parameter	Target for Good	Sheskinmore 2018	Condition
Area of habitat	Stable or increasing	Stable or increasing	Good
Deep-water community	Full development	n/a	-
Number of species	Stable or increase	Increase (26)	Good
Typical species	≥9 indicator species	10	Good
<i>Najas flexilis</i> population	Stable population	Appears stable	Good
Introduced species	Not present/not impacting on <i>Najas flexilis</i> / deep-water community	Not present	Good
Euphotic depth (m)	≥3	>1.5/max depth	n/a
Colour (Hazen units)	<40	149	Bad
Total phosphorus (TP) (mg/l)	<0.015	0.026	Poor
Hydrological regime	<50% <i>Lobelia – Littorella</i> zone exposed in summer	Regulated*	Good
<b>Overall assessment</b>			<b>Good</b>

\* the water level at Sheskinmore is has been controlled by a sluice since the outflow was excavated in the 1980s

Upper Lake, 2018			
Name	Upper Lake Killarney		Code UPR
Alternative name(s)			
Grid reference	V9059882013	Max. depth (m)	36 (Kelly <i>et al.</i> , 2012)
County	Kerry	EPA code	22_186
Area (ha)	167	OSi 1:50,000 sheet	78
Maximum length (km)	3.8	Nutrient data	EPA 2009-2015
Altitude (m)	18	SAC	000365, Killarney National Park, Macgillycuddy's Reeks and Caragh River Catchment SAC
Geology	Old Red Sandstone		
Previous survey	Scully (1916), FitzGerald & Preston (1994), Roden (2004), EPA in 2008, 2011, 2014, Roden & Murphy (2014)		
Previous <i>Najas flexilis</i> records	F.J. Hanbury and R.W. Scully 1906, A. Casement 28/10/1976, R. FitzGerald and C.D. Preston 26/07/1994, C. Roden, P. Murphy and C. Herdman 04/09/2014		
Other noteworthy species	<i>Pilularia globulifera</i>		
Snorkel survey date(s)	06/09/2018	Number of species	21
Surveyors	PM, CR, JR	Alkalinity (mg/l CaCO <sub>3</sub> )	6.1
Number of transects	3	Total phosphorus (mg/l TP)	0.008
Number of relevés	0	Colour (Hazen units)	28
Euphotic depth (m)	3.4	Secchi depth (m)	-
<i>Najas flexilis</i>	Not re-found during the survey, last seen in 2014		
Deep-water vegetation	Absent 2018 but present in 2014 – naturally limited in extent		
Noteworthy species	<i>Isoetes echinospora</i> , <i>Nitella gracilis</i> , <i>Pilularia globulifera</i>		
Introduced species	None noted		
Substrates	Rock, silt, mud		
Summary	A low alkalinity lake on Old Red Sandstone, marginally a <i>Najas</i> lake. The species, however, is known to have grown at a single location since 1906, but was not seen in 2018. A very rare charophyte, <i>Nitella gracilis</i> , was recorded in 2014 but not in 2018. There are no obvious threats		
Lake score	128	Lake rank	4
CONSERVATION CONDITION	<b>GOOD</b>		

### Previous accounts

1. *Najas flexilis* was first recorded by Scully and Hanbury in 1906 off Roynane Point (Scully, 1916). Scully's flora of Kerry also notes *Isoetes echinospora* and *Pilularia globulifera* from the lake (Scully, 1916).
2. R. FitzGerald and Chris Preston also found *Najas flexilis*, with *Nitella flexilis* and *N. translucens* off Roynane Point.
3. C. Roden snorkelled the Roynane Point site in 2004 but did not find *Najas flexilis*. He did note *Nitella confervacea*, *Nitella translucens* and *Isoetes lacustris*.
4. The EPA carried out surveys in 2008, 2011 and 2014. The species recorded are shown in the table including *Pilularia globulifera*, but *Najas flexilis* was not recorded. A euphotic depth of about 3 m was recorded.
5. C. Roden and P. Murphy snorkelled the Roynane Point site in 2014 and also examined sites at the western and eastern ends of the lake (Roden & Murphy, 2014). The results of this work is combined with the 2018 survey and outlined below. They only found *Najas flexilis* at Roynane Point at 4 m depth growing with a rich *Nitella* flora including *N. confervacea*, *N. translucens* and the extremely rare *N. gracilis*, as well as *Chara globularis*.

See also NPWS (2017d, e).

## 2014 and 2018 surveys

The results of the 2014 and 2018 surveys are summarised in the vegetation map and the 2018 species list. The 2018 survey included two snorkellers and one SCUBA diver (PM). However it was not possible to re-find *Nitella gracilis*, *Chara globularis* or *Najas flexilis*. In 2014, *Najas* was not found elsewhere in the lake other than Roynane Point. It had been hoped that SCUBA survey in 2018 might explain why *Najas flexilis*, *Nitella gracilis* and *Nitella confervacea* were confined to the area at Roynane Point.

## Species recorded

Taxon - Upper Lake	Before 2014	2014-2018	Taxon - Upper Lake	Before 2014	2014-2018
Charophytes			<i>Isoetes lacustris</i>	1	1
<i>Chara aspera</i>			<i>Juncus bulbosus</i>	1	1
<i>Chara curta</i>			<i>Lemna minor</i>		
<i>Chara globularis</i>			<i>Lemna trisulca</i>		
<i>Chara rudis</i>			<i>Littorella uniflora</i>	1	1
<i>Chara virgata</i>	1	1	<i>Lobelia dortmanna</i>	1	1
<i>Nitella confervacea</i>		1	<i>Myriophyllum alterniflorum</i>	1	1
<i>Nitella flexilis</i>	1		<i>Myriophyllum spicatum</i>		
<i>Nitella gracilis</i>		1	<i>Najas flexilis</i>	1	1
<i>Nitella opaca</i>			<i>Nuphar lutea</i>	1	1
<i>Nitella translucens</i>	1	1	<i>Nymphaea alba</i>	1	
<i>Tolypella glomerata</i>			<i>Oenanthe fluviatilis</i>		
<i>Chara cf. muscosa</i>			<i>Phragmites australis</i>	1	1
Other algae			<i>Pilularia globulifera</i>	1	1
<i>Ophrydium versatile</i>			<i>Potamogeton alpinus</i>		
Bryophytes			<i>Potamogeton berchtoldii</i>	1	1
<i>Fissidens fontanus</i>			<i>Potamogeton crispus</i>		
<i>Fontinalis antipyretica</i>		1	<i>Potamogeton filiformis</i>		
<i>Sphagnum</i> sp.			<i>Potamogeton gramineus</i>		
Vascular Plants			<i>Potamogeton lucens</i>		
<i>Alisma plantago-aquatica</i>			<i>Potamogeton natans</i>	1	
<i>Apium inundatum</i>	1	1	<i>Potamogeton obtusifolius</i>		
<i>Baldellia ranunculoides</i> subsp. <i>ranunculoides</i>			<i>Potamogeton pectinatus</i>		
<i>Baldellia ranunculoides</i> subsp. <i>repens</i>			<i>Potamogeton perfoliatus</i>	1	
<i>Callitriche brutia</i> subsp. <i>hamulata</i>	1	1	<i>Potamogeton polygonifolius</i>		
<i>Callitriche hermaphroditica</i>			<i>Potamogeton praelongus</i>		
<i>Carex rostrata</i>			<i>Potamogeton pusillus</i>		
<i>Ceratophyllum demersum</i>			<i>Potamogeton × angustifolius</i>		
<i>Cladium mariscus</i>			<i>Potamogeton × nitens</i>		
<i>Elatine hexandra</i>	1	1	<i>Ranunculus</i> sp.		
<i>Eleocharis acicularis</i>			<i>Schoenoplectus lacustris</i>		
<i>Eleocharis multicaulis</i>			<i>Sparganium angustifolium</i>		1
<i>Eleocharis palustris</i>			<i>Sparganium emersum</i>		
<i>Eleogiton fluitans</i>			<i>Sparganium erectum</i>		
<i>Elodea canadensis</i>			<i>Sparganium natans</i>		
<i>Equisetum fluviatile</i>	1		<i>Subularia aquatica</i>		
<i>Eriocaulon aquaticum</i>			<i>Typha angustifolia</i>		
<i>Hydrilla verticillata</i>			<i>Utricularia</i> sp.		1
<i>Isoetes echinospora</i>		1	<i>Zannichellia palustris</i>		

A total of 21 species was recorded in the 2014 to 2018 surveys, and 26 species have been recorded in all surveys combined.

- *Nitella gracilis* is an extremely rarely recorded charophyte, being only known from two other sites in Ireland. It was recorded in 2014, but not re-found in 2018. It is possible that it will be re-found in the future.
- *Isoetes echinospora* has been known from the Upper Lough since 1866. It was found in the western end of the lake in 2014.

*Pilularia globulifera* was first noted at the south-western end of the lake in 1890 by Scully (1916) and re-found in this area in 2014.

### *Najas flexilis*

The absence of *Najas flexilis* in September 2018 was unexpected. The plant has been recorded at this location in 1906, 1994 and 2014. The most likely change was the unusual hot and dry summer of 2018. *Najas flexilis* was not found in Lough Leane in 2018. The population in Upper Lough is unusual as the lake is more oligotrophic than most *Najas flexilis* lakes. It is unclear why the plant is only found off Ronayne Point. An underwater spring was suspected but a thorough SCUBA examination in 2018 found no evidence of this. The population in 2014 was confined to the area north of Ronayne Point and only covered a few hundred square metres (Roden & Murphy, 2014).

### Vegetation

The Upper Lake is a long narrow basin with a depth of >5 m. Most shores are steeply-sloping and rocky, but a soft sediment shore occurs at the western end and in some smaller bays elsewhere.

The lake appears to be a typical oligotrophic lake with Isoetid vegetation where shore conditions permit, but many shores are bedrock with no vegetation. At the western end, *Nuphar lutea*, *Apium inundatum*, *Juncus bulbosus*, *Callitriche brutia* subsp. *hamulata* and *Myriophyllum alterniflorum* occur on soft sediment, giving way to *Isoetes spp.* and *Pilularia*. At greater depths, 2 m, *Nitella translucens* and *Potamogeton berchtoldii* occur. The euphotic depth is 3-4 m.

The deep-water community recorded at Roynane Point in 2014 could not be located in 2018.

### Water chemistry data

Water quality data for the period 2009 to 2015 were made available by the EPA, for many samples from multiple depths. Values presented and used in assessment are averages of all data.

Parameter	Unit	Upper Lake EPA 2009-2015
Alkalinity	mg/l	6.1
Calcium	mg/l	1.7
Chloride	mg/l	10.2
Chlorophyll	µg/l	1.9
Colour	Hazen units	27.7
Conductivity	µS/cm	46.3
Magnesium	mg/l	0.9
pH		6.49
Potassium	mg/l	0.23
Secchi	m	3.8
Sulphate	mg/l	2.86
Total oxidised nitrogen	mg/l	0.14
Total phosphorus	mg/l	0.008

## Pressures and threats

Upper Lough is part of the Killarney National Park but is rated as only moderate WFD status by the EPA. No obvious threats could be seen and average nutrient data are not exceptional, however damage to water quality is very possible as a result of fires, such as those that occurred in 2021. There is also some turf cutting and conifer plantations on peat in the catchment.

## Conservation condition

The absence of the deep-water community in 2018 is not understood, except that *Najas flexilis* was not found in Lough Leane nor Loch an Chaolaigh in the same year, which was unusually warm. Assuming that the deep-water community will return, the lake is assessed as in *Good* Conservation Condition. Upper Lough, however, is only marginally a *Najas flexilis* lake due to low alkalinity.

Parameter	Target for Good	Upper Lake 2018	Condition
Area of habitat	Stable or increasing	Stable or increasing	Good
Deep-water community	Full development	Absent 2018 but present in 2014	Good/Poor
Number of species	Stable or increase	Stable (21)	Good
Typical species	≥9 indicator species	11	Good
<i>Najas flexilis</i> population	Stable population	Marginal population, not seen in 2018	Bad
Introduced species	Not present/not impacting on <i>Najas flexilis</i> / deep-water community	Not present	Good
Euphotic depth (m)	≥3	3.4	Good
Colour (Hazen units)	<40	28	Good
Total phosphorus (TP) (mg/l)	<0.015	0.008	Good
Hydrological regime	<50% <i>Lobelia – Littorella</i> zone exposed in summer	-	Good
<b>Overall assessment</b>			<b>Good</b>



