NPWS

Inishbofin and Inishshark SAC
(site code:278)

Conservation objectives supporting document-
Coastal lagoons

Version 1
May 2015

Contents

1. Introduction

1.1 Inishbofin and Inishshark SAC

This site is situated off the Co. Galway coast, about 5.5 km from the mainland. It comprises two main islands, Inishbofin and Inishshark, with several islets and stacks. The islands are composed almost entirely of Silurian slates and shales and rise to heights of 89 m (Inishbofin) and 69 m (Inishshark).

The SAC is selected for four habitats listed in Annex I of the Habitats Directive, including coastal lagoons.

"Coastal lagoons" (habitat code 1150) is a priority habitat in Annex I of the Habitats Directive. A coastal lagoon is a lake or pond that is fully or partially separated from the sea by a permeable barrier that can be entirely natural such as shingle, or can be an artificial embankment. Salinity varies depending on such factors such as freshwater inputs and barrier permeability. Lagoons support unique assemblages of flora and fauna, particularly invertebrates. In Ireland, coastal lagoons are considered to be in bad conservation status due to issues such as drainage and water pollution (NPWS, 2013).

A single lagoon is lagoon is listed for this SAC (Oliver, 2007). The table below gives the conservation status assessment of this lagoon as outlined in that report. See map in Appendix 1 and Appendix 2 for an account of the site (from Oliver, 2007).

Code[1]	Name	County	Conservation Assessment
IL070	Lough Bofin	Galway	Unfavourable inadequate

[1] Codes are those used in Oliver, 2007.

1.2 Conservation objectives

A site-specific conservation objective aims to define the favourable conservation condition of a habitat or species at site level. The maintenance of habitats and species within sites at favourable condition will contribute to the maintenance of favourable conservation status of those habitats and species at a national level.

Conservation objectives are defined using attributes and targets that are based on parameters as set out in the Habitats Directive for defining favourable status, namely area, range, and structure and functions.

Provisional reference conditions for Irish lagoons are proposed by Roden and Oliver (2013). Reference conditions aim to define ecological status prior to human impacts (i.e. "natural" conditions). The targets for the water quality attributes given below are based on reference values given by Roden and Oliver (2013).

Attributes and targets may change/become more refined as further information becomes available.

2. Area

The target for habitat area is: stable or increasing, subject to natural processes. Favourable reference area for the mapped lagoon is 8.0ha- see table below.

Code[1]	Name	Area (Ha) [2]
IL070	Lough Bofin	8.0
	Total	8.0

[1] Code is that used in Oliver (2007).

[2] Area is calculated from spatial data derived from Oliver (2007).

3. Range

The known distribution of lagoon habitat in Inishbofin and Inishshark SAC is shown in Appendix 1.

The target for the habitat distribution attribute is: no decline, subject to natural processes.

4. Structure and functions

Structure and functions relate to the physical components of a habitat ("structure") and the ecological processes that drive it ("functions"). For lagoons these include attributes such as salinity, hydrology and various water quality attributes.

4.1 Salinity regime

Lagoons can vary considerably in salinity both within and between sites depending on the volume and timing of inflowing and outflowing fresh and seawater. Salinity is probably the most important variable in the classification of lagoon types (Roden and Oliver, 2013).

The target for the salinity regime attribute is: median annual salinity and temporal variation within natural range.

There is no direct connection between Lough Bofin and the sea. The volume of the lagoon is small and the amount of seawater entering either through percolation or overwashing of the cobble barrier can be relatively high. Large amounts of freshwater can enter at times of high rainfall. The lagoon therefore appears to undergo extreme variations in salinity. It ranged from 13 to 17psu in August 1998, but salinities of between 32.33 and 33.1 psu were recorded in August 1995 (Oliver, 2007). Using information from Oliver (2007), the following table gives the salinity class for this lagoon. See Roden and Oliver (2013) for further information on salinity classes and Appendix 2 for lagoon report.

Code	Name	Salinity
IL070	Lough Bofin	Mesohaline to euhaline

4.2 Hydrological regime

Fluctuations in water depth are a natural feature of lagoon hydrology. However, if water levels fluctuate beyond their natural values due to issues such as drainage, the condition of the habitat can deteriorate.

The target for hydrological regime is: annual water level fluctuations and minima within natural ranges.

Lough Bofin lagoon identified within Inishbofin and Inishshark SAC can be classified as shallow (<1.5m) thus even small changes in water depth can cause significant losses in habitat area. Further information is required to investigate historic fluctuations to enable more specific targets to be set. See Appendix 2 for the site report.

4.3 Barrier: connectivity between lagoon and sea

The morphology of the barrier between a lagoon and sea determines how it functions ecologically. Changes to the barrier can be due to natural processes such as storms, but they can also be modified through human intervention. Active management is sometimes necessary, particularly if the lagoon is artificial.

The target for the attribute barriers: connectivity between lagoon and sea is: appropriate hydrological connections between lagoons and sea, including where necessary, appropriate management.

Lough Bofin lagoon is a natural sedimentary lagoon with a cobble barrier (Oliver, 2007). See also the site account in Appendix 2.

4.4 Water quality- Chlorophyll a

This attribute indicates the level of phytoplankton in the water column. Roden and Oliver (2013) make the assumption that, for shallow lagoons in "natural" condition, primary productivity is dominated by the benthos rather than the plankton. Phytoplankton tends to increase in density in response to increasing nutrient levels. Excessive shading from phytoplankton can reduce submergent macrophyte colonisation of the littoral zone of lagoons.

The target for the attribute water quality- Chlorophyll a is: annual median chlorophyll a within natural ranges and less than 5µg/L. Target based on Roden and Oliver (2013).

4.5 Water quality- Molybdate reactive phosphorus (MRP)

The target for the attribute water quality- Molybdate Reactive Phosphorus (MRP) is: annual median MRP within natural ranges and less than 0.1mg/L. The target is based on Roden and Oliver (2013).

This limit is required to ensure that excessive shading from phytoplankton does not reduce submergent colonisation of the littoral zone.

4.6 Water quality- Dissolved inorganic nitrogen (DIN)

The target for the attribute water quality- Dissolved Inorganic Nitrogen (DIN) is: annual median DIN within natural ranges and less than 0.15mg/L. The target is based on Roden and Oliver (2013).

As for phosphorus, the limit for set nitrogen is to ensure that excessive shading from phytoplankton does not reduce submergent colonisation.

4.7 Depth of macrophyte colonisation

As Lough Bofin has been identified as shallow, it is expected that macrophytes should extend down to its full depth (1.5m).

The target for the attribute depth of macrophyte colonisation is: macrophyte colonisation to maximum depth of lagoon.

4.8 Typical plant species

As lagoon specialist species do not easily recolonise, their presence is one of the indicators of long term continuity of quality.

The target for the attribute typical plant species is: maintain number and extent of listed lagoonal specialists, subject to natural variation.

The plant species recorded in Lough Boffin lagoon is summarised in Oliver (2007). Four species considered to be lagoonal specialists *Ruppia cirrhosa, Ruppia maritima, Lamprothamion papulosum* and *Chaetomorpha linum* occur within the lagoon. See Appendix 2 for the site report.

4.9 Typical animal species

Some invertebrate species are regarded as lagoonal specialists and their presence can indicate long term quality. As species found within each lagoon can vary considerably, depending on other attributes such as salinity, the target is based on site-specific species lists.

The target for the attribute typical animal species is: maintain listed lagoon specialists, subject to natural variation

The species recorded at this site are summarised in Oliver (2007). A single lagoonal specialist *Jaera nordmanni* was recorded from Lough Bofin. See Appendix 2 for site report.

4.10 Negative indicator species

Negative indicator species include non-native alien species as well as those that are not typical of the habitat. For example, accelerated encroachment by reedbeds can be caused by low salinity, shallow water and elevated nutrient levels.

The target for the attribute negative indicator species is: negative indicator species absent or under control.

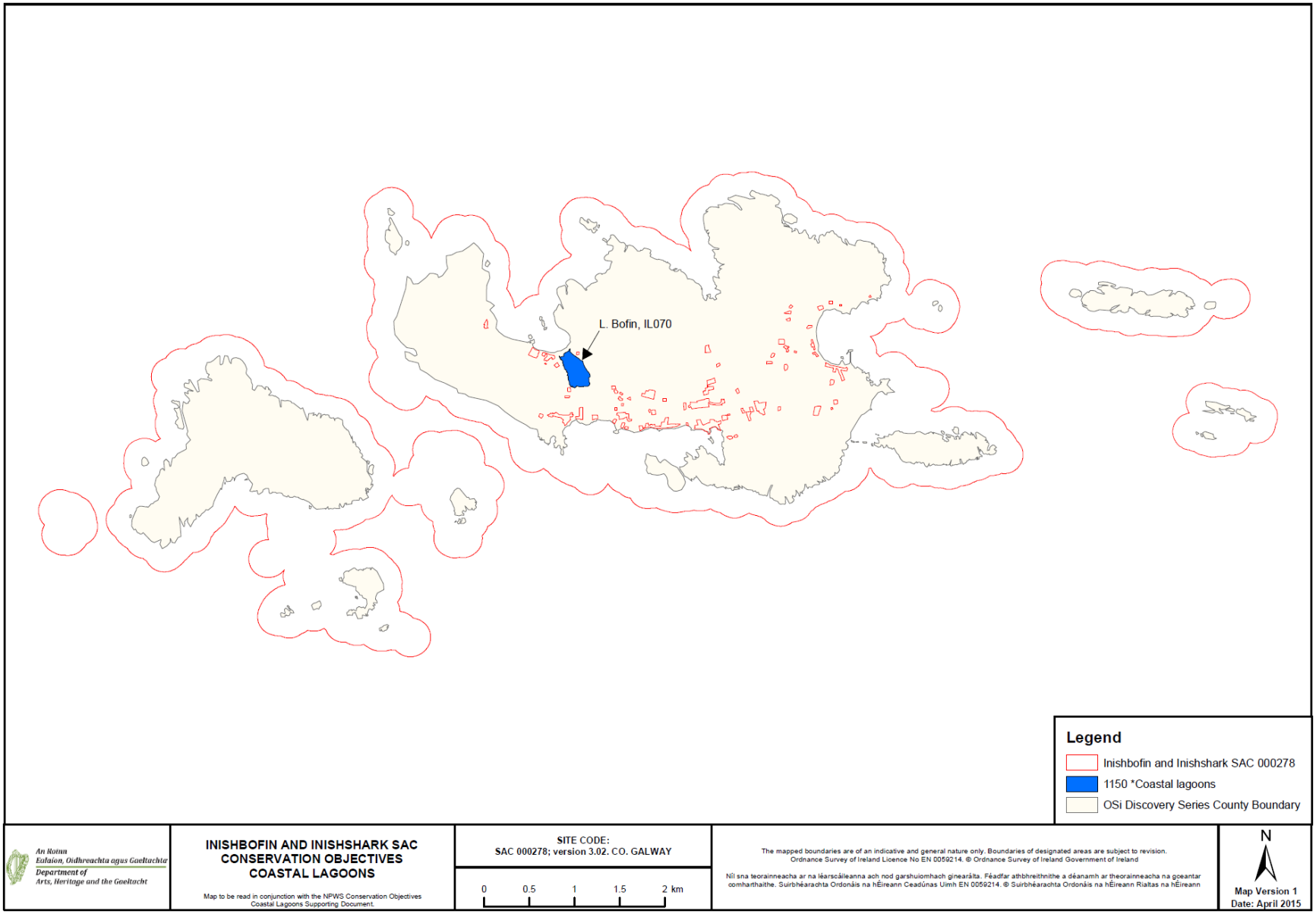
5. References

Roden, C.M. and Oliver, G. (2013) Monitoring and assessment of Irish lagoons for the purpose of the EU Water framework Directive. Unpublished report to the Environmental Protection Agency.

NPWS (2013) The status of EU protected habitats and species in Ireland. Unpublished report, NPWS. Department of Arts, Heritage and the Gaeltacht, Dublin.

Oliver, G. (2007) Inventory of Irish coastal lagoons (version 2). Unpublished report to the National Parks and Wildlife Service.

Appendix 1 Lagoon distribution map



Appendix 2 Site report

The following is the site account from Oliver (2007)

Code[1]	Name
IL070	Lough Bofin

[1] Code is that used in Oliver, 2007.

4.70	**Lough Bofin, Inishbofin, County Galway** O.S. L 525 656 O.S. Discovery Sheet 37

Conservation Designation: Inishbofin and Inishark SAC 000278

General description:

Lough Bofin is a small (8ha), shallow (<1.5m) **natural sedimentary lagoon** with a cobble barrier. The lagoon is situated on the north shore of the island of Inishbofin, approximately 2km to the west of the harbour. The barrier is high and seawater enters the lagoon by percolation and by overwash during storms. Although there is no direct connection with the sea, the volume of the lagoon is small and the amount of seawater that enters, either by percolation or overwashing can be relatively high. Large amounts of freshwater can also enter at times of high rainfall and it appears that the lagoon undergoes extreme variations in salinity. Salinity measured 13-17psu during the sampling period (5-7/8/98), but 32.3-33.1psu was recorded in August 1995.

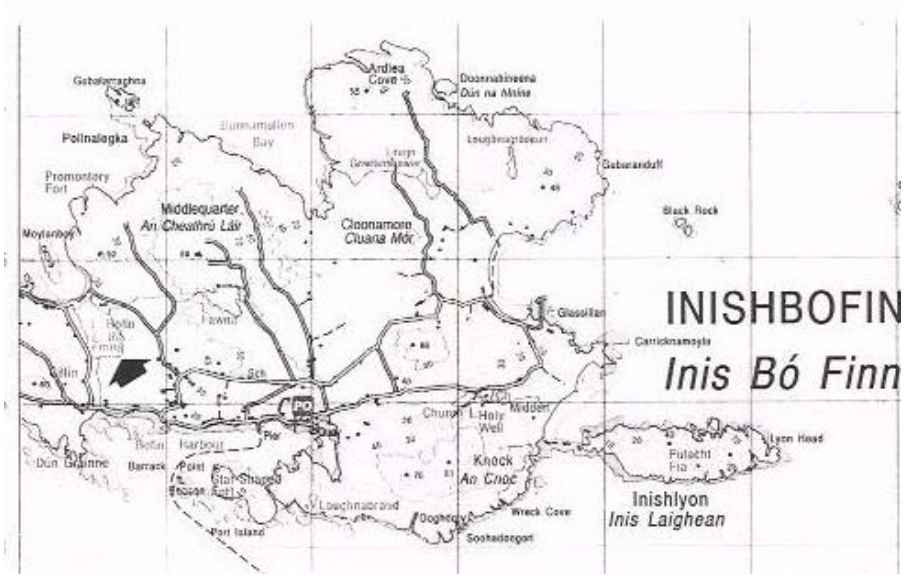


Figure 70.1 Location of map of Lough Bofin.

Lough Bofin was surveyed in 1998 for vegetation (Roden 1999), aquatic fauna (Oliver 1999) and ecotonal coleoptera (Good 1998, Good & Butler 2000). Results of these surveys are summarised by Healy (1999a,b; 2003).

Stations used for faunal sampling are not necessarily the same as those used for vegetation or ecotonal coleoptera.

Flora

The vegetation of L. Athola was surveyed in 1998 by C. Roden. The following is based on the report by Roden (1999), following his survey on 4-5/8/98.

The benthic vegetation is uniform consisting of stands of ***Ruppia cirrhosa*** and ***Ruppia maritima***, as well as a mixed *Ruppia* and ***Lamprothamnion papulosum*** community with some ***Chaetomorpha linum***. There are very few bare mud or sand patches and the vegetation is dense.

All four of the above species are lagoonal specialists.

Lamprothamnion papulosum was known from only three sites in Ireland before 1996 (Hatch and Healy 1998). As a result of the surveys it was relocated at two of these sites (Lady's Island L., Co. Wexford, L. Murree, Co. Clare), but not at Tacumshin L., Co. Wexford. It is also now known from a total of 14 lagoon sites, most of which are clustered in Connemara, but there are also new records from the North Slob, Co. Wexford, L. Bofin, Co. Galway and Maghery, Co. Donegal. This species is listed in the Red Data Book for Britain and Ireland (Stewart and Church 1992). Although recorded from the Baltic to the Mediterranean and Black Sea and also South Africa, it is believed to be declining in Europe. There are only five recent records from the south of England, but there are 12 important sites in the Outer Hebrides (Bamber *et al*. 2001). These Irish locations are very important in European terms, and it is especially encouraging to have found new sites.

Chaetomorpha linum. There is some doubt about the taxonomic status of the unattached lagoonal form of this species, and it was recorded by Hatch and Healy (1998) as *C. mediterranea*. It is a common, characteristic alga of semi-isolated Irish lagoons, recorded at 49 of the 87 (56.3%) lagoons surveyed.

Ruppia* spp.** are the most characteristic aquatic plant taxa of Irish coastal lagoons. The species are hard to distinguish when not flowering, and remain uncertain at some sites, but *Ruppia* of one species or the other (*R. maritima, R. maritima var brevirostris, R. cirrhosa*) was found at 62 of the 87 lagoons (71.3%) surveyed, and is one of the most useful indicators of coastal lagoon status. ***R. maritima appears to be the more common of the species and was found at 41 of the lagoons surveyed (47%).

R. cirrhosa is believed to tolerate higher salinities than the former species and to be less common, but neither of these statements is clearly supported in Irish lagoons and the two species were often found growing together. *Ruppia cirrhosa* was only identified at 23 lagoons (26%), but species was not determined at 12 sites. ***Ruppia maritima* var *brevirostris*** was only positively identified at two sites (Ballyteige, Co. Wexford and Inch L., Co. Donegal).

Marginal vegetation includes areas of *Juncus gerardii* association, including the *Potentilla anserina* variant and communities of gravel shores.

The phytoplankton is interesting with several brackish species of the genus *Procentrum.*

The benthic vegetation of Lough Bofin is an excellent example of the ***Ruppia/Lamprothamnium*** community. The phytoplankton appears to contain unusual species. All four of the aquatic plants recorded are lagoonal specialists, and one (*L.*

papulosum) is a rare charophyte. Based on aquatic flora, the site is rated as of **exceptional conservation value**.

Fauna

Four sampling stations were chosen for faunal sampling in 1998 (Figure 70.2, Table 70.1). The fauna of this lagoon was extremely poor with only 11 taxa recorded, of which 8 were identified to species (Table 70.2). One is a proposed lagoonal specialist in Ireland. None can be described as rare. Copepods were described as abundant in 1996 but were not identified. Surprisingly there were no Hydrobiids of any species found.

Jaera nordmanni. Isopod crustacean recorded at 24 of the 87 lagoons surveyed (27.6%) and may occur at others where it was not recorded due to the fact that only adult males are easily identified. Described in England (Barnes 1994, Hayward and Ryland 1995) as occurring in streams flowing down the shoreline, on south and west coasts only. All records in Ireland are from West Cork to Donegal. Proposed as a lagoonal specialist for Ireland by Oliver and Healy (1998).

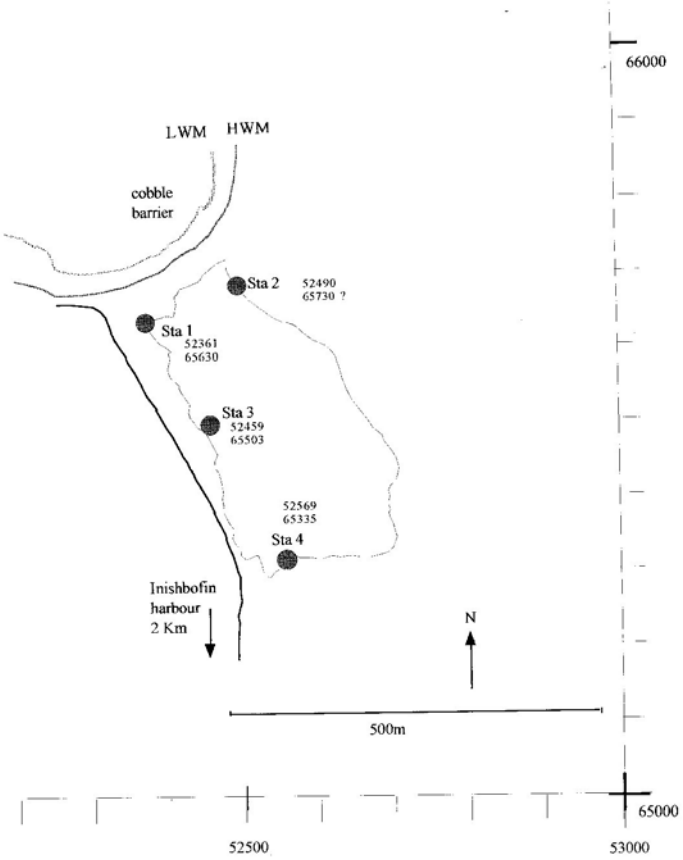


Figure 70.2 Sampling stations used at L. Bofin.

Table 70.1 Positions of faunal sampling stations in L. Bofin, 5-7/8/98, with salinity, depth of water and type of substratum.

	Sta 1	Sta 2	Sta 3	Sta 4
GPS position	L 52361 65630	L 52490 65730	L 52459 65503	L 52569 65335
Salinity(psu0	16-17.5	15-16	13.1	4-17
Depth(cm)	0-100	0-100	70-100	0-100
Substratum	Occasional large stones, cobbles, muddy gravel, fine silt	Bedrock (schist?) large stones, gravel	Silty peat	Gravelly mud, flat stones, isolated peat clumps.

Table 70.2 Aquatic fauna recorded at stations in Lough Bofin, Co. Galway 5-7/8/98. L.T. = light trap + = present, o = occasional, c = common, a = abundant, F = fyke net. Species in bold text are lagoonal specialists or rare species.

			Sampling Stations							
			1	L.T. 1	2	L.T. 2	3	L.T. 3	4	L.T. 4
Turbellaria		*Procerodes littoralis*								
Annelida			c		c					
	Polychaeta	*Nereis diversicolor*	o				o		c	
Crustacea										
	Copepoda	indet	(a)		(a)		(a)		(a)	
	Isopoda	***Jaera nordmanni***	c	7	c		8		6	2
	Amphipoda		a	c250		c250	a	c1000	+	c500
		Gammarus duebeni	28	27	8	60	a	131	11	225
		Melita palmata	1							1
	Decapoda	*Carcinus maenas*								
Insecta										
	Diptera	Chironomidae	+							
Bryozoa		*Bowerbankia gracilis*								
Pisces		*Anguilla anguilla*					F = 5			
		Gasterosteus aculeatus	c	1	c	3	c		a	20

The aquatic fauna of Lough Bofin is extremely poor, especially in comparison with the vegetation. Only 11 taxa were recorded in 1998, only one of which is a lagoonal specialist and is of any conservation value. Based on this fauna, the lagoon is rated as of **low conservation value**.

Ecotonal coleoptera

Two species of carabid and 9 species of staphylinid beetles were recorded at Lough Bofin (Good 1999, Good & Butler 2000), none of which is an indicator species, and based on ecotonal coleoptera the site is rated as of **no conservation value**.

Summary

Geomorphologically Lough Bofin is an excellent example of a **natural sedimentary lagoon** with a high **cobble barrier**. Aquatic flora is also rated as of exceptional conservation value due to the prolific growths of four lagoonal specialists, which include the rare charophyte ***Lamprothamnium papulosum***, as well as both ***Ruppia cirrhosa*** and ***R. maritima*** and ***Chaetomorpha linum***.

The fauna however is extremely impoverished, possibly due to extreme variations in salinity and periodic anoxia due to rotting algae. The lagoon could be referred to as what Hartog (1974) describes as a "shock system", in which the extreme variations make it impossible for most animals to survive.

Overall conservation, based mainly on the presence of *Lamprothamnium*, is rated as high.

Overall Conservation Value = High

Conservation Status Assessment (from Oliver 2007)	
Impacts	Natural eutrophication from decaying algae. Cattle poaching in areas. Urbanisation. Accumulation of organic material.
Conservation Status	Unfavourable-Inadequate

Further Information

Listed as a lagoon by Healy *et al.* 1997. Surveyed in 1998 for vegetation (Roden 1999), aquatic fauna (Oliver 1999) and ecotonal coleoptera (Good 1998, Good & Butler 2000). Results of these surveys are summarised by Healy (1999a,b; 2003). Included in a biological classification of Irish coastal lagoons (Oliver 2005) and in the Conservation Status Assessment (Oliver 2007).

References:

Bamber, R.N, Gilliland, P.M. & Shardlow, M.E.A. 2001. *Saline lagoons: a guide to their management and creation* (interim version).ISBN 1 85716573 X. Peterborough, English Nature.

Barnes, R.S.K. 1994. *The brackish-water fauna of northwestern Europe: a guide to brackish-water habitats, ecology and macrofauna for field workers, naturalists and students.* Cambridge University Press. 287 pp.

Good, J.A. 1999. A survey of *Irish coastal lagoons. Vol V. Ecotonal Coleoptera (Staphylinidae and Carabidae).* Dúchas, Dublin.

Good, J.A. & Butler, F.T. 2000. Coastal lagoon and saline lake shores as a habitat for Staphylinidae, Carabidae and Pselaphidae (Coleoptera) in Ireland. Part 2. *Bulletin of the Irish Biogeographical Society*. **24:** 111-41

Hartog, C. den 1974. Brackish-water classification, its development and problems. *Hydrological Bulletin,* **8**: 15-28.

Hatch, P. & Healy, B. 1998. Aquatic vegetation of Irish coastal lagoons. *Bulletin of the Irish Biogeographical Society*. **21:** 2-21.

Hayward, P. J. & Ryland, J.S. (eds.) 1995. *Handbook of the Marine Fauna of North-West Europe.* Oxford University Press. PB. 899 pp.

Healy, B. 1999a. *Survey of Irish coastal lagoons. 1996 and 1998. Vol. 1 Part 1. Background, description and summary of the surveys*. Dúchas, Dublin.

Healy, B. 1999b. *Survey of Irish coastal lagoons. 1996 and 1998. Vol. 1 Part 2. Lagoons surveyed in 1998*. Dúchas, Dublin.

Healy, B. 2003. Coastal Lagoons. In: *Wetlands of Ireland.* R. Otte (ed). Chapter 4. University College Dublin Press. Dublin. 44-78.

Healy, B., Oliver, G.A., Hatch, P. & Good, J.A. 1997a. *Coastal lagoons in the Republic of Ireland. Vol. 1. Background, outline and summary of the survey*. Report to the National Parks and Wildlife Service, Dublin.

Healy, B., Oliver, G.A., Hatch, P. & Good, J.A. 1997b. *Coastal lagoons in the Republic of Ireland. Vol. 2. Inventory of lagoons and saline lakes.* Report to the National Parks and Wildlife Service, Dublin.

Oliver, G.A. 1999. *A survey of Irish coastal lagoons. Vol. IV: Aquatic Fauna.* Unpublished report for Dúchas, The Heritage Service. Dublin.

Oliver, G.A. 2005. *Seasonal changes and Biological Classification of Irish Coastal Lagoons.* PhD Thesis. U.C.D., Dublin. Available on www.irishlagoons.com

Oliver, G.A. 2007. *Conservation status report: Coastal Lagoons (1150).* Unpublished report to the National Parks and Wildlife Service, Dublin.

Oliver, G.A. and Healy, B. 1998 Records of aquatic fauna from coastal lagoons in Ireland. *Bulletin of the Irish Biogeographical Society*. **21**: 66-115.

Roden, C. 1999. *Irish coastal lagoon survey, 1998. Vol. III, Flora.* Dúchas, Dublin.

Stewart, N.F. & Church, J.M. 1992. *Red Data Books of Britain and Ireland. Charophytes.* Joint Nature Conservation Committee and Office of Public Works, Dublin.