

Underwater Vegetation OF LOUGH CARRA

Cilian Roden

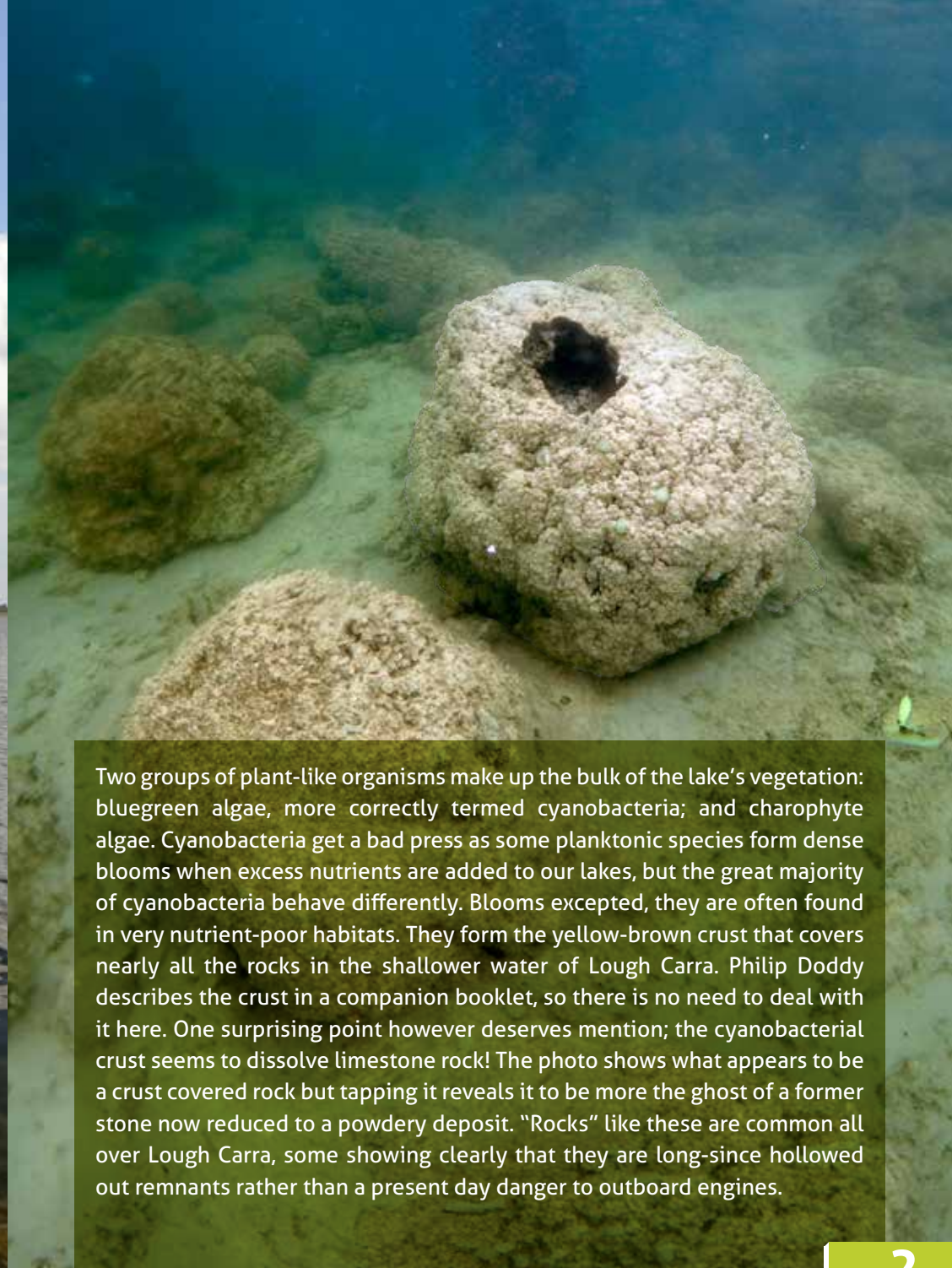
LCCA

Lough Carra
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MARL LAKES AND THEIR UNDERWATER VEGETATION

Unlike most Irish lakes, the full Gaelic name of Lough Carra is Fionn Loch Ceara, not simply Lough Carra, meaning of course fair or white Lough Carra. Its name comes from the huge sheets of white marl that lie on the lake bottom and reflect light back to the surface.

Lough Carra is perhaps the best Irish example of a lake type known as a marl lake, so-called because large quantities of marl (a lime rich deposit) accumulate in them. The marl accumulations are the result of calcium carbonate-rich water feeding the lake which makes the water more alkaline.



Two groups of plant-like organisms make up the bulk of the lake's vegetation: bluegreen algae, more correctly termed cyanobacteria; and charophyte algae. Cyanobacteria get a bad press as some planktonic species form dense blooms when excess nutrients are added to our lakes, but the great majority of cyanobacteria behave differently. Blooms excepted, they are often found in very nutrient-poor habitats. They form the yellow-brown crust that covers nearly all the rocks in the shallower water of Lough Carra. Philip Doddy describes the crust in a companion booklet, so there is no need to deal with it here. One surprising point however deserves mention; the cyanobacterial crust seems to dissolve limestone rock! The photo shows what appears to be a crust covered rock but tapping it reveals it to be more the ghost of a former stone now reduced to a powdery deposit. "Rocks" like these are common all over Lough Carra, some showing clearly that they are long-since hollowed out remnants rather than a present day danger to outboard engines.

The star species in Lough Carra are the charophyte algae. These are strange and very ancient organisms. There are only a few species - perhaps 30 in Ireland - compared to hundreds of land plants but in marl lakes they reign supreme, challenged only by the extensive cyanobacterial crusts of shallower water. Charophytes are constructed of long narrow tube-like cells which, unusually, contain many nuclei. Cells can be several centimetres long making them the giants of the cellular world. Each plant consists of long stems with whorls of branches every few centimetres. The stems consist of a big central cell often surrounded by a cladding of smaller cells. The whorled branches in turn carry small projections that are the site of the reproductive organs. Charophytes do not reproduce by seeds but by rather beautiful spores with calcium carbonate walls and spiral ridges- (see the caddisfly case photo below). The organisms don't have proper roots instead they attach to soft bottom sediment with thin rhizoids only one cell wide. Some species have white circular tuber-like organs, from which new plants can grow. The first thing most people notice about charophytes is their odd garlic-like smell and their stiff brittle nature. This brittleness is caused by the whole plant having a stiff coating of calcium carbonate, sometimes so thick that it is hard to believe they are alive and giving rise to their common English name of stoneworts.



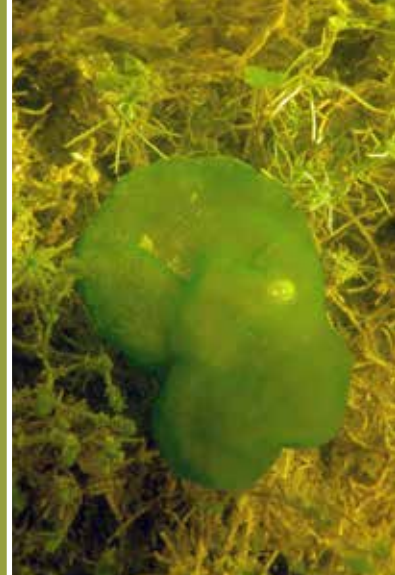
CHAROPHYTES

SOME OTHER SPECIES

An even stranger but equally ancient organism is *Ophrydium versatile*, for many it is no more than a green blob along the shoreline but actually it is a strange multispecies symbiosis of animal, algae and bacteria reminiscent of symbiotic corals. It occurs in many marl lakes growing attached to the crust or on reeds.

In pristine marl lakes such as occur in the Burren, very few flowering plants occur, probably because of a severe shortage of phosphorus. This is also the case for the Castle Carra basin of Lough Carra. However a few, very characteristic flowering plants do occur. My favourite is bladderwort. It does not root in the sediment but lies on the surface like a snake. Not only does it remind one of an animal, it feeds like one too. Its leaves are fine and pale green, and amongst them are an abundance of little bladders, each with a hair trigger. If the trigger is touched the bladder springs open and sucks in nearby water along with the unfortunate organism that touched the trigger. A few other plants occur in pristine lakes such as the underwater form of the yellow water lily or various pond weeds. In having a vegetation dominated by charophytes and marl crust, marl lakes are very peculiar. These strange lakes with their ancient lineages of bacteria and algae may well be relict communities that have existed on the earth's surface for unimaginable lengths of time. As such they are very valuable.

We will see later that as marl lakes are degraded by excess phosphorus and nitrogen, many other flowering plants appear, to the detriment of the original flora.



OPHRYDIUM VERSATILE

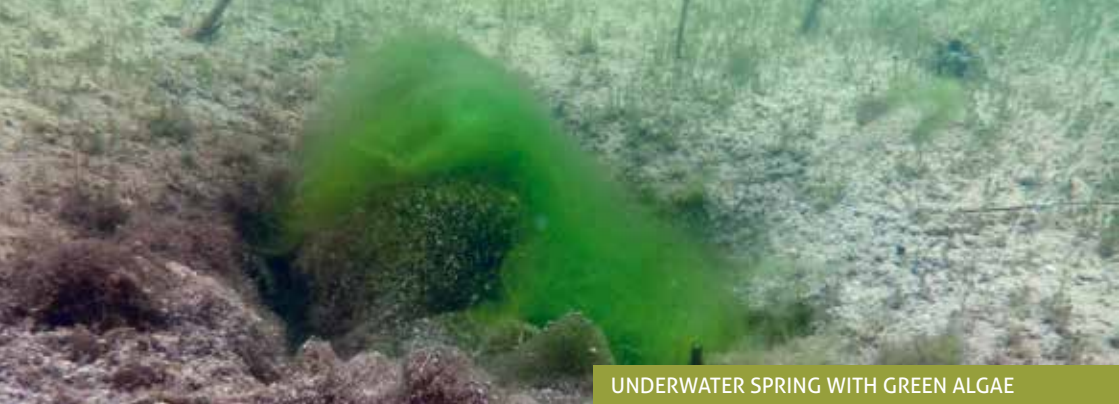


UTRICULARIA VULGARIS
OR BLADDERWORT

UNDERWATER MEADOWS

Most Irish marl lakes occur on Carboniferous limestone, the rock of Lough Carra and indeed the Burren. Rainwater dissolves Carboniferous limestone so rather than an ordered landscape of valleys and streams, the rock is a mass of interconnecting underground tunnels and springs, some of which discharge underwater into the lake. Carra, like some other marl lakes, is a mixture of extensive shallow water and a series of deep holes with steep sides, called pike holes, which possibly originated as collapsed caves. This morphology results in a series of deeper basins all but completely separated from each other by large expanses of shallow water.

Marl lakes are clear lakes; charophytes grow in 9-10 m depth of water in places. For plants to gather light at such depths, water clarity is essential. In good marl lakes, vegetation occurs in bands with each species found at a particular depth. In the Castle Carra basin of Lough Carra, a typical marl lake sequence occurs, starting with cyanobacterial crust growing from the surface to 2-3 m depth wherever there is outcropping rock. Soft marl in shallow water is often bare of vegetation. Following the crust from perhaps 2 m depth, the first band of charophytes occur, the dominant species is *Chara curta* with its short arms and spiny stems. Below *Chara curta* at perhaps 4 m, a larger wiry species *Chara subspinosa* appears. Sometimes a few pondweeds or water lily leaves occur here. At about 6 m, a finer delicate species *Chara virgata* forms large expanses. At the deepest point below about 8 m a very rare form is found in Carra and a few other Irish lakes, *Chara dissoluta*, often accompanied by *Chara contraria*. Beyond *Chara dissoluta* it is too dark for any large plant to occur but occasionally thin mats of purple coloured cyanobacteria can be seen.



UNDERWATER SPRING WITH GREEN ALGAE



CYANOBACTERIAL CRUST

1 METER DEPTH



CHARA CURTA

2 METER DEPTH



CHARA SUBSPINOSA

4 METER DEPTH



CHARA VIRGATA

6-8 METER DEPTH

MYRIOPHYLLUM VERTICILLATUM
OR WATER MILFOIL

INCREASING PHOSPHORUS AND DECLINING LIGHT

Not all of Lough Carra is like the Castle Carra basin. Long ago in 1904, the great naturalist Robert Lloyd Praeger spent four days exploring the lake and complained about the abundance of the marl and cyanobacterial crust and the almost complete absence of flowering plants anywhere. He assumed the marl deterred the plants but we now know that their absence is a sign of a marl lake in excellent condition with very little available phosphorus. Much of Lough Carra, unfortunately, is no longer in such good order. Nutrient additions, especially from the Annie's River and other streams, are gradually enriching the lake. The excess nutrient both reduces water transparency and increases shading through promoting plankton growth and also allowing flowering plants to replace the original charophyte flora. Philip Doddy has shown that the cyanobacterial crust is breaking down near the Annie's River and snorkelling nearby tells the same story. Lake vegetation no longer extends to 9 m depth but ends between 4 and 5 m. The deep beds of *Chara dissoluta* and even *Chara virgata* are gone replaced by bare mud.

BARE MUD AT 4.0 M



Other species of charophyte occur as well. The spiny *Chara aculeolata* occurs close to the surface and in the deep hole at Gallagher. A rare species *Chara tomentosa* is becoming more and more abundant in Lough Carra (both are shown on the cover page above). It was first noted in Carra in 1995 but seems to be spreading slowly throughout the lake ever since. It may well have been introduced, possibly by boats moved from the Shannon thirty years ago.

The charophyte beds are the most prominent vegetation in the lake, and cover many hectares of lake bottom. They are usually very dense and grow to a height of 50-75 cm forming a complex environment where invertebrate animals shelter. Snails are often seen grazing microalgae growing on charophyte stems. Studies elsewhere show that charophyte beds harbour very large populations of invertebrates-excellent food for trout- compared to bare mud. Grazing water birds need dense beds of underwater plants as food; An interesting question is whether the decline in winter bird numbers on Carra or Lough Corrib reflects the changing vegetation of these lakes. However as yet we know little about how plants and animals interact in the lake. A caddis fly larva's case (collected by Sabine Springer) covered in charophyte spores, shown here, points us to these as yet unexplored connections.

Large stands of pondweeds (*Potamogeton sp.*), water lily, the introduced Canadian Pondweed (*Elodea*) and water milfoil (*Myriophyllum verticillatum*) now occupy the space normally dominated by *Chara subspinosa*. Indeed, in places water milfoil forms huge stands growing from 5 m depth to the surface, dense enough to foul outboard engines and anglers' lines. All the evidence points to the gradual erosion of the special vegetation of the lake, first by commoner water weeds and ultimately by floating blooms of often toxic cyanobacteria. A current mystery is the collapse of Lough Carra's mayfly population. It is understandable that as vegetation diminishes and changes the underwater nymphal stage would be affected, but even in the Castle Carra section the animal has greatly diminished, even though the vegetation is not obviously in decline.

This change in vegetation is seen not only in the underwater habitats but also in plants such as reed and bulrush/clubrush which grow in water with their stems emerging into the air. These plants have always grown around Carra - they are mentioned by Praeger, but he only noted "patches" here and there. Now large beds occur in many places especially at the mouths of inflowing streams. Their spread almost certainly depends on an increased supply of nutrients. In recent years the Common Reed has died back in some places on the lake, but as yet we do not know the cause.



UNDERWATER YELLOW
WATER LILY LEAVES

DOES THE CHANGE IN VEGETATION IMPLY TROUBLE AHEAD ?

Most of the evidence suggests yes. To start with, we know that the lake was very different a century ago, a difference confirmed by

examining lake sediments which show a big increase in phosphorus bound in the mud in recent years (See Huxley and Huxley 2015 for a detailed discussion). Other recent work has compared the vegetation of many of Irish marl lakes and a clear picture emerges. The lakes with the most transparent water, the deepest vegetation, the most charophytes and the healthiest crust are also the lakes with the lowest nutrient concentrations. Those with the highest phosphorus content are dark, with little vegetation at depth, few charophytes and no cyanobacterial crust. If each basin in Lough Carra (there are about 7) was a separate lake, they could be arranged based on their vegetation from excellent (Castle Carra) to pretty bad (west of Annie's and Cloondaver). I doubt it is a coincidence that there are no surface streams flowing into Castle Carra and two into the deep at Cloondaver. A hundred years ago Praeger reported an interesting flora of Greater Spearwort and Whorled Water-milfoil at the mouth of Annie's River. Today the river mouth is choked with bulrush and blanket weed.



BULRUSH BED IN LOUGH CARRA

THE MOUTH OF THE ANNIE'S RIVER

Unfortunately, Marl or limestone lakes can get a lot worse than anything yet seen in Lough Carra. In the neighbouring Lough Mask, the crust has almost completely vanished, zebra mussels are everywhere and few charophyte species occur. Unless we find a way of treasuring our magnificent lake - one of the best in Europe - instead of regarding it as a site for dumping waste; the title Fionn Loch Ceara may soon be more a linguistic curiosity than a living wonder for future generations.

FURTHER READING

Huxley, C. and Huxley, L. (2015) Lough Carra, p203, Carra Books, Belcarra.

King, J. J. & Champ, W.S.T. (2000) Baseline water quality investigations on Lough Carra, western Ireland, with reference to water chemistry, phytoplankton and aquatic plants. *Biology and Environment: Proceedings of the Royal Irish Academy* 100B (1), 13-25.

Praeger, R.L. (1906) On the botany of Lough Carra. *The Irish Naturalist* 15: 207-214.

Roden, C. & Murphy, P. (2013) A survey of the benthic macrophytes of three hard-water lakes: Lough Bunny, Lough Carra and Lough Owel. *Irish Wildlife Manuals*, No. 70. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht,

Roden, C., Murphy, P. & Ryan, J. (2020) Benthic vegetation in Irish marl lakes: monitoring habitat 3140 condition 2011 to 2018. *Irish Wildlife Manuals*, No. 124. National Parks and Wildlife Service, Department of Housing, Local Government and Heritage, Ireland.
(with Appendix II site reports as second file)

ACKNOWLEDGEMENTS

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All photos taken by Cilian Roden

FRONT COVER IMAGE:

A MIXTURE OF SPINEY CHARA ACULEOLATA AND PINKISH CHARA TOMENTOSA GROWING IN LOUGH CARRA.

