

Non-technical summary of scientific results – water quality

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Under the EU Habitats Directive, Lough Carra is designated a candidate Special Area of Conservation (SAC), as an important example of a hard oligo-mesotrophic water with benthic vegetation of *Chara* spp. These lakes are typically of pH 6-7, and when of high quality have low concentrations of nutrients, clear water and a carpet of charophytes (often known as stoneworts). They are, like Lough Carra, often shallow and commonly associated with lowland landscapes dominated by limestone and productive agriculture. Over the last few decades, the Carra catchment has, increasingly, been developed for both agriculture and human housing. It is inevitable that such development puts pressure on the ecological integrity of the lake, and the research on the lake has shown that there has been an increasing amount of nutrients entering the lake in recent years. The clearest evidence of this is the increased concentration of phosphorus (the main nutrient affecting water quality of lakes) that has accumulated in the upper sediment of the lake (see paper by Hobbs et al., 2005). In many lakes, particularly calcareous ones, there is a capacity for the sediment to bind phosphorus to small particles of sediment. When the phosphorus is fixed to the sediment (and also soil in the catchment) it is not so readily available for use by plants as when it is in a dissolved form. However, the number of microscopic sites that can hold onto the phosphorus is not infinite and a lake sediment, or grassland soil, can with increasing amounts of phosphorus sticking to these sites lose its capacity to hold onto the phosphorus. Most sediment and soils act like “leaky sieves”, whereby the proportion of phosphorus that escapes from the sediment or soil matrix increases as that matrix becomes more enriched. When the sites are saturated, the capacity to hold the phosphorus is very much reduced.

The research reported in Hobbs et al. (2005) showed a reduction in the ability of the lake sediments to bind phosphorus, reducing the resistance of the lake to nutrient enrichment (eutrophication). This is an important warning sign, indicating increased susceptibility of the lake to further increases of phosphorus entering the lake. If the capacity to hold onto the phosphorus is reduced and high loads of phosphorus continue to enter the lake it is possible that the lake could “flip” to an alternative state, with high concentrations of phytoplankton, resulting in murky water and the loss of the charophytes and other aquatic plants. This has happened in many other shallow lakes in Europe. Given the very high local, national and international importance of Lough Carra, particular attention should be devoted to reducing as far as possible the phosphorus, and other nutrients, entering the lake. For Lough Carra this means land management in the catchment to reduce nutrients coming in from intensification of agriculture and rural housing. We know that high loading of phosphorus is associated with the improved grasslands to the east of the southern basin of the lake (see paper by Donohue et al., 2005). This grassland is on good quality soil (brown earths) and is well drained. High phosphorus loads from these areas are particularly evident following high rainfall occurring during summer and autumn. The land to the north and west of the lake is less well drained and has a more recent history of intensification. Particular attention to reducing nutrients applied within the catchment, and preventing further intensification, is an important safeguard for the lake.

In keeping with changes expected from agricultural intensification, nutrient concentrations in the lake have increased over the last 30 years, with anecdotal evidence of changes in vegetation community composition and water clarity. The survey of the aquatic plants in 1996 reported by King and Champ (2000) merits repeating to see if there has been any deterioration in the ecological status of these organisms. Recent surveys of the inshore littoral zone by Little (2006) and McGoff (unpublished data) of the TCD research group have suggested that the mayfly *Ephemera danica* is of low abundance, which concurs with other anecdotal evidence from fishermen. Recent observations of the alien fish species roach (*Rutilus rutilus*) provides a further concern for the overall ecological integrity of the lake.

In the 1850s, prior to the Great Irish Famine, the sediment record of Lough Carra indicated a gradual increase of nutrients and lake productivity associated with a large rural population and tillage agriculture. The nutrients declined in the second half of that century as the population reduced. Today, nutrient concentrations in the sediment, derived from a different generation of people and their activities, is greater than in the 1850s. Then the lake recovered. However, the longer a lake is enriched the less likely is rapid recovery and so careful and serious attention is needed to reduce the nutrients entering the lake. O'Reilly (1987) described the lake as "crystal clear". Few local anglers appear to agree that this is still the position. Shallow calcareous lakes like Carra are susceptible to eutrophication. There is evidence that the ecological balance of the lake is being increasingly disrupted, but little evidence of any effective management to address that.

References used:

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