Land use changes in the Lough Carra catchment.

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INTRODUCTION

Published and unpublished data from the relevant agencies (e.g. King and Champ, 2000; Lucey et al., 1999; Fisheries Boards; EPA and Local Authorities), from independent research projects (e.g. Irvine *et al.,* 2003) and informed anecdotal reports and personal observations all indicate a substantial and significant decline in the quality of water in Lough Carra, as well as changes in the ecological structure and processes of the lake and its lakeshore habitats. These changes appear to have been progressive over at least the last thirty years and the evidence presented in various reports and publications (including this volume) strongly suggests that the main cause of the decline in water quality is nutrient enrichment deriving from agricultural practices in the catchment.

Whilst it is possible to relate nutrient loads to livestock numbers and, thus, gain some insight into the scale and nature of the problem, no research has been published in relation to changes in the land use practices in the catchment. The study reported here attempts to explore this aspect in order to illustrate the way in which land use, primarily for agriculture, may influence the nutrient loads entering the lake. In particular, the study was aimed at obtaining some quantification of the changes that have occurred in the density of livestock, the nutrient inputs and the proportion of the land area used for intensive farming over a period of around thirty years.

METHODS

The study was undertaken during the winter of 2002/2003 and took the form of surveys of farms, located within the Carra catchment, through interviews conducted by a local resident known, and apparently accepted, by all the farmers interviewed. Each interview followed a structured questionnaire designed to record information on the farmer’s landholding, livestock numbers, fertiliser, manure and slurry use and general farming practices, including drainage and the conversion of land from natural

or semi-natural habitats to improved grassland or tillage. Each farmer was asked to provide information relating to the situation in 1970 and that pertaining in 2002/2003. Anonymity of the source of information was assured in order to avoid as far as possible any bias from belief that the information might be used in some negative or personal manner.

A total of 34 farms were covered with a current total landholding of 2,029 acres, amounting to around 7% of the catchment of Lough Carra. Since some farms had acquired land since 1970, the corresponding figure for 1970 was 1,723 acres.

A subset of the sample was "ground-truthed" with respect to acreage subject to intensive farming and this confirmed the accuracy of the data. There was no suggestion that the information provided by the farmers was biased in any significant manner, although clearly that relating to 1970 would be subject to the vagaries of human memory. We have every confidence in the results and believe that they are a true reflection of the overall trends in the catchment over the period studied with the single exception of that relating to pig numbers (see below).

In addition, some information was also collected with respect to the period 1940 to 1970, although this was, necessarily, less accurate and less reliable.

RESULTS

The average size of the landholdings in the study area in 1970 was 50.7 acres, but this had increased by 2002 to 59.7 acres, reflecting a trend towards slightly larger individual farms. We have no data available to support our assumption that the sample is typical of the Carra catchment in general terms, but local knowledge of the area suggests that this is the case.

1. *Livestock numbers*

Cattle numbers increased from 573 (0.33/acre) in 1970 to 959 (0.47/acre) in 2002/2003. This represents an overall increase in cattle density of 42% in the catchment.

Sheep numbers increased from 480 (0.28/acre) in 1970 to 1,340 (0.66/acre) in 2002/2003. This represents an overall increase in sheep density of 136% in the catchment.

The total number of pigs rose from 35 (0.02/acre) to 2,000 (0.99/acre) between 1970 and 2002, an increase of 5,614%. However, this one aspect is clearly atypical of the catchment as a whole, since the sample included a farm with the only large-scale piggery in the area. Therefore, this result should not be taken as indicative of the situation in the rest of the catchment. Nonetheless, the establishment of the large-scale piggery has increased the overall density of pigs in the catchment (even assuming no pigs in the remaining 93% of the land area not surveyed). Furthermore, an even larger piggery has been established just outside the Carra catchment, and it is known that some slurry from this latter operation is disposed of within the Carra catchment. Thus, it is clear that nutrient loads derived from pigs will have increased substantially between 1970 and 2002/2003.

2. *Fertiliser application*

The 34 farms used a total of approximately 75 tonnes of chemical fertiliser in 1970, an overall application rate of around 40 kg/acre. In 1970, all of the farms surveyed applied chemical fertiliser, whereas in 2003 five of the 34 no longer did so. Nonetheless the total used in 2003 was approximately 200 tonnes. This increase (of around 186%) is a clear indication of a significant increase in nutrient input in the catchment. Our data are insufficiently precise to show the proportions of P,K and N used, but it is unlikely that this has changed sufficiently to alter the implications of the findings.

It is also noteworthy that the 70 tonnes in 1970 were spread over around 1,000 acres (*c*. 58% of the total) at a rate of *c*. 70 kg/acre, whereas in 2003, the 200 tonnes were spread over around 1,500 acres (*c*. 74% of the total) at a rate of c. 133 kg/acre. This finding illustrates further the progressive conversion of land for more intensive agriculture (see below).

The results with respect to the use of farmyard manure and slurry are complicated by the fact that measurements of the former are not at all precise and are not directly comparable with the latter. However, the figures obtained are sufficient to allow some comparison of the changes occurring over the study period. In 1970, around 228,000 gallons of slurry and manure were spread, with the corresponding figure for 2003 being 1,071,600 gallons. The accuracy of these figures is less than satisfactory, but the indicated increase of close to fourfold is adequate to support the contention that there has been a highly significant increase in slurry/manure application.

3. *Land conversion and drainage*

The natural or semi-natural habitats of the area surveyed, and of the Carra catchment in general, include mainly woodland, limestone scrub, limestone grassland, fen, bog, marsh and wet grassland. The farmers interviewed were able to estimate that, during the thirty years prior to 1970, around 370 acres of land were converted from such natural or semi-natural habitats to more intensive agricultural land (some tillage, but mostly grassland). This represented some 21% of the landholding in 1970.

Between 1970 and 2003, a further 483 acres were converted, i.e. close to 25% of the total of 2,029 acres.

Drainage also took place, although on a much lesser scale: 17 acres (1% of the 1,723 acres) being drained in the thirty years prior to 1970, and a further 44 acres (2% of the 2,029 acres) between 1970 and 2003.

Other changes to land use were recorded, including the decrease in tillage from 50 acres in 1970 (with crops grown mostly for local consumption) to just 0.5 acres in 2002 (potatoes for personal consumption). Land previously used for tillage being re-converted to grassland.

4. *Human habitations*

In the thirty or so years covered by the study, 30 new dwellings were added to the area surveyed. The current human population of the area is in the region of 180 (*c*. 0.09/acre). We do not have data to compare this last figure with 1970.

DISCUSSION

There can be little doubt that the results of this study demonstrate a strong link between the eutrophication of Lough Carra (and probably some of the other ecological changes observed in the lake and lakeshore) and changes in agriculture in the lake's catchment over the last thirty years or so. Nutrient inputs to the land have risen dramatically over this period through increased application of artificial fertilisers and slurry to increased areas of land. Some of the slurry derives from large-scale piggeries which are totally dependent on "imported" foodstuffs and represents, therefore, a net increase in overall nutrient levels within the area, as is also the case with respect to the artificial fertilisers used.

However, what the results also show is that the underlying cause is not just intensification of existing agricultural land-use, but the conversion of natural and/or semi-natural habitats into improved grassland. This conversion of land is ongoing and was observed and recorded in many locations in the catchment in the course of the more general research project of which this study was a part (see Figures 1. and 2.). A consequence of this land conversion is the need for the farmer to add fertiliser and/or slurry in order to maintain an adequate sward for grazing and/or silage (and, occasionally, hay). Thus, the area of land farmed intensively has increased significantly, accounting in part for the large rise in application of fertilisers and slurry.

The implications of this land conversion reach beyond the nutrient enrichment of Lough Carra, as much of the land that has been and continues to be converted has very poor agricultural potential, but very high ecological value. It includes much semi-natural habitat on limestone, with its rich flora, as well as fens and other peatlands. Lough Carra's designation as a candidate Special Area of Conservation(cSAC) has done little, if anything, to prevent, or even slow down, the

destruction of these habitats. Conversion of land outside the cSAC which results in adverse impact on the ecological integrity of the cSAC is a breach of the existing legislation, unless approved in advance by the responsible authority. Even more worrying is the fact that some of this conversion has occurred recently within the cSAC itself.

While the figures for acreage of land drained in the area surveyed are small, it is probable that over the catchment as a whole the proportion of land drained is much higher. Our reasons for this assertion include the fact that the study area contained only small areas of peatland, marsh and wet grassland and was, perhaps, atypical in that respect. Also, major drainage works were carried out on Annie's River in another part of the catchment in the 1980s which probably resulted in more widespread land drainage than has occurred in our study area.

The increase in domestic dwellings, together with the concomitant increase in the use of washing powders and other domestic cleaning agents, will have added to the rise in nutrient loading in the area. All of these dwellings, and those already existing in 1970, rely on individual septic tanks to dispose of sewage and waste water since there is no communal sewage treatment plant in the catchment. However, the impact of these increases is likely to be negligible in comparison to the agricultural factors.

Overall, it can be concluded that nutrient loading in the Carra catchment has increased substantially over the last thirty years or so. Our findings show that this increase is related to a significant increase in the percentage of land used for intensive agriculture, as well as general intensification of agricultural practices. We believe that these changes are having a profound adverse impact on the ecological integrity of Lough Carra.

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Figure 1. Limestone scrubland in the initial stages of clearance for conversion to improved grassland.

Figure 2. Peatland drained and ploughed in the initial stages of conversion to improved grassland.