

WP8.5 – analysis of water quality data collected during the Ythan Project

1. Introduction

The Ythan Project was established in response to increased public interest in the River Ythan during the late 1990s. This increase in interest occurred when questions began to be raised over increases in nutrient levels in the river waters and the potential impact of these increases on wildlife at the Ythan estuary. Particular concerns were expressed over nitrate levels as the European Nitrates Directive sets a maximum permissible limit of 11.3mg/l of nitrate as N, and some of the results recorded for sites in the Ythan catchment began to be above this limit.

The Ythan Project involved a variety of actions to improve and restore the river. In particular it included actions that involved working with land managers to promote the use of riparian buffer strips and the use of nutrient budgeting on farms. The project also aimed to promote the involvement of local people in the management of the river. The project included an element of monitoring work, both to learn more about the river and the estuary and to see if any of the changes being made as part of the project were impacting on the river. Part of this monitoring work included water sampling at key sites around the catchment. The aims of this sampling were to pick up changes in water quality on the smaller tributaries and to involve local people in the sampling process.

2. Methods used

Eight monitoring sites were selected in July 2002 and these are marked on the map below (*to be inserted*). Ideally the sites selected needed to be on tributaries where there would be changes in land management practices upstream of the sampling point (development of buffer strips, increase in nutrient budgeting etc). However, as these changes would take place during the life of the project, there was no way of guaranteeing at the beginning of the project which geographical areas would experience changes, as the reaction of the relevant land managers could not be predicted. Therefore a 'best guess' had to be made of suitable monitoring sites where changes in land management, particularly in the creation of buffer strips, were most likely to occur. This guess was based on knowledge of which farms had recently applied to agri-environment schemes such as Rural Stewardship Scheme and the Woodland Grant Scheme. However, it was not possible to know if these applications would be successful and so there was no guarantee that land management would change at any of the sites during the length of the project.

Sampling began in August 2002 and was undertaken throughout the project by local residents working as volunteers for the project. A 1 litre water sample was collected from each site on a monthly basis and was brought to the project office in Ellon. Samples were then collected from Ellon and taken to the SEPA lab in Aberdeen for analysis. A variety of analyses were undertaken on the samples, including:

Biological oxygen demand
PH
Buffering capacity / alkalinity
Suspended solids
Nitrite, nitrate and ammonia levels
Orthophosphate levels

The data collected were recorded by SEPA and supplied to project staff at regular intervals.

Samples were taken from August 2002 until February 2005, when the project's European funding finished.

In addition to direct chemical analysis of water quality, some sites were selected for analysis of water flow levels, in order that total loads of particular chemicals could be calculated. In August 2002, gauge boards were installed at two sites (YP4 and YP5) and when samples were collected the water level on the gauge board was noted down by the volunteer so that flows could be calculated. These sites were gauged regularly in the following months and by September 2004 15 gaugings had been done.

These gaugings were then used to obtain rating equations which could convert gauge readings to flows.

In addition, the flows measured at these gaugings were compared with the flows at Ellon. A reasonable correlation was obtained and this correlation was used to calculate flows on days when no gauge reading was taken.

For the years of the project (2002 – 2004), average flow over the year as recorded at Ellon was as follows:

2002 11.33 cumecs (cubic metres per second)
2003 5.36 cumecs
2004 9.374 cumecs

Clearly 2003 was a year of very low flows, with 5.36 cumecs being only 67% of the long term mean flow for Ellon.

In January 2004 gauge boards were also installed at sites YP8 and YP1. Six gaugings were done at each of these sites and suitable ratings obtained.

As with the two earlier sites the gauged flows were correlated with those at Ellon on the same day. Reasonable correlations were obtained but, in some instances, the flows for 2003 were judged to be unreliable. (This is not surprising as the flows in 2004 were not as low as those of 2003). This meant that the correlation had to be extrapolated considerably to obtain the lowest flows of 2003.

Once flow data had been obtained for these sampling sites, chemical loads could then be calculated for orthophosphate, nitrate and suspended solids.

3. Site descriptions:

Samples were taken from the following sites:

YP1, Mill of Auchedly, Wedder burn (NJ901339)– this burn is approximately 2 kilometres long and joins the main stem of the Ythan at Ythanbank. The majority of the catchment area for the burn is fields used for arable farming. By the summer of 2004 there were buffer strips along the entire length of this burn, and it is believed that some of these were in place at the start of the water sampling work.

YP2, Throopmuir, Keithfield burn (NJ826357) – this site is on one of the feeder tributaries for the Keithfield burn. There is approximately 1.1 kilometres of burn upstream of the sampling point. The majority of the catchment area for the burn is improved grassland, with very few buffer strips. The catchment area also includes a road, which is frequently muddy and the muddy water runs off the road and into this burn. Immediately downstream of the sampling site the farm has entered into a Woodland Grant Scheme, so there is a mix of improved grassland and tree planting, but with no stock on the grassland.

YP3, Kirkton, Keithfield burn (NJ816349) – this site is also on one of the feeder tributaries for the Keithfield burn. There is approximately 1.3 kilometres of burn upstream of the sampling point. The catchment area is a mix of improved grassland, a moss and arable fields. There are buffer strips along the length of the burn upstream of this point, and it is believed that these were created during the life of the project as the farm had a successful RSS application in 2003.

YP4, Earlsford, Keithfield burn (NJ834341) – this site is located where the feeder burns of YP2 and 3 join together. There are approximately 3 kilometres of each tributary upstream of this sampling point. The catchment is a mix of improved grassland and arable fields and there are few buffer strips between points YP2 and 3 and point YP4.

YP5, Tillery, Foveran burn (NJ912224) – this site is approximately 2.1 kilometres downstream from the source of the Foveran burn. The catchment is predominantly improved grassland and there are no large buffer strips although there are small strips of tall herb vegetation immediately next to the burn. It is believed that there were no RSS applications in this area during the life of the project.

YP6, Bridgefoot, Foveran burn (NJ927229) – this site is approximately 1.8 kilometres downstream from YP5. The majority of the burn between YP5 and YP6 has some form of woodland strip adjacent to it, and some irrigation of the nearby tree nursery takes place in the summer.

YP7, Kilblean, Youlie burn (NJ835278) – this site is approximately 1.7 kilometres downstream from the source of the Youlie burn. The catchment is mostly arable with a moss near the source. There are no significant sized buffer strips until the moss is reached.

YP8, Craigies Smithy, Youlie burn (NJ857292) – this site is approximately 2.9 kilometres downstream from YP7. There is a mix of improved grassland and arable land adjacent to the burn and the burn is also dammed to create a fishing pond between the two points. Approximately 35% of the burn has a buffer strip between the two points.

At all of the monitoring points there was contact with the local farmers during the life of the project, to promote both RSS and nutrient budgeting. Although several farmers undertook nutrient budgets, the implementation of the budget recommendations seems to take several years on farms, so is unlikely to have an impact on this data, although it may begin to impact in the future.

4. Results analysis

Data was collected on several variables, but for the purposes of this report, only the following parameters are considered: nitrate levels, phosphate levels, suspended solids levels.

Nitrate levels:

It can be seen from the figure showing nitrate levels at all sites that there is a great deal of variation in the data and that no clear trends are obvious. The nitrate levels at site YP1 remained more or less consistently high throughout the project, except for one reading in Sept 04, whereas other sites were more variable. The levels at YP5 and YP6 are very closely matched, implying that the levels don't increase as you go downstream, whereas the levels for YP2,3 and 4 mostly show an increase as you go downstream. The same is true for YP7 and YP8 particularly during the later months of the project. It would appear that the presence or absence of buffer strips makes no appreciable difference to the nitrate levels and that the differences between the sites must be due to some other factor.

Phosphate levels:

For phosphate, the levels appear to decrease as you go downstream for points YP2,3,4,7 and 8. Levels are generally higher in the Keithfield burn, but no clear reason for this can be seen from the catchment land use. Again the levels at YP5 and YP6 are very closely matched, suggesting no significant change as you go downstream.

Suspended solids levels:

In general this data peaks during the autumn months, presumably when water levels are lower and ploughing may be taking place nearby, causing

loose soil particles to be available. Sites YP1, 5 and 6 all have relatively low suspended solids, suggesting that the presence of some form of buffer strip next to a burn helps to reduce the suspended solids entering the water. Levels are also quite low in YP8, even though this burn has farming activity going on right to the edges of the water. The frequent reduction in the levels between YP7 and YP8 may be due to the presence of the fishing pond, which would allow the water to slow and enable many suspended solids to settle out.

5. Flow data

Flow data was calculated for four sites (only four sites were viewed as suitable for gauge board installation) and the flow value in cumecs can then be combined with the chemical analysis data to give total loads of specific substances. For this data total loads were calculated for nitrate (as N), phosphate (as orthophosphate) and suspended solids and the results are shown in the graphs in figures * to *. It can be seen that the total loads for site YP4 are very variable, with both phosphate and nitrate showing clear seasonal variability. The levels of nitrate and phosphate peak during the winter months, and drop in the summer months, presumably when there is greater plant growth to utilise the available nutrients. The other sites mimic this pattern although to a much smaller degree. Suspended solid loads are generally fairly low, with only one large peak for site YP4 during December 2002. This is likely to be the result of exposed ploughed soil being washed into the burn during a heavy rainfall event. The lack of any similar peak later in the project suggests that the introduction of buffer strips further upstream in the Keithfield system may be helping to protect the burn, although it may also be due to an absence of heavy rainfall events when the soil was exposed.

6. The future

It is hoped that monitoring will continue at many of these points in future years. This may be done by the existing volunteer group on a regular basis, or it may be done more infrequently as part of SEPA's ongoing monitoring regime. However the monitoring takes place, it would be useful to continue to gather data on these sites. As can be seen from the analysis above, it is difficult to see trends in the data when there is so much variability from month to month. It is likely that more farmers will implement changes such as the creation of buffer strips over time, if these continue to be funded under agri-environment schemes, and so continued monitoring of the effect they may have on water quality will provide useful feedback for farmers and agricultural advisors.