

The Faunal Richness of Headwater Streams: Stage 4 - Development of a Conservation Strategy

Institute of Freshwater Ecology

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NRA

National Rivers Authority





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**THE FAUNAL RICHNESS OF HEADWATER STREAMS:
STAGE 4 - DEVELOPMENT OF A CONSERVATION STRATEGY**

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EXECUTIVE SUMMARY

This report is on the final stage of a four stage study of the faunal richness of headwater streams. Headwaters were defined as the first 2.5km of a watercourse.

In earlier stages of the study four major conclusions were reached:

- headwaters contribute about 20% of the total aquatic macro-invertebrate biodiversity of complete river systems
- many of the taxa exclusively or predominantly found in headwaters are sufficiently rare to have national conservation status
- most headwater streams had buffer, or riparian protection zones of <2.5m and 75% of bank length was bordered by zones of less than 1m wide
- only 40% of headwater sites were in "good" biological condition, as judged by their macro-invertebrate fauna and the condition of 30% was either "poor" or "bad"

The poor quality of headwaters has particular significance because of the important bearing on chemical and biological conditions further downstream.

On the basis of these findings it is considered imperative that the NRA should develop a strategy for the protection and remediation of headwaters.

The programme should comprise four key elements:

- **AWARENESS** • **COLLABORATION** • **CONTROL** • **IMPROVEMENT** •

Awareness of the needs of headwaters must to be established within all parts of the NRA, including their statutory advisory committees and amongst a wide variety of external organisations

Awareness should be transmitted via business management; talks, displays and exhibitions; reports and scientific papers; semi-populist journals and house newspapers; fact files and newspapers, television and radio.

It is recommended that an early stage of the strategy should be the development of a national headwaters data-base.

The NRA has already collected considerable amount of macro-invertebrate and river habitat survey data on headwaters but that this information has never been pulled together in order to develop a better understanding of headwaters and the conservation strategies they require.

A national network of headwater sampling sites should be established, as part of the NRA's General Quality Assessment (GQA) in order to monitor trends in the biological condition of these streams and to evaluate the success of the conservation strategy

Recommendations are made for a sampling strategy for macro-invertebrates, river habitats and water chemistry. These are based on a five year rolling programme.

Wherever possible the NRA should seek to protect and remediate headwaters through voluntary action by farmers and other landowners and through collaborative programmes with other organisations.

The role of the NRA's Pollution Control Officers, the Agricultural Development and Advisory Service (ADAS), the Farming and Wildlife Advisory Group (FWAG), the National Farmers' Union (NFU) and the Country Landowners' Association (CLA) will be particularly important in developing the cooperation of farmers and landowners.

The NRA and the conservation agencies should collaborate to seek the inclusion of headwaters as a special category in the United Kingdom Biodiversity Action Plan

Where protection and remediation cannot be achieved by voluntary action the NRA should vigorously pursue those statutory powers available to it

A summary is provided of the legislation which may be invoked to protect and restore the ecological quality of headwaters.

Programmes of monitoring, awareness, collaboration and control should be synthesised into an integrated policy for improving the general ecological quality of headwaters

Key components of the strategy for conservation and improvement are catchment management plans which should always include specific policies for headwaters

The main components of catchment management plans, as they relate to headwaters are outlined in the report. The role of riparian protection zones is seen as particularly important.

Catchment management plans should indicate the likely benefits of their headwater improvement plans, the timescale over which those benefits may accrue and the costs of making those improvements

It is essential that evaluation measures and performance indicators are in place to appraise the effectiveness of all elements of the headwater conservation strategy

Evaluation measures should comprise assessments of improvements in the biological condition of streams, the satisfaction of the user communities including farmers and landowners and cost-benefit analyses.

It is important that the NRA develops a programme of research upon which to refine and improve its headwater conservation strategy and catchment management plans

A variety of research programmes are suggested but priority is given to the following:

- the implementation and evaluation of headwater restoration projects
- the operational development of a headwaters module for RIVPACS
- studies of headwaters as habitats, spawning grounds and recruitment areas for fish
- an understanding of the role played by soils in the transport of chemicals and sediment into headwaters and the consequences for their habitat diversity and biological condition
- sources of macro-invertebrate species richness in headwaters and the implications for the restoration and management of streams for conservation purposes

KEYWORDS: Headwaters, conservation, fauna (macro-invertebrates), agriculture, catchment area, streams (in natural channels)

1. INTRODUCTION

1.1 Background

The 1990 Countryside Survey of Great Britain provided a disturbing picture of the state of headwater streams. The majority of these small watercourses were shown not to be of good biological condition and the incidence of dry streams was high (Barr et al. 1993).

The reasons for the sub-standard biological condition of so many headwaters were varied and included point-source and diffuse pollution, dredging, straightening and channelisation, re-alignment, culverting and drought.

Literature searches, in preparation for reporting on the survey, revealed that a paucity of published data or co-ordinated sampling programmes existed for small streams.

The combination of lack of widespread information and the results of Countryside Survey 1990 prompted the National Rivers Authority to Commission the Institute of Freshwater Ecology to undertake a five year R&D study of headwaters entitled "The Faunal Richness of Headwater Streams".

The overall objectives of the study were to:-

- *assess the conservation value of headwater stream macro-invertebrates and their contribution to catchment macro-invertebrate richness.*
- *determine agricultural impacts upon headwaters and their fauna.*
- *propose a headwaters conservation strategy.*

The project was divided into four successive stages of which the first three involved data collection and analysis. This report is the output of the fourth and final stage of the study.

The specific objectives of this stage are:-

- *to propose a conservation strategy to maximize faunal diversity and protect endangered species, taking into account other factors, e.g. flow regime, which may influence the fauna*
- *to make recommendations for any future development of this work for the benefit of the environmental quality of headwater streams*

1.2 Definition of headwaters

The definition of "headwater" as used in this document is "a watercourse within 2.5km of its furthest source as marked with a blue line on Ordnance Survey (OS) Landranger maps with a scale of 1:50,000".

1.3 The number and length of British headwaters

Headwaters represent a substantial proportion of the total length of flowing water courses in Britain. This proportion is probably in excess of 70%.

This conclusion is based on an Institute of Terrestrial Ecology (ITE) study (Smith and Lyle 1979). Using 1:10,000 scale maps, they calculated that there were 146,853 first order streams (streams without tributaries) and 36,534 second order streams (streams with only first order tributaries).

Only approximate estimates of total length may be made from these data. If the mean length of first order stream is assumed to be 500m and the subsequent 2km of the watercourse is assumed to be second order then the total length of British headwaters would be 146,136km.

In comparison the total length of stream and river reaches, largely beyond 2.5km from source, evaluated during the 1990 River Quality survey of Great Britain was 90,499km (National Rivers Authority 1991, Scottish Office 1992).

1.4 The findings of the first three stages of the study

1.4.1 Stage 1 - Characteristic headwater taxa

Stage 1 of the study (Furse et al. 1991) was a review of existing data including a compilation of those taxa whose distribution was significantly or characteristically associated with small watercourses.

Analyses and review led to the production of a list of 101 taxa statistically or significantly associated with headwaters. Numerically the list was dominated by three insect orders; Coleoptera, Trichoptera and Diptera. The numerical dominance of Diptera would have been greater still if taxa could have been identified to species rather than more generally to genus.

The 101 taxa included at least three with "Red Data Book" status (Ball 1986), two that are "nationally notable - a", nine that are "nationally notable - b" and one that is "nationally notable - unclassified".

1.4.2 Stage 2 - Contribution of headwater streams to total catchment biodiversity

The Stage 1 analyses had provided some evidence that headwater streams make a substantial contribution to the total macro-invertebrate biodiversity of river systems. This theme was taken up in detail in Stage 2 of the study (Furse et al. 1993).

Four river systems were investigated, the Cam, Yorkshire Derwent, Lugg and Dorset Stour. Between nine and fourteen new headwater sites per river system were sampled for macro-invertebrates three times in a year in each river system.

Macro-invertebrate taxon lists were compared with those obtained from previous NRA and IFE sampling of other sites of all sizes and stream orders in the same river systems. All headwater and downstream sampling sites in the study were chosen in the belief that they were in good biological condition.

The major conclusions of the study were:-

- an average of 45 taxa per river system were exclusively found in headwater samples. This represented almost 20% of the taxa that were found, on average, in each of the four river systems
- approximately 55% of all taxa found at headwater sites were more commonly found in those types of stream than in any other part of the river network
- many of the taxa which were exclusive to headwaters, or predominantly confined to them, were sufficiently rare to warrant special national conservation status
- many of the taxa exclusive to headwaters were common to two or more of the river systems studied but most of the exclusive taxa and the taxa of conservation importance were limited to a small number of sites
- the limited distribution of many of the taxa is significant if headwater sites, collectively, are subjected to attrition of quality

1.4.3 Stage 3 - The biological condition of headwaters

In the third stage of the research programme (Furse et al. 1995a) the general biological condition of headwaters in different landscape types and with different catchment land cover and land use was compared. The same four river systems were used as study areas.

A total of 131 new sites were sampled or surveyed for aquatic macro-invertebrates; physical, geographic and chemical characteristics of the sampling sites; land cover in the immediate catchment of each site and detailed corridor studies in which data were collected on buffer zone width and riparian land cover within 20m of either water's edge.

Details were also collected on the occurrence of potential sources of perturbation to the stream in both the catchment as a whole and the specific stream corridor.

A multivariate statistical procedure, similar to RIVPACS (Wright et al. 1993), was used to assess the biological condition of each study site. This was based exclusively on a classification of 214 headwater sites of presumed good biological condition.

The procedure was thus used to compare the observed BMWP index values of the 131 headwater sites with those expected to occur at sites with very similar environmental characteristics.

The ratio of observed to expected values is the Ecological Quality Index (EQI) of a site. (Sweeting et al. 1992). EQIs can be banded into quality ranges. In this study four quality ranges were used to describe the biological condition (Biological Monitoring Working Party 1978) of sites. These were termed "good", "fair", "poor" and "bad".

Two forms of EQI were used based on the number of BMWP families in a sample and on the average BMWP score of those taxa present (ASPT). Both forms of EQI were used because ASPT is a measure of the average tolerance of the taxa present to organic pollution, whereas low taxon richness may also be due to other causes such as poor habitat quality, acidification or drought.

An overall assessment of the site was achieved by taking the poorer of the two separate forms of EQI band. This approach took account of the loss of biological condition from whatever cause. For example the loss of taxa is more indicative of declining condition of acidified streams than ASPT which can remain high.

When the separate EQI bands were integrated into overall assessments of each site then only 39.7% were "good", 30.5% "fair", 23.7% "poor" and 6.1% were "bad".

For comparative purposes, summer samples from over 5,000 English and Welsh sites in the 1990 River Quality Survey were indexed in an identical manner except that RIVPACS II was used to provide the expected BMWP index values. These were of all sizes and orders but only about 8% headwaters (Table 1.1). The frequency distribution of quality bands of these 5,000+ sites in summer showed them to be of slightly better biological condition than the 131 headwaters.

A comparison between the quality banding of the 131 study headwater sites and the 123 English and Welsh headwater sites in Countryside Survey showed close similarities between the two indicating that the findings from the four river systems studied in detail could justifiably be extrapolated to England and Wales as a whole.

In summary, the analyses of quality presented a pessimistic picture of the biological condition of headwater sites, even in comparison with the quality distribution of English and Welsh sites as a whole.

1.4.4 Stage 3 - The impact of agricultural activities

The principal findings of the study of the impact of agricultural activities, were:

- the composition of macro-invertebrate assemblages was related to a principal upland to lowland environmental gradient
- along the same gradient there was a marked upland to lowland increase in the number of sources of potential stream perturbations
- **streams whose biological condition was not good were frequent in catchments of all land cover types**
- in upland sites loss of quality was mainly represented by low faunal diversity but at lower altitudes both the number of taxa present and those taxa's average tolerance of organic pollution both declined due to environmental stress
- in moorland and evergreen woodland sites the lowest faunal richness occurred in streams with catchments on rocks with medium to low buffering capacity and acidic soils and whose waters had low alkalinity and, by implication, high acidity

- moorland streams where bracken was common in their catchments tended to be of better quality than streams where it was sparse or absent
- poorest overall quality was shared between pastoral and arable landscapes
- in pastoral streams quality loss was greatest where the main form of livestock was cattle and this loss was associated with an increase in the number of slurry lagoons, silage clamps and dairy yards in the site catchments
- in pastoral landscapes where sheep were the commonest form of livestock 8.0% of headwater bank length was damaged by poaching (trampling) whereas, where cattle were commonest, only 3.6% of bank-length was poached
- three principal stresses were important in arable landscapes, nutrient enrichment, channel modification and drought
- the impact of arable land upon stream quality appeared greater when that land was adjacent to the bankside but this needs to be confirmed by further study
- mean nitrate levels in arable landscapes (9.11 mg l⁻¹ NO₃) were higher than pastoral (3.13 mg l⁻¹), woodland (0.87 mg l⁻¹) or moorland (0.04 mg l⁻¹)
- in predominantly arable landscapes 41.4% of watercourse length was channelised compared with 14.3% in all other catchments
- data from Countryside Survey 1990 showed that in lowland arable landscapes in that year, 45% of 1km squares shown to have watercourses on 1:50,000 scale OS maps had no flowing watercourses when visited, mid-year, by the field surveyors
- **75% of headwater bank length had buffer zones less than 1m wide and a further 14% had buffer zones less than 2.5m wide**

1.4.5 Stage 3 - Indicator taxa of biological condition

Eight macro-invertebrate indicator taxa were identified whose presence was diagnostic of good quality in almost all landscapes. These were *Polycelis felina* (Dalyell), *Ancylus fluviatilis* (Muller), *Gammarus pulex* (L.), *Baetis rhodani* (Pictet), *Elmis aenea* (Muller), *Elodes* sp., *Agapetus* sp. and *Simulium ornatum* group.

Other taxa were identified whose occurrences were specifically associated with either low alkalinity, nutrient enrichment or drought. These are listed in Furse et al. (1995a).

The small beetle, *Anacaena globulus* (Paykull), was very persistent in stressed watercourses in all types of landscapes.

1.4.6 Stage 3 - Taxa under threat

Two categories of macro-invertebrates were identified as being most threatened by environmental stress in headwaters.

The immediate threat is to those common and widespread taxa identified as indicators of good quality sites but the long-term and more serious threat is to those rare taxa with national conservation status whose distribution is predominantly confined to headwaters (Furse et al. 1991, 1995a).

1.5 The current state of national monitoring of headwaters

Detailed information on the headwater streams regularly or occasionally sampled for macro-invertebrates by the National Rivers Authority is difficult to compile. However, headwater sites were included amongst those monitored during previous River Pollution and River Quality Surveys (RQS) and are being surveyed during the current, 1995, General Quality Assessment (GQA) survey.

The most recent statistics come from the 1990 RQS (National Rivers Authority 1991) and are abstracted from the national data-base for that survey. Most of these data are also held by the Institute of Freshwater Ecology (IFE). The most accessible information to IFE is for those sites sampled once in each of spring, summer and autumn.

Of the 5109 available sites falling into this category, 409 of them (Table 1.1) are within 2.5km of source, i.e. headwaters as defined here. These sites have been sub-divided by NRA regions, as they existed in 1990, and by five, 500m long, distance from source categories.

On this basis, headwaters account for 8% of the English and Welsh sites sampled in each of the three seasons during the 1990 River Quality Survey.

IFE also hold environmental data on 181 sites sampled in only two seasons during the 1990 RQS and on a further 1310 sites which were sampled just once. Thus the distances from source of 6600 of the 1990 River Quality Survey sites, out of the 8633 thought to have been sampled (Sweeting et al. 1992), were known to the IFE (Table 1.2).

Of these 6600 sites, 714 were on headwaters (Table 1.2). Headwaters therefore represented just 10.8% of the survey sites for which distance from source data were held, even though they may contribute 70% of total English and Welsh watercourse length.

The biological condition of the 409 sites sampled in each of three seasons is also presented (Table 1.1), where A = "good", B = "fair", C = "poor" and D = "bad". In summary, only 25.9% of headwater sites sampled during the 1990 RQS were in "good" biological condition with 30.1% "fair", 29.8% poor and as many as 14.2% bad. These values are based on the integrated 5M banding system, which takes account of each form of EQI (Sweeting et al. 1992).

These results are a cause for concern although they may exaggerate the problems existing in rural landscapes.

Firstly, they include sites in urban and industrial areas as well as agricultural landscapes.

Table 1.1 The number of headwater sites included in the 1990 River Quality Survey of England and Wales, out of 5109 sites known to IFE. Sites sampled in all three RIVPACS seasons.

NRA Region	Number of sites per distance from source category						Total number of sites sampled of all sizes	Headwater sites as a percentage of all the sample sites	Percentage of headwater sites per "quality band"			
	Total number of headwater sites								A	B	C	D
	0.1 - 0.5	0.6 - 1.0	1.1 - 1.5	1.6 - 2.0	2.1 - 2.5							
Anglian	15	28	17	35	20	115	952	12.1	27.8	33.9	22.6	15.7
Northumbrian	2	5	5	4	1	17	361	4.7	23.5	23.5	41.2	11.8
North West	1	0	1	4	8	14	417	3.4	21.4	35.7	28.6	14.3
Severn Trent	6	10	18	28	27	89	849	10.5	4.5	24.7	46.1	24.7
Southern	5	9	15	19	12	60	376	16.0	35.0	36.7	23.3	5.0
South West	2	4	5	7	12	30	483	6.2	50.0	20.0	23.3	6.7
Thames	2	2	5	5	4	18	256	7.0	38.9	22.2	27.7	11.1
Welsh	2	1	5	7	7	22	685	3.2	22.7	27.3	36.4	13.6
Wessex	2	3	7	8	5	25	389	6.8	44.0	40.0	16.0	0.0
Yorkshire	1	1	3	9	5	19	341	5.6	21.1	26.3	31.5	21.1
TOTAL	38	63	81	126	101	409	5109	8.0	25.9	30.1	29.8	14.2

Table 1.2 The number of headwater sites included in the 1990 River Quality Survey of England and Wales, out of 6600 sites known to IFE. All sampling frequencies.

NRA Region	Number of sites per distance from source category						Total number of sites sampled of all sizes	Headwater sites as a percentage of all the sample sites
	0.1 - 0.5	0.6 - 1.0	1.1 - 1.5	1.6 - 2.0	2.1 - 2.5	Total headwater sites		
Anglian	16	30	19	38	22	125	1018	12.3
Northumbrian	2	8	7	6	4	27	400	6.8
North West	15	22	38	56	58	189	1190	15.9
Severn Trent	6	14	20	33	33	106	928	11.4
Southern	7	13	17	27	15	79	420	18.8
South West	2	4	5	7	12	30	496	6.0
Thames	7	7	15	21	15	65	383	17.0
Welsh	2	1	5	9	7	24	833	2.9
Wessex	2	3	7	8	5	25	395	6.3
Yorkshire	3	7	11	14	9	44	537	8.2
TOTAL	62	109	144	219	180	714	6600	10.8

Secondly the overall results may also reflect a bias in the selection of headwaters for inclusion in the national surveys with a greater tendency to select sites with known problems than those perceived to be of good biological condition.

Thirdly, the banding system used here is derived from RIVPACS II and not the headwater classification used to band the 131 Stage 3 and 123 Countryside Survey sites. It may be slightly more severe than the system used to generate the values in section 1.3.5 but nevertheless re-emphasises the overall picture presented there of the generally poor biological condition of headwater sites.

Headwater sites have also been included in those subjected to River Habitat Surveys (RHS) which are designed to index the overall quality of the entire segments of river corridors based on the conformity of both their instream and riparian habitats in relation with the optimal characteristics set for the sites. River Habitat Quality will be expressed as a single reach index likely to be termed the Habitat Quality Index or HQI (Dawson personal communication).

Habitat surveys have been carried out jointly by the NRA and IFE in each of 1994 and 1995. Site selection was based on stratified random techniques and provided a wide coverage of English and Welsh watercourses. In total 1521 reaches were surveyed in 1994 and a similar number are being surveyed in 1995. Each reach was 500m long.

In 1994 an estimated total of 385 reaches had mid-points which were no more than 2.5km from the source of their watercourse. These were taken as headwater reaches for the purpose of this review. Headwater reaches thus represented 25.3% of all reaches surveyed.

It is anticipated that headwater sites will represent a similar or just slightly lower proportion of the sites surveyed and that after the first two years surveying something in the order of 700-750 headwater reaches will have had an RHS undertaken on them.

The numbers of headwater sites sampled chemically during the 1990 River Quality Survey, or planned for sampling during the 1995 General Quality Assessment are not known to IFE.

1.6 The current conservation status of headwaters

Within Great Britain three statutory agencies, English Nature (EN), the Countryside Council for Wales (CCW) and Scottish Natural Heritage (SNH) play a lead role in co-ordinating the conservation of species and habitats. Their activities are overseen by the "umbrella" organisation, the Joint Nature Conservation Committee.

The responsibilities of the national agencies include designating geographic areas of special conservation value as National Nature Reserves (NNRs), Sites of Special Scientific Interest (SSSIs), RAMSAR sites and Special Protection Areas (SPAs). SSSIs may include linear features such as running water courses.

In England there are currently only thirteen headwaters within the National Series of Rivers notified as SSSIs (Withrington personal communication). A further five headwaters are within sectional SSSIs in England.

Other headwater reaches lie within SSSIs whose notification is based on aspects of their terrestrial habitats. These streams do not necessarily have floral and faunal assemblages which would justify SSSI status in their own right but are afforded special conservation protection by virtue of their location. Precise figures for the number of headwaters in this category are not readily available. However information is accessible for "stream size 1" watercourses, which have a width of <5m (Withrington personal communication).

In the latter category are eight English and 17 Welsh streams which are in river valleys. These may be SSSIs because of their woodland or other non-aquatic interest. Another 17 English and eight Welsh headwaters are in SSSIs where the river "adds interest". These may include sites designated because they are on moorland.

Other headwaters also receive a measure of protection because they are situated in other designated areas of special worth such as National Parks, Local Nature Reserves (LNRs), Sites of Nature Conservation Interest, other reserves (eg Royal Society for the Protection of Birds - RSPB, local naturalist's trusts etc.), Areas of Outstanding Natural Beauty (AONBs), Nitrate Vulnerable Zones and Water Protection Zones or in areas covered by special schemes such as Environmentally Sensitive Areas (ESAs), Nitrate Sensitive Areas, the Agri-Habitat Scheme or the Countryside Stewardship Scheme.

Numbers of these are not easy to count but the total length of headwaters in receipt of some measure of special environmental protection remains small in relation to the total length of all headwaters in Great Britain.

1.7 The way forward

The information presented in this introductory chapter presents a salutary summary of the state of English and Welsh headwaters and the extent to which their biological condition is monitored and their faunal assemblages protected.

In the following chapters an outline plan is formulated to better manage headwaters and conserve their fauna.

The plan includes four key elements and a separate chapter is devoted to each. These are:-

- MONITORING AND SURVEILLANCE
 - PROTECTION AND REMEDIATION
 - EVALUATION
- and
- RESEARCH

Before developing each theme the role of the NRA and the national and international legislature which govern its powers and activities are set out briefly.

2. THE ROLE OF THE NRA

The duties and powers vested in the NRA by United Kingdom legislation and Council of the European Union Directives govern the manner in which it may implement a conservation management plan for headwaters.

The corporate strategy of the Authority (National Rivers Authority 1994a) sets out the purpose, mission, aims and objectives which govern its operational policies.

2.1 Corporate strategy

2.1.1 The purpose of the NRA

The NRA was created through the Water Act 1989 to act as an independent environmental watchdog. The Authority sees its prime purpose as being to:-

"protect and improve the aquatic environment throughout Britain"

The NRA's ability to achieve this purpose is defined by UK legislation. It has statutory responsibilities for water quality, conservation, fisheries, water resources, flood defence, navigation and recreation.

The Authority also acts as the UK competent authority for those Council of the European Community Directives which are concerned with the chemical and ecological quality of rivers, estuaries and coastal waters.

The NRA plays important roles, as statutory consultees, in relation to waste disposal, site licensing, domestic and agricultural planning and the authorization of industrial processes controlled by Her Majesty's Inspectorate of Pollution (HMIP).

They are responsible for issuing consents for discharges into controlled waters and for licensing abstractions made from water held in natural underground storage and from all surface waters above the tidal low water mark.

They have a duty to ensure that all Statutory Water Quality Objectives (STQOs) set by the Secretary of State for the Environment are met. The NRA may also request the Secretary of State to set minimum acceptable flows, levels or volumes for inland waters or to establish "emergency" or "ordinary" drought orders which enable them to take measures to deal with water shortages.

The NRA has additional duties to further and promote conservation and to consult with English Nature, the Countryside Council for Wales, the National Parks Authority and the Broads Authority with respect to sites of special interest.

2.1.2 The corporate mission and vision

In seeking to fulfil their statutory duties and powers, the NRA describe their mission as to:-

"protect and improve the water environment by the effective management of water resources"

and their corporate vision as:

"a healthy and diverse water environment, managed in an environmentally friendly way, balancing the needs of all users"

Within this framework the Authority set out a range of aims and objectives, many of which have direct relevance to the formulation of a conservation strategy for headwaters.

2.1.3 The corporate aims of the NRA

The corporate aims most pertinent to the management and conservation of headwaters are to:

- *achieve a continuing overall improvement in the quality of rivers, estuaries and coastal waters through the control of pollution*
- *manage water resources to achieve the right balance between the needs of the environment and those of the abstractors*
- *conserve and enhance wildlife, landscape and archaeological features associated with inland and coastal waters of England and Wales*
- *ensure that dischargers pay the costs of the consequences of their discharges, and, as far as possible, to recover the costs of water environment improvements from those who benefit*
- *improve public understanding of the water environment and the NRA's work.*

2.1.4 The corporate objectives of the NRA

The principal objectives of the NRA are defined within three key cross-functional areas of activities. These are *"Integrated Environmental Management"*, *"Working With Others"* and *"Measuring Success"*.

Each activity includes several objectives of direct relevance to the development of a headwaters conservation strategy.

Integrated Environmental Management

- *assess catchment resources, uses and activities*
- *balance conflicting uses and identify actions needed by NRA and others*
- *consult with customers on issues to be tackled within catchment management plans*
- *establish a long-term vision for individual catchments*
- *use effective and proactive planning to prevent future environmental damage and to provide lasting solutions to environmental problems*

Working With Others

- *maximise environmental benefit by consultation, collaboration and partnership*
- *work with ... partners to pre-empt regulation and encourage voluntary action*
- *exert an influence on draft policy programmes and EC Directives with environmental implications*

Measuring Success

The NRA consider their success can be determined by the achievement of a few critical measures of which the most relevant to headwaters are:

- *successful implementation of catchment management plans*
- *achievement of environmental standards and objectives ...*

These cross-functional functions complement a series of specific objectives included in separate strategies for the NRA's seven core functions; water quality, water resources, flood defence, fisheries, recreation, conservation and navigation (National Rivers Authority 1993a-g), together with the NRA's strategy for R&D (National Rivers Authority 1993h).

2.2 The legislative framework

2.2.1 United Kingdom law

A principal purpose of the Water Act 1989 was to provide for the establishment and functions of a National Rivers Authority and of committees to advise that authority (Howorth 1990). The Act superseded the Water Resources Act of 1963 and the Water Act of 1973 in which the principle of integrated river basin management of the water cycle was enshrined.

The new Act segregated those integrated responsibilities into water supply and sewage treatment which were to be within the purview of privatised water companies and regulatory and law enforcement functions which were devolved to the NRA.

Within two years the duties and powers vested in the NRA to control the abstraction and impoundment of water were further consolidated in the Water Resources Act 1991. The Water Resources Act 1991 also consolidated the provisions, in England and Wales, of the Control of Pollution Act 1974 to prevent water pollution.

The principle statutes which define the functions, duties and powers of the NRA are the:

- Water Resources Act 1991
- Water Act 1989
- Water Act 1945
- Control of Pollution Act 1974
- Environmental Protection Act 1990
- Land Drainage Acts 1991/1994
- Public Health Act 1936
- Public Health (Drainage of Premises) Act 1937
- Public Health Act 1961
- Salmon and Freshwater Fisheries Act 1975.
- Town and Country Planning Acts 1971/1990

2.2.2 European Community law

The National Rivers Authority is the competent UK authority for a variety of European Directives as implemented through UK legislation. Over twenty directives fall within its remit of responsibility, of which the most pertinent to a headwater conservation strategy are listed here (Table 2.1).

Table 2.1 Enacted and proposed Council of the European Union directives pertinent to the functions, duties and powers of the NRA, with particular relevance to the conservation and management of headwaters.

NUMBER	NAME	NRA COMPETENT AUTHORITY?
76/464/EEC	Pollution caused by the discharge of certain dangerous substances into the aquatic environment	Yes
78/659/EEC	Quality of freshwaters needed to support fishlife [to be repealed with effect from 1 January 1999]	Yes
80/68/EEC	Protection of groundwater against pollution caused by certain dangerous substances	Yes
80/778/EEC	Quality of water for human consumption	Yes
91/271/EEC	Urban waste water treatment	Yes
91/676/EEC	Pollution caused by nitrates from agricultural sources	Yes
92/43/EEC	Conservation of natural habitats and of wild fauna and flora	No
Proposed	The ecological quality of water	Yes

3. A STRATEGY FOR MONITORING AND SURVEILLANCE

An essential component of a conservation strategy is the knowledge on which is based.

The "Faunal Richness of Headwater Streams" project is the first co-ordinated attempt to develop that knowledge-base and is concerned primarily with macro-invertebrate data.

Historically the water industry's acquisition of headwater data has been in a piecemeal fashion with no concerted attempt to integrate the information in a meaningful manner in order to address the specific problems of these small watercourses.

Despite this, a considerable amount of data has been acquired, particularly on macro-invertebrates and, more recently on "river habitats" (see section 1.5). The situation is less clear for floral and other faunal groups but some data undoubtedly exist on these subjects too, especially for water chemistry.

- **THE NRA NEEDS TO DEVELOP GREATER AWARENESS, USE AND DISSEMINATION OF THE HEADWATER DATA THEY ALREADY POSSESS, BY DEVELOPING A NATIONAL HEADWATERS DATA-BASE**
- **THEY SHOULD EXTEND THEIR DATA-HOLDING THROUGH A CO-ORDINATED NATIONAL HEADWATER SAMPLING PROGRAMME**

3.1 Development of a national headwater data-base

Many existing headwater sites would form the basis of this network and reliable historical data held for them would form the initial data-holding.

- **data derived, by past and future sampling, should be held within a co-ordinated, spatially and temporally referenced national headwaters data-base utilising appropriate geographic information system (GIS) technology**
- **headwater data should be held in such a fashion that it can be abstracted, viewed and queried either as a stand-alone data-set or as part of the full data-base of sites sampled by the NRA on waterbodies of all types and sizes**

Although information derived from the national network should form the core of the data-holding, all headwater data derived from one-off surveys and special investigations should be stored in such a manner that they may be integrated into the national headwater data-base. This requires a common underlying data-base structure for all components of the NRA's national data storage and retrieval systems but does not preclude specialised modules being developed for the headwater data-base.

- **a co-ordinated national NRA information technology (IT) strategy is required for this purpose because the national headwaters data-base needs to be equally accessible in all regions and areas of the Authority**

Optimally, the national headwaters data-base should contain the fullest range of available and reliable information. The core components should be data on water chemistry, flora and fauna, river habitat characteristics and all derived quality indices from these data.

However, to fully fulfil the requirements of a headwater conservation strategy the data-base should also contain components of external data relevant to the stresses operating on headwaters and the measures being undertaken to control them.

The data-base should therefore contain information on reported pollution incidents in headwater streams, on consented anthropogenic influences upon headwaters (including discharges, abstractions, impoundments and other channel modifications) and all known spatially and temporally referenced information on special environmental and agricultural incentive schemes liable to have beneficial impact upon streams.

In order to develop adequate protection for all important types of headwaters, the data-base should contain information on the special conservation status of streams including those intrinsically due to the special characteristics of the stream and those due to the special characteristics of the landscape through which the river flows.

The capacity to relate individual headwaters to other spatially referenced digitised layers such as river networks, terrain models, soils, geology, climate and land cover or to stream hydrology, as available, would be helpful in identifying the extent of headwaters of different types such as, for example, Corallian Limestone streams or lowland, heathland watercourses.

In order to base strategy on the widest available experience, the data-base might contain a spatially referenced bibliography of internal and external reports and papers on headwater studies.

- **the Water Archive Management System (WAMS), under development by the NRA, appears suitable for a data-base of the type described**
- **if WAMS is to form the basis of a national GIS for the Authority then the headwater data-base should be structured to be compatible with it**
- **in order to develop a national headwater data-base each NRA Region needs to acquire an awareness of their own holdings of appropriate data**

3.1.1 Awareness of current data-holding

Development of an awareness of current headwaters data-holdings will require input from a range of NRA sections and divisions including, biology, fisheries, conservation, water quality and flood defence. All site data should be spatially referenced as well as by watercourse and location name because the latter may differ from department to department.

Some existing data-sets will be easier to access than others and, similarly, some types of data will be of greater priority to the NRA's business needs than others. Initial priority should be given to water chemistry and macro-invertebrate sampling since these are the core activities for assessing chemical quality and biological condition of streams and rivers.

Information on River Habitat Survey coverage is also readily accessible and likely to be easy to collate. This form of survey has recently been a major NRA activity and procedures to use the acquired data to assess the habitat quality of headwaters will re-inforce its importance.

- **each NRA region should be aware of appropriate data, particularly macro-invertebrate and River Habitat data held by other organisations, such as IFE and the conservation agencies**

In general floral surveys are less commonly undertaken whilst fisheries surveys tend to be concentrated on larger reaches on "main river" sections. Again the NRA should be aware of data held by other organisations which may be relevant to its activities.

The collation of data on consented anthropogenic activities, pollution incidents and land cover are also priority items because they provide the NRA with a framework for assessing the sources of environmental pressure operating on headwaters and, in conjunction with chemical, biological and habitat data, criteria for the assessment of the effectiveness of headwater conservation strategies.

Background environmental layers may often need to be purchased or held under licence from other organisations, such as Ordnance Survey, British Geological Survey, Soil Survey and Land Research Centre and the Institute of Hydrology. These may already be held by the NRA for other purposes

Information on those headwaters notified directly or indirectly as SSSIs, on RAMSAR sites or Special Conservation Areas, in National or Local Nature Reserves, National Parks and Areas Of Outstanding Natural Beauty, if not known to the NRA, should be acquired from national conservation agencies.

Wherever possible, information from each region should be entered into the national storage and retrieval system locally, although central co-ordination of the data-base development would also be desirable.

3.1.2 Assessment of adequacy of data-holding

In relation to their total watercourse length, headwater sites have been considerably under-represented in national surveys of biological conditions. The same probably holds for chemical surveys but the data to confirm this are not to hand. These national surveys are now known as General Quality Assessments and the sampling locations as GQA sites.

- **having assembled data on headwater coverage, each NRA Region should assess the adequacy of their sampling of headwaters for ecological and chemical quality**

Adequacy of sampling should be assessed in relation to overall geographic coverage and also in relation to altitude, geology, soil types, land cover and land-use. This may be achieved through use of maps or, if in place, through WAMS or other NRA-preferred GIS.

Assessment of regional coverage should be complemented by a national overview of the distribution of headwater sites in order to ensure that decisions made at local level provide a well balanced national coverage.

The following guidelines are offered in order to make that assessment.

- **MACRO-INVERTEBRATE SAMPLING SHOULD BE THE PRINCIPAL MEANS OF ASSESSING THE QUALITY OF HEADWATERS**

- **in each NRA Region a minimum of 20% of GQA sites sampled for macro-invertebrates should be on headwaters**

This reflects a balanced accounting of their relative frequency, in the region of 70% of total British watercourse length, but their relatively lesser importance than larger, downstream reaches with greater industrial, domestic and recreational usages.

This recommendation will require the sampling of approximately 1900 sites compared with an estimated 900 sites sampled during the 1990 River Quality Survey.

Adequate data-holding on sites of good biological condition are necessary in order to provide biological standards against which the macro-invertebrate fauna of other sites of similar environmental types may be judged.

- **existing sites of good chemical quality and biological condition should be considered independently when assessing the adequacy of cover of headwater sampling**

This will highlight geographic areas, landscape types or altitudinal zones where no or few good sites of apparent high quality have been sampled. Although the inclusion of sites of this type may bias the general quality assessment procedure the advantages of ensuring their presence in the data-set outweighs the disadvantages.

Routine chemical sampling should only be undertaken at a sub-set of biological GQA sites.

- **a minimum of 10% of chemical GQA sites should be on headwaters.**

However additional chemical sampling should also be undertaken where biological sampling suggests that a form of chemical pollution is occurring which needs more detailed investigation.

The recommendation to undertake this level of chemical sampling is based on the need to understand the chemical characteristics and variability of headwaters in order to best acquire the background knowledge to underpin the conservation strategy.

River Habitat Surveys (RHS) are likely to be an on-going NRA activity and are particularly relevant to headwater streams. This is because of the particularly intimate relationship between headwaters and their riparian zones resulting from the primacy of agricultural, rather than industrial or domestic activity as a possible source of habitat degradation.

- **RIVER HABITAT SURVEYS SHOULD BE UNDERTAKEN AT ALL HEADWATER GQA SITES, STARTING FROM THE BIOLOGICAL SAMPLING LOCATION AND WORKING UPSTREAM**

A survey of the occurrence of potential perturbations within the 40m corridor of 131 headwater study sites showed many possible sources of aquatic environmental stress to be commonplace in headwater corridors and to be generally negatively correlated with good biological condition (Furse et al. 1995a).

- **River Habitat Surveys of headwater GQA sites should include the collection of data on aquatic macrophyte assemblages and on the occurrence of the distribution of potential sources of stream perturbation within 20m of either water's edge within the 500m survey area**

The importance of headwaters as spawning grounds and nursery areas for fish has yet to be fully evaluated by the NRA and further research is needed in this area.

- **it is not recommended that any general increase in monitoring activities of fish populations be undertaken until the importance of headwaters as spawning grounds can be established by research**

At the time of writing this report the NRA are initiating a research proposal on the status of headwaters as fisheries and their tolerance to low level habitat restoration. It is intended that work carried out under this programme will provide a basis for the strategic management of fisheries in headwaters and will lead to operational practices that the Authority can deploy, together with options for policy development.

3.1.3 Expansion of monitoring and surveillance activities

- **having assessed the adequacy of headwater coverage at regional and national level and having identified gaps in coverage, new biological GQA sites should be created in each region to complete the national headwaters sampling network**

Most new sites should be selected using random stratified procedures in order not bias selection towards sites of particular chemical quality or biological condition. However, where necessary in order to obtain macro-invertebrate data on sites of good chemical quality and biological condition, limited targeting is desirable.

3.1.4 Provision of resources

At a time of diminishing budgets (National Rivers Authority 1994a) recommendations for additional headwater sampling have important resource implications.

Attaining the recommended proportion of headwater sites sampled needs to be achieved in some or all of the following ways:

- reviewing the need to sample all existing sites
- reducing the seasonal frequency of sampling
- spreading the sampling load through the adoption of rolling programmes.

Prioritising resources is an internal NRA decision but the following recommendations should be considered in developing a national headwater sampling network:

- **MACRO-INVERTEBRATE SAMPLING OF EXISTING AND ADDITIONAL HEADWATER GQA SITES IS RESTRICTED TO A SINGLE SEASON**

If the total number of sites in the national headwaters data-set is of the order of 1900, as recommended above then the 1900 samples collected by single-season sampling compares with an estimated 1804 headwater samples taken during the 1990 River Quality Survey (Table 1.2 and Sweeting et al. 1992).

- **GQA BIOLOGICAL SAMPLING OF MOST HEADWATER SITES SHOULD BE PERFORMED IN A ROLLING PROGRAMME WITH EACH SITE SAMPLED ONE YEAR IN EVERY FIVE**

This would reduce the number of headwater samples collected annually to approximately 400, or 50 per Region. However it would require that each site was visited three times during the biological sampling year in order to acquire the most appropriate environmental data for predictive purposes.

A feature of the results of the "Faunal Richness of Headwater Streams" project was the occurrence in headwaters of many taxa with national conservation importance. The normal level of identification adopted by the NRA for national quality surveys is to BMWP family. In order to detect species of conservation importance species level identification is required.

- **the extent to which national headwater sites support taxa of conservation importance should be assessed by identifying a proportion of samples to species level and this may best be achieved by contracting out the work**
- **RIVER HABITAT SURVEYS OF EACH HEADWATER MACRO-INVERTEBRATE SAMPLING SITE SHOULD BE UNDERTAKEN IN THE YEAR OF BIOLOGICAL SAMPLING**
- **GQA chemical sampling should also be performed on a rolling programme using the general rules of frequency and timescale of sampling used for all other GQA sites**

Longitudinal variation of macro-invertebrate assemblages has been shown to be an important characteristic of headwaters (Furse et al. 1995a) and for reasons of compatibility of sites it is recommended that:

- **wherever feasible, sampling locations should be situated between 500m and 1.5km from source**

This will make observed macro-invertebrate assemblages most directly comparable with those used, RIVPACS-style, to set the optimal expected fauna.

Given their small discharge and vulnerability to environmental stress, inter-annual and intra-annual variation may also be an important feature of small watercourses. It is recommended that:

- **a sub-set of GQA headwater sites should be sampled twice per year in every alternate year**
- **each of these sites should be sampled at approximately 100m, 500m and 1.5km from source**

This will provide valuable data in order to better understand spatial and temporal variation in streams of different environmental types.

The number of sites that could be sampled this intensively will depend upon the size of each region and their staffing and financial resources. Precise recommendations are therefore impractical. However, if 50 headwater GQA sites throughout England and Wales are sampled with this additional intensity then, on average, each NRA Regions would collect and process an additional 35 headwater samples per year.

Intensive studies are seen as a lower priority than including additional headwater sites in the GQA programme. However, the additional work load involved in the recommended intensive study of macro-invertebrate assemblages at selected headwater sites could be offset by the loss of 18 non-headwater sites per region per year if each of these would otherwise have been sampled twice annually.

Similarly it is recommended that:

- **the number of RHS sites sampled over a five year period is not increased but that the relative proportions should be adjusted, if required, in order to meet the recommended headwater sampling programme**

The adjustments necessary to the chemical sampling programme cannot be determined without further information and the proposed headwater sampling region, if adopted, may lead to a decrease in effort. However it is recommended that:

- **streams sampled for temporal variation in macro-invertebrate assemblages be sampled on a monthly basis at each of the three biological sampling points**

3.2 Development of procedures for assessing and reporting the biological condition of headwaters

In the preceding section it was recommended that the primary procedure for monitoring the condition of headwaters is the use of macro-invertebrate sampling in order to determine their biological condition (Biological Monitoring Working Party 1978).

In larger watercourses the River In-Vertebrate Prediction And Classification System (RIVPACS), (Wright et al. 1993), is now widely used to convert macro-invertebrate data into EQIs or Ecological Quality Indices. RIVPACS operates by comparing the observed fauna with that predicted to occur in the absence of significant environmental stress. The mechanism for quantifying the relationship is the use of Biological Monitoring Working Party (BMWP) indices (Armitage et al. 1983).

The principal of comparing the existing site fauna with that to be expected if the site were unstressed is fully in line with the approach recommended in the forthcoming Council of the European Union directive on the ecological quality of water.

Operational version RIVPACS II (Wright et al. 1993) holds data on very few sites meeting the definition of headwaters used here. An updated version, RIVPACS III (Wright et al. 1995) will hold more but they will still represent a small proportion of the total site holdings. Thus the predictions generated by RIVPACS for headwaters are less likely to be reliable than those for sites further down river systems.

In Stage 3 of the current headwater study a pilot version of the RIVPACS system, based entirely on unstressed headwaters, which was used to assess the quality of study sites (Furse et al. 1995a). This was considered to provide more reliable predictions of the expected fauna because of the more direct environmental analogies between the sites being assessed and those being used to make the assessment.

This headwaters version of RIVPACS was based entirely on single season samples and its use would be entirely compatible with the single season sampling strategy recommended in 3.1.4. Samples in the prediction system were all collected between June and November inclusive.

However, at present, the headwaters "RIVPACS" is not developed as a practical, user-friendly system which is readily available for operational use.

- **THE PRINCIPAL PROCEDURE FOR GENERAL REPORTING ON THE QUALITY OF HEADWATERS IS THROUGH THE USE OF ECOLOGICAL QUALITY INDICES BASED ON MACRO-INVERTEBRATE ASSEMBLAGES**
- **AN OPERATIONAL MODULE OF RIVPACS BASED ENTIRELY ON SINGLE SEASON HEADWATER SAMPLES SHOULD BE DEVELOPED FOR DETERMINATION OF EQIs**

The principal of compatibility of assessment of all types of watercourses and sites is important for national reporting purposes. It is thus further recommended that

- **THE PRINCIPAL PROCEDURE FOR GENERAL REPORTING ON CHEMICAL QUALITY OF HEADWATERS SHOULD BE THE SAME AS THAT ADOPTED THROUGHOUT THE GQA SYSTEM**
- **THE PRINCIPAL PROCEDURE FOR GENERAL REPORTING ON THE HABITAT QUALITY OF HEADWATERS SHOULD BE THE SAME AS THAT ADOPTED THROUGHOUT THE RIVER HABITAT SURVEY OF 1995**

All other reporting of chemical, biological and habitat data, other than General Quality and River Habitat assessment should be appropriate to the particular purposes of investigation.

- **HAVING DEVELOPED STRATEGIES FOR COLLECTING, STORING AND ASSESSING HEADWATER DATA IT IS ESSENTIAL THAT THE STRATEGY IS CONSOLIDATED BY ACCESSIBLE REPORTING**

It is therefore recommended that:

- **simultaneously with the publication of the results of the periodical national GQA surveys a separate, an independent report should be published exclusively devoted to headwaters**

This should not preclude the inclusion of headwater data in the general report where information on these watercourses should be summarised and cross-referenced to the independent report.

4. A STRATEGY FOR PROTECTION AND REMEDIATION

A PRACTICAL MANAGEMENT STRATEGY FOR THE PROTECTION AND REMEDIATION OF HEADWATER STREAMS SHOULD OPERATE AT BOTH REGIONAL AND NATIONAL LEVEL.

It should comprise a set of key components:

- **Awareness** - through information and education
- **Collaboration** - through communication and interaction
- **Control** - through licensing and legislation
- **Improvement** - through policy and planning

These issues are dealt with in this chapter and need to be supported by:

- **Evaluation** - through performance criteria (Chapter 5)
- **Knowledge** - through promotion of strategic research (Chapter 6)

Many of the recommended elements of the NRA's headwater protection strategy, as given in bold type throughout this and other chapters of this report, are already current NRA practice and are restated here for purposes of comprehensiveness.

4.1 Awareness

A variety of mechanisms are available to promote awareness through the dissemination of information. These include:

- NRA internal business management
- talks, displays and exhibitions
- reports and scientific papers
- semi-populist journals and house newspapers
- fact files
- national and local newspapers
- television and radio

The appropriateness of each of these devices will depend upon the target audience. Seven separate categories of audience are considered:

- the water industry
- the statutory conservation agencies
- wildlife and conservation bodies
- national and local government
- landowners, managers, tenants and others with riparian interests
- the scientific community
- the general public

4.1.1 The water industry

The National Rivers Authority

The NRA, with their statutory duties and powers, are the organisation in the most influential position to control the chemical quality and biological condition of headwater streams.

In order to exert that influence a high level of awareness needs to exist within the organisation. This awareness needs to exist amongst its professional staff at all levels from management to field operators and amongst those members of the statutory committees that advise the Authority.

The primary route by which the importance of headwaters is transmitted to both professional staff and advisory committees is through corporate planning. Thus:

- **THE NRA'S CORPORATE STRATEGY MUST INCLUDE A DISCRETE PLAN FOR THE CONSERVATION AND MANAGEMENT OF HEADWATERS**
- **DETAILED STRATEGIES SHOULD BE PUBLISHED FOR ALL RELEVANT CORE BUSINESS ACTIVITIES**

Special responsibility will lie with appropriate headquarters staff for transmitting national requirements to regional level and with R&D Topic leaders for recognising and promoting those research activities most beneficial to establishing the knowledge base upon which to develop, refine and implement the strategy.

At operational level the development of the headwater sampling network and data-base will bring immediate awareness to all those involved in the process. The diversity of information recommended for inclusion in the data-base will be an important factor here, with chemists, biologists, fisheries and conservation officers and water resources staff all involved.

- **the development of the headwater data-base should be used to inform and involve the widest possible range of NRA personnel of the importance of headwaters**

This broad-based approach to the implementing headwaters strategy is directly in line with the central thrust of the NRA's overall strategy, the development of catchment management plans. These plans represent a fully integrated approach to meeting a sustainable management of river basins, taking into account the needs to promote economic and social development whilst at the same time furthering the needs of conservation.

Main rivers are themselves an integration of the quality and quantity of water supplied from the headwaters and environmental stresses in headwaters, when aggregated, may lead to significant environmental degradation lower down the catchment.

- **IT IS ESSENTIAL THAT ALL CATCHMENT MANAGEMENT PLANS TAKE SPECIFIC ACCOUNT OF THE CONSERVATION IMPORTANCE OF HEADWATERS AND THE ENVIRONMENTAL THREATS POSED TO THEM AND THEIR RECEIVER STREAMS**

An important component of awareness is an understanding of the reasons for attaching such importance to headwaters:

- **full copies of the reports of "The Faunal Richness of Headwater Streams" project should be held by each regional and area office of the NRA and made readily accessible to the relevant staff on a "need-to-know" basis**

Other important mechanisms for communicating the importance of headwaters are:-

- **THE SUMMARY REPORT ON "THE FAUNAL RICHNESS OF HEADWATER STREAMS" SHOULD BE WIDELY CIRCULATED AT ALL LEVELS OF THE NRA**
- **the results of the headwaters research programme to all appropriate NRA working groups, committees and individuals through talks and discussion forums**
- **THE NRA SHOULD ORGANISE HEADWATER SEMINARS AND/OR CONFERENCES TARGETED AT THE WATER INDUSTRY, LOCAL AND NATIONAL GOVERNMENT AND STATUTORY AND NON-STATUTORY CONSERVATION ORGANISATIONS**
- **A GENERAL "HEADWATERS FACT FILE" SHOULD BE PRODUCED FOR INTERNAL NRA INFORMATION AND FOR CIRCULATION TO EXTERNAL ORGANISATIONS AND INDIVIDUALS**

The fact file should provide details on the abundance of headstreams, their importance to catchment biodiversity and chemical and ecological quality distribution. It should also provide succinct practical information on how environmental stress on these systems can be avoided or remediated by good agricultural, industrial and urban practice and on the powers and duties that the NRA have available to them.

Representatives of all seven categories of audience considered in this chapter should be invited to participate in the seminars and conferences and all organisations which interact with the public should be provided with copies of the fact files for widespread circulation. These strategies of awareness are assumed in all subsequent sections of this chapter.

- **THE IMPORTANCE OF HEADWATERS AND THE PROBLEMS AFFECTING THEM NEEDS TO BE KNOWN TO THOSE STATUTORY COMMITTEES THAT ADVISE THE NRA AND FORM A PRACTICAL LINK BETWEEN THE AUTHORITY AND THE VIEWS AND CONCERNS OF THE PUBLIC**

These statutory committees were set up by the Water Act 1989 and include the Advisory Committee for Wales, Regional Rivers Advisory Committees and Regional Fisheries Advisory Committees. The provision of the Act require the NRA to consult these committees on the manner in which the Authority carries out its functions and to consider any representation from the committees relating to the way these functions are exercised.

More recently, the role of the advisory committees has been strengthened by the involvement of their members in the development and monitoring of catchment management plans. This is achieved by representation of advisory committee members on catchment management groups whose role is to monitor the effectiveness and cost-benefit of the management plans and to offer direction for their further development.

- **the importance of headwaters and their management and conservation should be a regular agenda item of meetings of the statutory advisory committees to the NRA and of the monitoring groups with specific responsibility for catchment management plans**

The water companies

The privatised water companies are responsible for water supply and disposal and the treatment of sewage. As such their main interaction with headwaters will concern the discharge of effluent into small watercourses.

- **the NRA should take steps to inform the water companies of their concern for the quality of headwaters and of the need for co-ordinated action to prevent further deterioration and to effect a programme of improvements**

This transfer of information should be achieved through:

- **regular inclusion of headwater issues on the agenda of meetings between the organisations and executive and operational level**

Internal Drainage Boards

Under the terms of the Water Act 1989 and the Land Drainage Act 1991, as amended by the Land Drainage Act 1994, the Internal Drainage Boards retain statutory powers to "exercise a general supervision over all matters relating to the drainage of land within their district".

Whereas, under the Water Resources Act 1991, the NRA operate the licensing process for those the erection of dams, weirs, culverts or other structures within "main" rivers, as defined in the Land Drainage Act 1976, the Internal Drainage Boards (IDBs) exercise this function in "ordinary" watercourses under the terms of the Land Drainage Act 1991.

These "ordinary" watercourses commonly include small streams, drains and ditches. This places the IDBs in a very important position with regard to headwater conservation strategies because they are more likely than the NRA to exercise direct management control over most headwaters in England and Wales.

In some circumstances the Land Drainage Act 1991 vests the permissive powers, normally granted to the IDBs, to the Local Authority. It also provides that the NRA may function as the IDB where appropriate. Furthermore, under section 7 of the Act the NRA may "give such general or special directions as it considers reasonable for the guidance of the IDBs with respect to the exercise and performance by those boards of their powers and duties as such".

- **the NRA and Internal Drainage Board must liaise effectively in order to promote the best land drainage practices for the protection of headwaters**
- **headwater issues should be included regularly on the agenda of meetings between the organisations at executive and operational level**

4.1.2 Conservation agencies

In England and Wales the statutory agencies responsible for nature conservation are English Nature and the Countryside Council for Wales. Each was formed in 1991 and took over the unitary powers and duties previously undertaken by the Nature Conservancy Council.

The two agencies inherited a traditional set of criteria for establishing the worth of individual sites for conservation purposes. These included size (extent), diversity, naturalness, rarity, fragility, typicalness, recorded history, position in an ecological/geographical unit, potential value and intrinsic appeal (Ratcliffe 1986).

Whereas the chief instrument for safeguarding sites was to designate them as National Nature Reserves (NNRs), since 1981 this function has been largely succeeded by the creation of Sites of Special Scientific Interest (SSSIs). In this context the term "site" is equated with "area" (Ratcliffe 1986).

Much of the basis for the designation of protected areas was an extensive national appraisal exercise known as the Nature Conservation Review (Ratcliffe 1977). Many NNRs and SSSIs were created as a result of it. More recently the notification of SSSIs has been on the basis of special merit rather than a comprehensive national exercise.

This, more ad hoc approach requires that occasional overviews are necessary in order to appraise the balance of sites designated protection. This form of review is likely to take account of other types of designated areas under the mandated responsibility of the agencies. These include RAMSAR sites (wetland sites designated under the UK role as signatories of the Convention of Wetlands of International Importance Especially as Waterfowl Habitat), Special Protection Areas, or SPA's, (designated under the terms of the European Communities Council Directive of April 1979 on the Conservation of Wild Birds) and Local Nature Reserves, or LNRs (designated by local authorities in consultation with the agencies under section 21 of the National Parks and Access to the Countryside Act 1949).

In making judgements about the level of conservation protection afforded to headwaters the agencies need to be aware of the best available information.

- **THE STATUTORY CONSERVATION AGENCIES NEED TO BE INFORMED OF THE ROLE HEADWATERS PLAY IN MAINTAINING CATCHMENT BIODIVERSITY, THE THREATS THESE STREAMS ARE UNDER**
- **a copy of the summary report of the headwaters project should be lodged with all regional offices of the agencies**

Information should also be presented to Scottish Natural Heritage, the conservation agency for Scotland. SNH are currently developing a computer package called SERCON (System for Evaluating River Conservation) which will be used to assess the conservation value of sections of rivers and streams throughout Great Britain. This system, when fully operational will have an important role to play in selecting running water sites for conservation protection. It is important that the significance of headwaters is recognised in the system.

- **the Scottish Natural Heritage staff, and their consultants and advisers, responsible for developing the SERCON model should be made fully aware of the importance of headwaters and the need for the software system to evaluate these for conservation purposes**

In the light of their awareness of the importance of headwaters the agencies should take stock of the current level of conservation protection afforded to headwaters.

- **THE NRA SHOULD REQUEST THE STATUTORY CONSERVATION AGENCIES TO MAKE AVAILABLE THE NUMBERS, LENGTH, DISTRIBUTION AND PROTECTION STATUS OF HEADWATERS IN DESIGNATED CONSERVATION SITES**

The agencies therefore need to participate fully in the process of informing others as well as being informed themselves.

4.1.3 Other wildlife and conservation bodies

A wide variety of other professional governmental and non-governmental organisations and amateur environmental organisations, including "pressure groups" exist with probable interest in the findings of the "headwaters" project (Table 4.1).

- each organisation should be encouraged to transfer information on headwaters to their membership through publication of articles in their in-house magazines and through the widespread distribution of NRA fact files

Table 4.1 A representative list of organisations with involved with wildlife and countryside issues in England and Wales

GOVERNMENTAL BODIES

Government departments	English Nature
Local government	Countryside Council for Wales
National Rivers Authority	Joint Nature Conservation Committee

NON-GOVERNMENTAL BODIES

Water undertakings	Water Services Association
Internal Drainage Boards	The Broads Authority
The Research Council Institutes	Educational establishments
Museums	Royal Commission on Environmental Pollution
Countryside Commission	Council for the Protection of Rural Britain
Forestry Commission	National Parks
Groundwork Foundation	Institute of Wastes Management
Town and Country Planning Association	Inst.for Ecology and Environmental Management
Farming and Wildlife Advisory Group	Agricultural Development & Advisory Service
National Union of Farmers	Country Landowners Association
National Trust	World Wide Fund for Nature
Wildlife Trust	Royal Society for Nature Conservation
British Trust for Ornithology	Royal Society for the Protection of Birds
Butterfly Association	Vincent Wildlife Trust
National Federation of Anglers	Anglers Cooperative Association
Salmon and Trout Association	Game Conservancy
World Conservation Monitoring Centre	Ramblers Association
County and local wildlife trusts	

ENVIRONMENTAL "PRESSURE GROUPS"

Friends of the Earth	Greenpeace
Green Alliance	Plantlife

4.1.4 National and local government

National government has overall responsibility, at policy level, for implementing national and international legislation relating to the environment. The two departments with the greatest level of involvement are those of the Department of the Environment and the Ministry of Agriculture, Fisheries and Food.

The Department of the Environment's main involvement in freshwater policy implementation is through their Water Directorate, based in London, and their Wildlife and Countryside Division (formerly the Rural Affairs Directorate) based in Bristol.

The remit of the Water Directorate, as taken from Croner's Environmental Management (1994) includes, amongst other items:

- sponsorship of the NRA
- liaison with the NRA on water pollution control policy and water resources management
- general water quality policy issues
- development of water quality classification schemes
- the setting of Statutory Water quality Objectives
- development of domestic policy on nitrates, including liaison with MAFF on nitrate sensitive areas
- policy development on water protection zones
- implementation of the Council of European Union directives on freshwaters
- monitoring compliance with conservation and recreation duties
- waste water treatment
- sludge disposal policy

The Wildlife and Countryside Division deal with a variety of policy issues, listed in Croner's Environmental Management (1994), the most relevant of which include:

- sponsorship of English Nature and lead responsibility for the Joint Nature Conservation Committee
- sponsorship of the Countryside Commission, National Parks and the Broads Authority
- policies towards landscape protection
- policies towards wildlife conservation
- habitat and species safeguard
- countryside research
- environmental education
- liaison with MAFF on environmental aspects of agricultural policies
- liaison with the Forestry Commission on environmental aspects of forestry policy

Other responsibilities relevant to headwaters are exercised by the Ministry of Agriculture Fisheries and Food. These include:

- administering arrangements for the approval of pesticides and pesticide legislation
- the approval and control of pesticides for use in agriculture and horticulture
- the implementation of measures designed to reduce agricultural pollution and to encourage of the recycling of farm wastes in an economical and environmentally friendly way
- the implementation of legislation to reduce nutrient inputs to water from agriculture, including the Council of the European Union directive on nitrates in agriculture
- the co-ordination of policy on alternative land use and agricultural planning legislation, including farm diversification
- liaison with the Forestry Commission on agricultural and land use issues.
- policy management of environmentally sensitive areas
- policy management of agricultural aspects of wildlife and landscape conservation

This summary clearly demonstrates the importance of informing government departments of the conservation importance of headwaters and the way in which their successful management is dependant upon national policy issues.

- **as part of the requisite process of liaison between the DoE and the NRA, the Authority should inform the department of the findings of their research programme on headwaters, how these relate to national and European legislation, and of the need to best monitor and manage these watercourses and their biotic assemblages**

Local government also have certain duties and powers which have relevance to a conservation strategy for headwaters.

There principal activities of relevance include

- the production of county and district structure plans including strategic plans for agriculture, conservation, recreation and rural development
- planning control, including statutory consultation with the NRA
- declaration of Local Nature Reserves
- consultees in environment impact assessments, through district Environmental Health Officers (EHOs)

In order to better inform local government:

- **local government officers should receive copies of the headwater summary reports and fact files**

4.1.5 Landowners, managers and tenants

The successful management of headwaters depends on the co-operation of those who own or control the land through which the streams flow, including the Forestry Commission (see section 4.2.11). It is these owners who may operate the critical day-to-day management of these streams and whose activities most need to be directed by the NRA. This co-operation can be better achieved if those people are well informed of the reasons for environmentally sensitive management practices.

Landowners and land managers are best informed through their "trade press", unions and associations, the appropriate advisory services and the NRA.

- **PUBLICITY ON HEADWATERS SHOULD BE SOUGHT THROUGH AGRICULTURAL AND COUNTRY MAGAZINES**
- **publicity on headwaters should be sought through the in-house magazines of the National Farmers' Union and various local and county publications) and the Country Landowners' Association**
- **PUBLICITY ON HEADWATERS SHOULD BE SOUGHT ON SPECIALIST FARMING PROGRAMMES ON TELEVISION**
- **PUBLICITY ON THE USE OF STALLS AND EXHIBITIONS AT LOCAL, COUNTY AND NATIONAL AGRICULTURAL SHOWS AND CONFERENCES**

- **landowners and managers should be provided with fact-files on headwaters on all professional visits by ADAS, FWAG and the NRA and in all appropriate non-contact correspondence with these organisations**

4.1.6 The scientific community

The results of "The Faunal Richness of Headwater Streams" project need to be presented to the wider scientific community in order to promote critical review and more widespread research. This should be achieved by

- **publication in leading scientific journals**
- **publication in semi-populist magazines**

An article presenting the key findings of the study, written in consultation with IFE and NRA by freelance journalist Oliver Tickell, appeared in the July edition of *The Geographical Magazine* (Tickell 1995).

- **presentation of talks at scientific conferences and seminars**

4.1.7 The general public

PUBLIC AWARENESS OF THE STATE OF ENGLISH AND WELSH HEADWATERS SHOULD BE PROMOTED.

In targeting information at the general public wider awareness will also be stimulated in those organisations, associations and individuals discussed in the preceding sections of this chapter.

The obvious routes for disseminating information are:

- **publicity through television**
- **publicity by national and local radio**

Each of these media provides opportunities through specialist countryside and wildlife programmes together with local news broadcasts and magazine programmes.

- **publicity through newspapers**
- **publicity through popular journals, including general interest, geographic, countryside, wildlife or fishing magazines**
- **awareness through education**

This could involve the preparation of software and educational literature, including the fact files for schools and colleges and could be part of a broader package incorporating the NRA's involvement in monitoring and conservation. It could also include visits by NRA staff to schools to give talks to the pupils.

An example of the use of educational material is the nationally produced Key Stage 2 Geography package on Water Sources and the locally produced package on the same subject by Northumbria & Yorkshire NRA for Key Stages 3 and 4 (National Rivers Authority 1994b).

- **awareness through public displays**

This could include exhibitions at craft fayres, museums, country houses, libraries, railway stations and many other public meeting places.

4.2 Collaboration

The process of managing and conserving headwaters should involve a double-headed approach of collaboration and constraint in which the former is applied wherever possible and the latter only where necessary.

This is in line with the NRA cross functional objective of maximising environmental benefit by consultation, collaboration and partnership and their intention to work with partners to pre-empt regulation and encourage voluntary action.

The purpose of developing an awareness of the importance of headwaters amongst its own staff and advisory committees and those departments, organisations, associations and public interest groups considered in section 4.1 is to form a basis for a collaborative and co-operative approach to the management of headwaters which should minimise the need to use of legislative control

- **THE NRA SHOULD SEEK TO DEVELOP PROGRAMMES OF CO-OPERATION AND COLLABORATION WITH LANDOWNERS AND MANAGERS SO AS TO BEST MANAGE HEADWATERS WITHOUT THE USE OF LEGAL CONSTRAINT**
- **THE NRA SHOULD ENCOURAGE AND COOPERATE WITH OTHER GOVERNMENTAL AND NON-GOVERNMENTAL ORGANISATIONS IN ORDER TO BEST MANAGE AND CONSERVE HEADWATERS WITHOUT THE USE OF LEGAL CONSTRAINT.**

4.2.1 Collaboration between the NRA and its statutory advisory committees

The central importance of catchment management plans to the business needs of the NRA and the increasingly important role the members of the statutory advisory committees play in developing, implementing and monitoring them was referred to in section 4.1.1.

The Catchment Management Plans Monitoring Groups comprising professional NRA staff and members of the statutory advisory committees therefore play a critical role in implementing national headwater management strategies at an individual catchment level.

- **THE NRA AND ITS STATUTORY ADVISORY COMMITTEES SHOULD WORK TOGETHER TO BEST IMPLEMENT NATIONAL HEADWATER STRATEGIES AT INDIVIDUAL CATCHMENT LEVELS**
- **the effectiveness of catchment-management plans at safeguarding the environmental quality of headwaters and the conservation of their flora and fauna should be subject to regular review by the Catchment Management Plans Monitoring Groups**

- **the statutory advisory group should act as an important communication link between the NRA and landowners and land managers in order to best implement catchment management plans on a collaborative basis**

4.2.2 Collaboration between the NRA and landowners and land managers

The NRA Pollution Control Officers are in frequent contact with landowners during their regular work. This often involves drawing attention to potential problems in headwaters and advising on ways of overcoming them.

The priority actions recommended here are already part of the routine practice of Pollution Control Officers. The new information which has become available on the conservation value of headwaters and the extent of the current degradation of their biological condition will be of benefit to them in carrying out these duties which include:

- **directing regular attention towards monitoring potential or actual agricultural threat to headwaters**
- **where land management practices are observed to be detrimental to the best interest of headwaters, discussing these with farmers and informing them of the problems facing headwaters generally and on their own land in particular**
- **using farm visits to advise on best agricultural practices to avoid degrading headwaters and procedures for remediating current problems**
- **drawing attention to the importance, particularly to small watercourses, of maintaining or creating 10m buffer zones alongside the length of watercourses**
- **supplying farmers with the relevant NRA Pollution Prevention Guidelines**
- **advising farmers of the various grant and incentive schemes available to support good land management practices**
- **helping farmers to develop voluntary plans of action to remediate current problems and to avoid future degradation of watercourses**
- **encouraging farmers to contact both ADAS and FWAG in order to seek further advice on development of these good land use management plans**

In addition to these normal duties:-

- **headwater fact files should be supplied to farmers in order to reinforce the purpose of the visit**

To emphasise the importance of the findings of the headwaters research programme:-

- **THE NRA SHOULD MOUNT SPECIAL REGIONAL CAMPAIGNS DIRECTED TOWARDS BETTER MANAGEMENT OF HEADWATERS BY FARMERS THROUGH VOLUNTARY PLANS OF ACTION**

4.2.3 Collaboration between the NRA and the National Farmers' Union and the Country Landowners Association

The NRA should consolidate contact with individual farmers by building on their existing liaison and collaboration with the National Farmers' Union (NFU) and the Country Landowners Association (CLA).

National Farmers' Union

Collaboration between the NRA and the NFU is seen as a productive mechanism for encouraging ecologically sound agricultural practices to protect headwater streams. An example of such collaboration is the on-going discussions between the two organisations and MAFF to promote economic development and improved management of water resources in the agricultural sector (National Rivers Authority 1994b).

- **the NRA should seek endorsement from the NFU for its measures to protect headwaters and conserve their fauna and flora**
- **the NFU should be encouraged to disseminate information through its journals, newsletters, the farming press, the general media, public exhibitions and conferences on the importance of protecting headwaters and the manner by which this can be achieved**

Country Landowners Association

- **the NRA should seek the same collaboration with the CLA as with the NFU**

4.2.4 Collaboration between the NRA and the agricultural advisory organisations

Both the Agricultural Development and Advisory Service (ADAS) and the Farming and Wildlife Advisory Group (FWAG) offer specialist advice to farmers on best practices to maintain a balance of sound ecological management and sustainable economic production.

Agricultural Development and Advisory Group

ADAS is an agency of MAFF operating as an increasingly self-financing advisory service to the agricultural industry. A core element of their business activities is the provision of free advice to farmers on the prevention of pollution (Agricultural Development and Advisory Service 1995).

The ADAS service is provided by experienced professional staff with extensive knowledge of their subject and a well developed awareness of the risks to water quality associated with various forms of agricultural activity. The services they offer will already take account of those activities likely to be detrimental to waterbodies of all types, including headwaters.

However, the information now to hand on the general biological condition of headwaters and their importance to the maintenance of catchment biodiversity will be of importance in their dialogues with farmers. An appreciation of the need for pollution control, and an understanding of the ecological consequences of not doing so, are seen as important components of convincing farmers to modify and improve their land management practices.

- **the NRA need to fully inform ADAS of the findings of their research programme on headwaters, with particular reference to the most damaging agricultural activities**
- **the NRA need to maintain effective liaison and collaboration with ADAS to ensure that the latter's clients are informed of the rationale for managing their activities so as to best protect headwaters and conserve their fauna**
- **ADAS should be encouraged to produce their own fact files on the conservation importance of headwaters and the potential impact of poor land management practices upon them**
- **THE NRA AND ADAS SHOULD MOUNT JOINT, OR COMPLEMENTARY, EXHIBITIONS ON THE CONSERVATION AND MANAGEMENT OF HEADWATERS FOR DISPLAY AT AGRICULTURAL SHOWS AND EVENTS**
- **the NRA and ADAS should undertake joint research on the best agricultural practices to maintain or restore the biological condition of headwater streams**

Existing mechanisms which may provide a framework for joint research exist through various grant and incentive schemes and specially protected areas schemes. In particular the recent Water Fringe Areas (WFA) scheme provides financial incentives to farmers to develop riparian zones in arable land or less intensive use of riparian pasturer as a means of environmental protection for watercourses. The cost-effectiveness of this approach could be experimentally tested on headwaters in areas where extensive take-up of the scheme occurs.

- **ADAS AND NRA SHOULD ACTIVELY WORK TOGETHER TO ENCOURAGE LANDOWNERS TO PARTICIPATE IN THE WATER FRINGE AREAS SCHEME AND JOINTLY MONITOR THE ECONOMIC AND ENVIRONMENTAL BENEFITS OF THE SCHEME**

Other protected areas where the impact of the measures on the biological condition of headwaters could be tested are Nitrate Vulnerable Zones and Nitrate Sensitive Areas, set up under the terms of the Council of the European Union directive on pollution caused by nitrates from agricultural sources, Environmentally Sensitive Areas and in the Country Stewardship Scheme areas implemented through the national conservation agencies.

- **ADAS should be encouraged to include headwater policy statements in any corporate strategy documentation they produce**

Farming and Wildlife Advisory Group

The Farming and Wildlife Advisory Group (FWAG) is a independent charitable organisation receiving funding from a variety of sources. Like ADAS, it advises farmers on good ecological practice on agricultural land.

They have a particularly important relationship with the farming community who value their independence and the farming background of many of their staff. They also value the environmentally and economically sound, practical solutions the Group offers. For example their ability to demonstrate the careful use of fertilisers can both save money and protect the environment (Farming and Wildlife Advisory Group 1995).

The NRA already plays an important role as a funder of FWAG and as a collaborator in special schemes and projects. An example of the effective working partnership developed between the NRA and FWAG, together with the Countryside Commission and the Internal Drainage Board, has been the creation of a 33 million gallon washland in Lincolnshire which is now an outstanding habitat for wetland birds (Farming and Wildlife Advisory Group 1995).

- **the NRA should seek the same form of collaboration with FWAG that is recommended for ADAS**
- **in particular it should build upon the excellent relationship between the two organisations to develop a working partnership to protect headwaters**
- **THE NRA SHOULD PROVIDE MATERIAL AND FINANCIAL SUPPORT TO FWAG SPECIFICALLY TARGETED TOWARDS HEADWATER PROTECTION**
- **THE NRA AND FWAG SHOULD PRODUCE COMMON DISPLAYS AND EXHIBITIONS AT AGRICULTURAL SHOWS AND OTHER MEETING PLACES OF THOSE WHO MANAGE THE LANDSCAPE**

FWAG run a number of special schemes and projects, of which one of the latest is their initiative, "Conservation Means Business". They also produce a series of simple practical booklets of which an example is No. 15 Pond Management.

- **THE NRA AND FWAG SHOULD COLLABORATE TO DEVELOP A HEADWATERS AWARENESS AND PROTECTION INITIATIVE SUPPORTED BY AN INFORMATIVE AND PRACTICAL ADVISORY BOOKLET**

General

In order to be credible to farmers, it is essential that the separate advice they receive from the NRA, ADAS and FWAG should be consistent.

- **A COMMON APPROACH TO THE IMPLEMENTATION OF GOOD HEADWATER MANAGEMENT PRACTICES SHOULD BE DEVELOPED BETWEEN THE NRA, ADAS AND FWAG**

4.2.5 Collaboration between the NRA and the MAFF

The national responsibilities of MAFF were summarised in an earlier section (4.1.4). They included the control of pesticide use in agriculture and the reduction of nutrient and other polluting agricultural inputs to water. This it has done by the production of the "Code of Good Agricultural Practice for the Protection of Water" (Ministry of Agriculture, Fisheries and Food 1991) which was subsequently adopted as a Statutory Code of Practice, Water Prevention of Pollution (Code of Practice) Order 1991 (SI 1991/2285), under the terms of the Water Resources Act 1991.

Further codes and regulations designed to control agricultural pollution of watercourses are The Control of Pollution (Silage, Slurry and Agricultural Fuel Oil) Regulations 1991, Control of Pesticides Regulations 1986 (COPR) and the Control of Substances Hazardous to Health Regulations (COSHH) 1988.

The Code of Good Agricultural Practice for the Protection of Water sets out very detailed and specific advice on the conduct of agricultural activities in order to minimise the risk of pollution of surface and groundwater. Included within the code are many recommendations restricting specific activities and constructions within 10m of any flowing watercourses and drains. Even stricter recommendations are made in relation to undertaking many of these activities in the proximity of springs, wells and boreholes.

In the code it is also stated that dirty water of various kinds should not be discharged into watercourses. The code also provides instructions on application rates for organic and artificial fertilisers and pesticides and on the safe disposal of these items and dairy and other farm wastes.

At many points in the code the practitioner is referred to the specific role played by the NRA in regulating these codes and offering practical advice and more detailed information on their implementation.

The Minister of Agriculture, Fisheries and Food also has the powers, under section 94 of the Water Resources Act and as set out in the Nitrate Sensitive Areas (Designation) Order 1990 (SI 1990/1013), as amended, to designate certain catchments as Nitrate Sensitive Areas (NSAs). According to the Code of Good Agricultural Practice for the Protection of Water, paragraph 261 (Ministry of Agriculture, Fisheries and Food 1991) the NRA are responsible to MAFF for suggesting areas for designation as the NSAs.

At present the scheme has been introduced into England under the EC (Council of Europe) Agri-Environment Regulation which aims to encourage farmers to implement their own measures to conserve the rural environment (Ministry of Agriculture, Fisheries and Food 1994). Under its terms farmers in selected areas of the country, currently 22, receive payments for voluntarily helping to control the levels of nitrate entering surface and groundwaters through restrictions in their agricultural activity.

- **the NRA and MAFF should collaborate in the implementation of the Nitrate Sensitive Areas scheme by joint encouragement of farmers to participate, by joint monitoring of the effectiveness of the scheme with special reference to participant uptake and nitrate levels in headwaters and by considering any other such areas as are appropriate to designate under the scheme**
- **THE NRA AND MAFF SHOULD CONTINUE TO WORK TOGETHER TO PROMOTE THE SOUND MANAGEMENT PRINCIPLES OUTLINED IN THE CODE OF GOOD AGRICULTURAL PRACTICE FOR THE PROTECTION OF WATER**
- **THE DETAILED GUIDELINES FOR THE PREVENTION OF POLLUTION TO WATERCOURSES PROVIDED BY THE CODE SHOULD FORM THE BASIS OF THE NRA'S OWN STRATEGY ON THE PROTECTION OF HEADWATERS IN AGRICULTURAL CATCHMENTS**
- **the NRA and MAFF should constantly review the Code in the light of new research findings and issue revised editions and/or seek to have the statutory code amended where this is justified by the new information**
- **THE NRA AND MAFF SHOULD JOINTLY PROMOTE FURTHER RESEARCH TO VALIDATE AND IMPROVE EXISTING STRATEGIES FOR PROTECTING HEADWATERS IN AGRICULTURAL CATCHMENTS**

4.2.6 Collaboration between the NRA and the DoE

The national responsibilities of the DoE were outlined in section 4.1.4. More detailed consideration of these powers follows in subsequent sections and only those powers relating to a collaborative policy of headwater protection are discussed here.

Under the Water Resources Act 1991, as amended by the Surface Waters (Dangerous Substances) (Classification) Regulations 1992 (SI 1992/337) the Secretary of State has the power to set strict water quality objectives for relevant inland freshwaters. These shall be related to the purposes to which the water is put, the substances to be regulated and the special characteristics of the waters.

The Secretary of State and the NRA are jointly responsible for the achievement of the objectives and NRA's duty is to develop water quality standards to allow the set objectives to be complied with. The possibility exists that these objectives be made statutory and require biological, as well as chemical, standards.

- **THE NRA AND THE DOE SHOULD UNDERTAKE THE NECESSARY RESEARCH TO OBTAIN RIGOROUS SCIENTIFIC CRITERIA FOR THE SETTING OF WATER QUALITY OBJECTIVES FOR HEADWATERS, WITH PARTICULAR RESPECT TO THE FORTHCOMING COUNCIL OF THE EUROPEAN UNION DIRECTIVE ON THE ECOLOGICAL QUALITY OF WATER**

These WQOs should also take full account of the additional obligations placed on the Department and the Authority by existing Council of the European Union's directives on the discharge of dangerous substances (76/464/EEC), the quality of freshwaters needed to support fishlife (78/659/EEC), the protection of groundwater (80/68/EEC), the quality of water for human consumption (80/778/EEC) and urban waste water treatment (91/271/EEC).

Similarly, the Secretary of State, after consultation with the NRA, may set up Water Protection Zones in which activities which may result in pollution of controlled waters are either prohibited or restricted. The Secretary of State may empower the NRA to decide what activities, under what circumstances may be carried on in a Water Protection Zone.

- **the NRA should collaborate to develop a common policy for using Water Protection Zones for the welfare of headwater streams and the nature of practices which need to be regulated in order to best achieve acceptable biological conditions**

The directive on the uses of nitrates in agriculture also needs to be considered in liaison with MAFF who also exercise the power to prevent or control the entry to water of nitrates from agriculture through the designation of nitrate sensitive areas.

The Department of the Environment also has the responsibility for implementing the Council of the European Union directive on the conservation of natural habitats and of wild fauna and flora. The NRA is not the UK competent authority for this directive which is vested in the statutory conservation agencies but it is in a position to advise both the agencies and DoE.

- **THE NRA SHOULD LIAISE WITH THE DEPARTMENT AND WITH THE STATUTORY CONSERVATION AGENCIES TO SEEK THE WAYS IN WHICH THE ARTICLES OF THE COUNCIL OF THE EUROPEAN UNION'S DIRECTIVE ON THE CONSERVATION OF NATURAL HABITATS AND OF WILD FAUNA AND FAUNA MAY BE BEST IMPLEMENTED, THROUGH STATUTE AND RESEARCH, IN ORDER TO ENSURE THE PROTECTION OF BRITISH HEADWATERS AND THE RARE AND ENDANGERED TAXA THEY SUPPORT**

Article 5 of the directive specifically refers to the establishment of a coherent European ecological network of special areas of conservation entitled Natura 2000. This network is to comprise sites hosting natural habitats or individual species listed in annexes to the Directive. Member States are required to contribute to the network of sites comprising Natura 2000.

At present none of the site types listed for inclusion in the network include any type of British headwater nor any rare, vulnerable or endangered taxa specifically associated with British headwaters.

- **the NRA, DoE and the statutory British conservation agencies should work together to seek an amendment to the Directive to incorporate types of British headwaters which they see fit to recommend by virtue of their special habitat qualities or the importance of the taxa associated with them and themselves worthy of inclusion in the annexes to the Directive**

Other ways in which the NRA may collaborate with the conservation agencies are given in the following section.

4.2.7 Collaboration between the NRA and conservation bodies

The statutory conservation agencies

The roles of the statutory agencies for England and Wales, English Nature and the Countryside Council for Wales were discussed in section 4.1.2.

Their remit empowers them to designate certain areas as National Nature Reserves or Sites of Special Scientific Interest. Implicitly this requires the designation of a balanced range of protected areas covering all principal habitat types and biotic assemblages, together with the special protection required by individual rare or endangered species.

Information provided by English Nature (section 1.6) shows that few English or Welsh headwaters are in designated SSSIs, either specifically because of the characteristics of the stream or because they are in an SSSI designated because of other, non-aquatic criteria.

- **THE NRA AND THE CONSERVATION AGENCIES SHOULD WORK TOGETHER TO EXTEND THE COVERAGE OF HEADWATERS RECEIVING CONSERVATION PROTECTION**
- **EACH CONSERVATION AGENCY SHOULD BE ENCOURAGED TO INCLUDE A HEADWATER POLICY STATEMENT IN THEIR CORPORATE STRATEGY DOCUMENTATION AND INITIATE HEADWATER PROTECTION PROGRAMMES AS OBJECTIVES IN THEIR ANNUAL WORK PLANS**
- **each agency should promote the importance of headwaters in spoken and written presentations of their work at public meetings, seminars, scientific conferences and liaison with other organisations**
- **THE NRA AND THE CONSERVATION AGENCIES SHOULD COLLABORATE TO SEEK THE INCLUSION OF HEADWATERS AS A SPECIAL CATEGORY IN THE UNITED KINGDOM BIODIVERSITY ACTION PLAN AND THUS DRAW ATTENTION TO THEIR CONTRIBUTION TO FAUNAL BIODIVERSITY AND THE POTENTIAL THREAT THEY ARE SUSCEPTIBLE TOO DUE TO AGRICULTURAL AND OTHER ACTIVITIES**

County Wildlife Trusts

Most, if not all, English and Welsh counties have their own wildlife trust, although the form of their title may vary by more than just their different county names.

Each of these organisations will have a role to play in cataloguing and protecting the wildlife of their county. A common recent development has been the establishment of County Wildlife Site Liaison Officers, sometimes known as Sites of Nature Conservation Interest Liaison Officers. The job of these officers has been to identify other areas of conservation interest than those receiving statutory protection as Nature Reserves or SSSIs.

Data are acquired by the officers through field surveying and the data obtained are considered by the members of the trust, local government officers and the conservation agencies. Those considered worthy are designated as Sites of Nature Conservation Interest (SNCI).

Although these sites have no statutory status or legal protection the Liaison Officers then try to work in collaboration with the landowners for each SNCI to best manage them to maintain and enhance their wildlife interest. This may include practical help and advice on potential sources of grant aid.

The existence of the SNCI system provides further opportunities for the NRA to participate in schemes to protect and enhance headwaters.

- **THE NRA SHOULD ACTIVELY COLLABORATE WITH THE COUNTY WILDLIFE TRUSTS IN ORDER TO IDENTIFY POTENTIAL SITES FOR DESIGNATION AS SNCIs**
- **the County Wildlife Trust should develop strategic plans for the incorporation of headwaters in their network of designated sites**
- **the NRA Conservation Officers should assist County Wildlife Trusts in offering practical help in managing sites designated as SNCIs**
- **WHERE CONSIDERED COST EFFECTIVE, THE NRA SHOULD PROVIDE ADDITIONAL MATERIAL AND FINANCIAL SUPPORT FOR THE WORK OF THE COUNTY WILDLIFE SITE LIAISON OFFICERS**

4.2.8 Collaboration with Local Government

Local Authorities have the opportunity to influence the protection of headwaters in two important areas. Firstly, they may do so through the powers they are granted under the Town and Country Planning Acts of 1971 and 1990 to refuse permission to undertake any development of land or the carrying out of any unauthorised operations on any land. This system was designed to prevent environmental degradation rather than to remediate any degradation after it had occurred.

The NRA are statutory consultees in the planning process whose opinion must be sought by local government officers.

- **THE NRA AND THE ASSOCIATION OF LOCAL PLANNING OFFICERS SHOULD ESTABLISH AND DISSEMINATE COMMON GUIDELINES FOR THE GRANTING OR REFUSAL OF PERMISSION FOR DEVELOPMENTS WHICH MIGHT IMPACT UPON THE BIOLOGICAL CONDITION OF HEADWATERS**

The NRA are also statutory consultees for certain Environmental Impact Assessments (EIAs). The statutory need for EIAs for development projects likely to have significant environmental effects is a consequence of the Council of the European Directive on the assessment of the effects of certain public and private works on the environment (85/337/EEC).

- **where a development, designated as requiring an environmental impact assessment, may have impact upon headwaters then the common guidelines should clearly state the scope of the EIA in relation to these waters**

Under Section 21 of the National Parks and Access to the Countryside Act 1949, the Local Authorities also have the power, in statutory consultation with the national conservation agency, to declare an area as a Local Nature Reserve. In order to do so the site must have special local value and to be on land which the Authority has a legal interest in.

In recent years there has been a substantial increase in the number of sites declared as LNRs. At the end of 1994 there were 393 of them in England alone (English Nature 1994).

- **THE NRA SHOULD LIAISE WITH LOCAL AUTHORITIES TO PROMOTE OPPORTUNITIES TO DESIGNATE HEADWATERS, OR AREAS CONTAINING HEADWATERS, IN GOOD BIOLOGICAL CONDITION AS LOCAL NATURE RESERVES WHERE THE AUTHORITY HAS LEGAL INTEREST IN THE LAND THROUGH WHICH THE STREAMS FLOW**

4.2.9 Collaboration between the NRA and the Water Undertakings

Many headwaters are in receipt of effluent waters from sewage and waste water treatment works operated by the regional and local water undertakings. Some of the works may not be operating as efficiently as required to maintain the good biological condition of the streams.

- **THE NRA AND THE WATER COMPANIES SHOULD WORK TOGETHER TO FORMULATE AND IMPLEMENT A SPECIAL CAMPAIGN TO IMPROVE ALL SEWAGE AND WASTE WATER TREATMENT WORKS WHOSE EFFLUENT MAY BE LIABLE TO DEGRADE THE BIOLOGICAL CONDITION OF HEADWATERS**

4.2.10 Collaboration with the Countryside Commission

The Countryside Commission is a non-governmental organisation whose remit in England is threefold;

- to promote conservation
- to enhance the natural beauty of the countryside
- to encourage the provision of access to the countryside for informal recreational activities.

The Commission also advises the government on all issues relating to the countryside. In Wales, under the terms of the Environmental Protection Act 1990 these duties are carried out by the Countryside Council for Wales.

In the exercise of their responsibilities the Commission acts as a statutory consultee in all developments requiring an environmental assessment.

- **the NRA and the Countryside Commission should develop common guidelines for protecting the environmental quality of headwaters likely to be impacted by developments requiring an Environmental Assessment**
- **the NRA should encourage the Countryside Commission to include a headwaters protection policy in their corporate strategy**

4.2.11 Collaboration between the NRA and the Forestry Commission

Under the terms of the Forestry Act 1967, the Forestry Commission is the government department with responsibility for forestry in Great Britain. The Act places a duty on the Commission to endeavour to seek a balance between its forestry functions and the conservation of flora and fauna.

Their obligations towards flora and fauna include aquatic as well as terrestrial assemblages. In seeking to exercise their responsibilities the Commission have published a detailed set of guidelines for the protection of waters from detrimental impact of forestry activities (Forestry Commission undated).

The guidelines directly acknowledge the importance of headwater streams, about which it is stated:

The water flowing from small headwater streams has a major effect on water quality and habitat downstream. These small streams and their catchments must be well managed if forests, fisheries, wildlife and other uses are to coexist.

They are easily altered by man and are very responsive to changes along their banks. ... Management of the riparian zones must be sensitive and well planned, because they are fragile and water quality and habitat are both easily damaged.

In order to best protect streams the guidelines make detailed recommendations many of which are specific to a particular type of forestry activity. More generally the Commission recommend the development of bankside protection zones where no forestry activity takes place. In the case of headwaters it is recommended that these zones be a minimum of 5m wide and should leave at least 50% of the stream open to direct sunlight. The Guidelines also include recommendations on the landscape design of protection zones and the best sorts of trees to plant in these zones to maintain appropriate shading and ground vegetation.

It is further recommended that drains and cultivation furrows should be stopped well short of watercourses in order to prevent solids from entering and silting watercourses. Where this cannot be achieved the drainage channels should be fitted with settling pools or silt traps to intercept debris and sediments.

- **the NRA and the Forestry Commission should continue to work together to promote the sound management principles outlined in the Commission's Guidelines on Forest and Water**
- **THE DETAILED GUIDELINES FOR THE PROTECTION OF HEADWATERS PROVIDED BY THE COMMISSION SHOULD PROVIDE A WORKING BASIS OF THE NRA'S OWN STRATEGY ON THE PROTECTION OF HEADWATERS IN FORESTED AREAS**

- **the NRA and the Commission should constantly review the Guidelines for Forests and Water in the light of new research findings and issue revised editions where this is warranted in the light of new information**

The adoption of a consistent 10m protection zone, as recommended by MAFF in their Code of Good Agricultural Practice for the Protection of Water (Ministry of Agriculture, Fisheries and Food 1991), should be one of the items considered.

- **the NRA and the Forestry Commission should seek to jointly promote further research to validate and improve existing strategies for protecting headwaters in forested catchments**

4.2.12 Collaboration between the NRA and the National Parks

In total there are ten National Parks in Great Britain of which seven are in England and three in Wales. Their total area is approximately 13,600 km². The Norfolk Broads also have a designated status equivalent to that of the National Parks. By virtue of their size the parks will inevitably contain a broad range of headwaters. Their location, in some of Britain's most beautiful and often most natural landscapes means that many of these streams will be in very good biological condition.

Much of the land in the National Parks is still privately owned and farmed but each Park is under the control of a Park Authority who manage its development through their own internal regulatory powers. Through sympathetic management they have the powers to promote the best biological condition of headwater streams. The Park Authorities are therefore in a strong position to assist the NRA in developing and testing a headwaters protection strategy.

- **THE NRA AND THE NATIONAL PARKS AUTHORITIES SHOULD INCORPORATE A PROGRAMME FOR THE PROTECTION AND REMEDIATION OF HEADWATER STREAMS IN THE MANAGEMENT STRATEGY OF ALL NATIONAL PARKS**
- **the NRA and the Parks Authority should jointly seek to implement the programme through securing the voluntary agreement and commitment of landowners and land managers**
- **the NRA should be advise and encourage Parks Authorities to set such internal regulations as necessary to promote the welfare of headwaters**
- **the NRA and individual Parks Authorities should collaborate to undertake a programme of experimental research programmes to test different aspects of the conservation and remediation of headwaters**

Examples of relevant strategic research programmes include those directed towards an understanding of

- the factors governing species distribution and bio-diversity and the impact upon these of differing management regimes
- role played by bracken management in regulating the quality of moorland headwaters

4.2.13 Collaboration between the NRA and other conservation and wildlife organisations and societies

A wide variety of professional and voluntary conservation and wildlife organisations, including environmental pressure groups, have genuine interests in the protection of headwaters and their fauna and flora. Most of these are listed in Table 4.1.

Many will have their own national or local action programmes and their own in-house magazines and/or publicity material. Contributions from their officers and members to conservation and wildlife magazines, exhibitions, field centres and museums will be commonplace. The organisations are well placed to publicise the need to protect headwaters and to promote public and political interest in the conservation of their flora and fauna.

- **the NRA should collaborate with a wide variety of conservation and wildlife organisations to promote national concern for the well-being of headwaters**
- **the NRA should encourage the organisations to publicise the problems facing headwaters in their in-house journals and brochures, national magazines and static and mobile exhibitions**
- **where the organisations have their own corporate strategy the NRA should encourage them to incorporate policy statements on headwaters as far as they relate to the special interests of the organisation**

4.3 Control

In the preceding sections a policy of awareness, collaboration and voluntary action is presented as the preferred way forward in protecting headwaters in a manner which is sensitive to the economic needs of the land owners and managers. The advisory roles of the NRA, ADAS, FWAG and the Forestry Commission are seen as crucial to this strategy and each already offers codes of good land management practice. These advisory services are generally free, at least at the point of initial contact and development of land management plans.

- **WHEREVER POSSIBLE THE NRA SHOULD SEEK TO PROMOTE THE WELFARE AND CONSERVATION OF HEADWATERS THROUGH PROGRAMMES OF AWARENESS AND VOLUNTARY ACTION**

However voluntary agreements do not cover all eventualities and there will be occasions where statutory control needs to be exercised in order to best safeguard headwaters.

- **WHERE EDUCATION AND VOLUNTARY ACTION ARE INSUFFICIENT TO PROTECT HEADWATERS AND THEIR BIOTA THEN THE NRA SHOULD TAKE ALL NECESSARY STATUTORY AND LEGISLATIVE STEPS IN ORDER TO ACHIEVE THEIR OBJECTIVES**

A wide variety of European and national legislation is available if required, supported by ancillary codes, regulations and bye-laws. These are outlined here in relation to specific land and water resource management activities.

4.3.1 Planning Control

The NRA are statutory consultees in the local planning process under the terms of the Town and Country Planning Acts of 1971 and 1990. Their remit is to ensure that the development proposals will not lead to the environmental degradation of any controlled water.

One of the statutory grounds for objection is thus that the development is liable to be detrimental to the biological condition of a controlled water.

- **THE NRA SHOULD FULLY EXERCISE THE POWERS GRANTED TO THEM UNDER THE TOWN AND COUNTRY PLANNING ACTS OF 1971 AND 1990 TO OBJECT TO ANY PROPOSED DEVELOPMENT WHICH IS LIKELY TO HAVE UNACCEPTABLE CONSEQUENCES FOR THE BIOLOGICAL CONDITION OF ANY HEADWATER STREAM, DRAIN OR DITCH**
- **the NRA should seek to limit or prevent any part of a proposed development which is within 10m of any headwater stream and to general restrict developments within 20m of any such watercourse**
- **THE NRA SHOULD INCLUDE A SPECIFIC HEADWATER SECTION IN THE PLANNING LIAISON STANDARD PARAGRAPHS BEING DEVELOPED AT REGIONAL AND NATIONAL LEVEL OR SPECIFIC HEADWATER RELATED PARAGRAPHS IN OTHER INDIVIDUAL SECTIONS**

The NRA also act as statutory consultees in all Environmental Impact Assessments which are deemed, under Article 18 of the Town and Country Planning General Development Order 1988 (SI 1988/1813), to be relevant to its interests (see section 4.2.8 of this report). These interests are again to prevent environmental degradation of any controlled surface or ground water.

- **THE NRA SHOULD FULLY EXERCISE THE POWERS GRANTED TO THEM TO OBJECT TO ANY ENVIRONMENTAL IMPACT ASSESSMENT OR STATEMENT WHICH FAILS TO OFFER ADEQUATE PROTECTION OF THE BIOLOGICAL CONDITION OF ANY HEADWATER LIABLE TO BE AFFECTED BY A PROPOSED DEVELOPMENT**

4.3.2 Control of waste storage and disposal

The small discharge and hence dilution potential of headwaters makes them particularly vulnerable to pollution by organic run-off from material and chemicals applied to the land.

Several acts, orders and regulations relate to the safe storage and disposal of organic agricultural waste products and these will need to be enforced where remediation and improved practice cannot be achieved by voluntary agreement.

The principal control of the storage and application of slurry is defined under the Control of Pollution (Silage, Slurry and Agricultural Fuel Oil) Regulations 1991. The power to create such regulations is vested in the Secretary of State for the Environment under section 92 of the Water Resources Act 1991. The Secretary may make such regulations in order to prescribe precautions to be taken in the custody or control of noxious or polluting matter and to grant a power to the NRA to require precautions to be taken in the custody or control of such matter.

If the NRA believes that poisonous, noxious, polluting matter or solid waste is entering or is likely to enter controlled waters it may carry out its own work to control the discharge and ameliorate its effects. This work can include preventing the pollutant from entering the water, removing or disposing of the matter, remedying or mitigating the pollution and restoring the water and its biota.

The NRA may recover, from the polluter, any reasonable charge incurred in carrying out the work. It may also require the polluter, or potential polluter, to undertake such work as is necessary to improve the design of waste storage containers and other such constructions.

Other regulations governing the storage and disposal of waste material are the Sludge (Use in Agriculture) Regulations 1989, concerning the application of sewage sludge onto agricultural land and the Meat (Sterilisation and Staining) Regulations 1982 which control and/or prevent the spreading of untreated abattoir waste on agricultural land. Many of the terms and clauses of these regulations are summarised in the Code of Good Agricultural Practice for the Protection of Water.

Although contravention of the code does not, of itself, give rise to a criminal or civil liability, the NRA must take it into account when exercising its powers to impose relevant prohibitions and any other powers it is granted concerning precautions to be taken in the custody or control of poisonous, noxious or polluting matter.

Many of other powers the NRA is granted relate to those Water Protection Zones. The Secretary of State may declare such Zones after consultation with the Minister of Agriculture, Fisheries and Food. The NRA act as advisors to the Secretary of State on suitable areas for designation.

- **THE NRA SHOULD IDENTIFY THOSE HEADWATER CATCHMENTS THAT IT DEEMS IN NEED OF SPECIAL PROTECTION FROM POLLUTION FROM AGRICULTURAL WASTE PRODUCTS AND EXERCISE ITS DUTY OF CONSULTATION WITH THE SECRETARY OF STATE FOR THE ENVIRONMENT IN ORDER TO INFORM HIM OF THE CASE FOR DESIGNATING THOSE CATCHMENTS AS WATER PROTECTION ZONES**

The activities which the NRA are given the power to control in headwater protection zones should include the exclusion of all waste storage and disposal practices, including the application of waste for purposes of fertilisation, within 10m of any watercourse as described in the Water Prevention of Pollution (Code of Practice) Order 1991

The power to prosecute those who allow pollutants to enter controlled waters is provided in Section 85 of the Water Resources Act 1991. Under this section it is an offence to cause or knowingly permit:

- poisonous, noxious or polluting matter, or any solid waste matter, to enter controlled waters
- matter, other than trade or sewage effluent, to enter controlled waters by being discharged from a drain or sewer in contravention of a relevant prohibition
- any matter to enter inland waters so as to tend, directly or in combination with other matter, to impede the flow of the waters in a manner leading, or likely to lead to a substantial aggravation of pollution

Other powers of prosecution are defined under Section 41 (1) of the Salmon and Freshwater Fisheries Act 1975 which states that:

- any person who causes or knowingly permits to flow, or puts or knowingly puts or permits to be put into any waters containing fish or into any tributaries of waters containing fish, any liquid or solid matter to such an extent as to cause the waters to be poisonous or injurious to fish or the spawning grounds, spawn or food of fish, shall be guilty of an offence

4.3.3 Control of nitrates

Nitrates may enter water through the agricultural waste products mentioned above, such as slurry, solid manure and various forms of dirty water. However, its chief source in most catchments is through the application of artificial fertilisers to the land.

Many of the powers, codes, and acts of law available to control the entry of nitrates into headwaters are the same as those outlined in the previous section (4.3.2) together with those sections of the (Silage, Slurry and Agricultural Fuel Oil) Regulations 1991. The same form of recommendations apply as to the control of agricultural waste products:

In addition to the general means of controlling agricultural waste material other special powers permit the control of nitrates in water. The function exercised by the NRA in relation to Nitrate Sensitive Areas (NSAs) has already been discussed in section 4.2.5 and currently involves voluntary agreements operating between farmers and MAFF. No special regulatory or statutory powers are presently available to police the operation of the Scheme.

As part of the implementation of the Council of the European Union directive concerning the protection of waters against pollution by nitrates from agricultural zones (91/676/EEC), the NSA scheme will be gradually be phased out by the implementation of Nitrate Vulnerable Zones.

Like the NSAs, the NVZs are areas where the nitrate concentrations in sources of public drinking water exceed, or are at risk of exceeding, the limit of 50 mg l⁻¹ laid down in the Council of the European Union directive on the quality of water intended for human consumption. All existing NSA's have been or will be designated as NVZs.

The principal difference between NSAs and NVZs is that, whereas the former involved the adoption of voluntary, compensated actions by farmers to control nitrates, the NVZs will be subjected to mandatory, uncompensated measures.

- where necessary the NRA should enforce the regulations controlling the implementation of Nitrate Vulnerable Zones

4.3.4 Control of agri-chemical use

In addition to artificial and organic fertilisers a wide variety of other chemicals are widely applied in normal agricultural activity. These are predominantly, but not exclusively, pesticides, herbicides and fungicides. Other categories include hydro-carbon fuels, metals such as copper and zinc in foodstuffs and cleaning and sterilising agents.

Where these enter watercourses as noxious, poisonous or polluting substances then the polluter is again subject to prosecution under section 85 of the Water Resources Act 1991. The best practices for the use of these substances is also outlined in the Water Prevention of Pollution (Code of Practice) Order 1991. Their use may also be regulated in Water Protection Zones.

Other regulations and statutes governing the use of pesticides include Part III of the Food and Environmental Protection Act 1985, the Control of Pesticides Regulations 1986 and the Control of Substances Hazardous to Health Regulations 1988.

In addition, many commonly used agri-chemicals are subject to the terms of the Council of the European Union directive on pollution caused by certain dangerous substances discharged into the aquatic environment of the community and many of its "daughter" directives (e.g. 85/513/EEC, cadmium; 86/491/EEC, lindane; 86/280/EEC, DDT and 88/347/EEC, aldrin and dieldrin).

The directives refer to two categories of substances, List I or "Black List" substances and List II or "Grey List" substances. The directive requires that pollution by "Black List" substances be eliminated and that by "Grey List" substances be reduced.

In the United Kingdom the directives were implemented through the Water Act 1989 and consolidated through the Water Resources Act of 1991. This requires that statutory water quality objectives are defined for all List I substances and that pollution reduction programmes, with timetables, are established for List II substances.

- **the NRA should rigorously enforce all statutory water quality objectives (SWQOs) for headwater streams, relating to the Council of the European Union Directive and allied directives on certain dangerous substances, as implemented in UK law, and seek to establish suitable SWQOs for other headwaters where such provision has yet to be made**
- **THE NRA SHOULD UNDERTAKE SUCH MONITORING AND RESEARCH AS TO BEST BE ABLE TO ADVISE ON APPROPRIATE SWQOs FOR HEADWATER STREAMS IN RESPECT OF BOTH LIST I AND LIST II SUBSTANCES AS SET OUT IN THOSE DIRECTIVES**

Further information on the UK's implementation of the dangerous substances Directive is given in DoE circular 7/89, Water and the Environment.

4.3.5 Control of groundwater quality

Many of the chemicals and organic waste products used in agriculture are vulnerable to leaching into groundwater. The degree of vulnerability will depend upon many factors including concentration of application, soil type, soil saturation, degree of land drainage management, aspect of the land and state of vegetation cover.

Headwaters are likely to be particularly responsive to polluted groundwater supplies because, for many of them, much of their baseflow emanates from spring sources.

Underground waters are deemed "controlled waters" and pollution of them is also liable to prosecution under section 85 of the Water Resources Act 1991. Strong recommendations for the protection of groundwaters are also set out in the Water Prevention of Pollution (Code of Practice) Order 1991. In that Order, based on the Code of Good Agricultural Practice for the Prevention of Pollution of Water many practices are deemed inappropriate within 50m of any spring, well or borehole. Whilst this is primarily designed to protect drinking water it also affords an increased measure of safeguard of groundwaters.

The protection of groundwaters is also addressed by a specific Council of the European Union directive on the protection of groundwater against pollution caused by certain dangerous substances. This directive also provides for List I and List II substances.

In this case Member States are required to take necessary steps to prevent discharges to groundwaters of List I substances by prohibiting direct discharges, investigate and, where necessary prohibit, those tipping for disposal activities which may involve indirect discharge and take appropriate measures to prevent indirect discharges from other activities.

With respect to List II substances all direct discharges and tipping for disposal or other disposal shall be investigated and authorization to proceed only granted where it can be shown that all technical precautions are taken to protect groundwaters.

Guidance on the implementation of this directive in the UK is given in two DoE circulars; 4/82 and 20/90. As of 1992 the UK government was intending to update and expand these circulars and to give legal force to the guidance contained in them.

- **the NRA should rigorously enforce any existing legislation relating to the Council of the European Union directive 80/68/EEC in order to prevent pollution to groundwaters supplying baseflow to headwater streams**
- **the NRA should take adequate monitoring to ensure effective compliance with any conditions attached to authorised discharges and take vigorous action to secure the conviction of those who fail to comply with those conditions**

An extension to the safeguarding of groundwaters may be achieved by the creation of protective perimeters around groundwater catchments in which particular activities may be prescribed. This statutory use of this device has not yet been introduced into British law although it has been in France (Kiss and Shelton 1993). However this strategy is recognised in the document "Policy and Practice for the Protection of Groundwater" (National Rivers Authority 1992) and they are seeking to establish protection zones around all boreholes through their role as statutory planning consultees and through liaison with other regulatory bodies and industry (NRA 1994b).

4.3.6 General controls on pollution by noxious or poisonous substances

Most pollutants entering headwaters or their groundwaters from agricultural sources will do so from diffuse sources or as a result of a particular incident or technical failure. More rarely agricultural effluent will be deliberately discharged via discrete channels or pipes. This form of point-source discharge is more common from domestic and industrial sources and from highways. It is also an offence under section 85 of the Water Resources Act 1991 to discharge trade or sewage effluent into controlled waters without the NRA's prior consent.

The NRA has powers to regulate intentional discharges into controlled waters, including headwaters, through the application of a system of licensed consent. Issuing of discharge consents and monitoring of compliance with their terms is a major function of the NRA.

All discharge consents are issued by the NRA under the provisions of section 10 of the Water Resources Act 1991. The NRA can either refuse consent, grant it subject to stipulated conditions or grant it unconditionally.

Where the discharger is the NRA itself consent to discharge is required from the Secretary of State for the Environment under the terms of the Control of Pollution (Discharges by National Rivers Authority) Regulations 1989 (SI 1989/1157).

In exercising their duties of consent the NRA has extensive powers available to them. They may place conditions upon the place of discharge and design of outlets and upon the nature, origin, composition, temperature, volume and rate of discharge. They may also make conditions concerning the times of discharge. Dischargers may be set conditions for the facilities and procedures for monitoring discharges and the keeping and supplying of records relating to the discharges. The NRA can also set charges for dealing with the application to discharge and for monitoring any consents given.

- **THE NRA SHOULD TAKE FULL ACCOUNT OF THE FINDINGS THAT HEADWATERS ARE IMPORTANT SOURCES OF BIODIVERSITY OF RIVER CATCHMENTS IN UNDERTAKING THEIR DUTIES UNDER THE WATER RESOURCES ACT 1991 TO GRANT DISCHARGE CONSENTS**
- **no consent should be granted which is likely to significantly decrease the biological condition of any receiving headwater**

Procedures for assessing the significance of observed changes in macro-invertebrate assemblages have recently been given by Furse et al. (1995b).

- **conditional consented discharges to headwater streams should be monitored both chemically and biologically**
- **particular attention should be given to maintaining the consented quality of effluent entering headwater streams and groundwaters from small rural sewage treatment plants, septic tanks and cess pools**

Other powers to control discharges are given under the Environmental Protection Act 1990, the Water Industry Act 1991 in as much as it applies to discharge into sewers, the Control of Pollution (Discharge into Sewers) Regulations 1976 (SI 1976/958) and the Trade Effluents (Prescribed Processes and Substances) Regulations 1989 (SI 1989/1156) and 1992 (SI 1992/339). The Public Health (Drainage of Trade Premises) Act and the 1961 Public Health Act also allowed conditions to be imposed on industrial effluent entering sewers and the latter Act extended the scope of the Act to be extended to include agriculture (Garbutt 1992).

More recently the Council of the European Union Directive concerning urban waste water treatment has also required that industrial waste water which enters the municipal system is subject to prior consent.

Civil law also permits individuals, under section 259 of the Public Health Act 1936, to take out a prosecution against any person whose act or default permits any pond, pool, ditch, gutter or watercourse to become so foul or silted up as to cause nuisance or endanger public health.

Under the terms of the Water Act 1945 water undertakings may also set such local byelaws as they deem necessary to control the quality of water for use for public supply.

- **THE NRA SHOULD EXERCISE ALL SUCH DUTIES AND POWERS VESTED IN THEM BY THOSE UK STATUTES OTHER THAN THE WATER RESOURCES ACT 1991, AND ENCOURAGE OTHERS TO EXERCISE THEIR OWN POWERS, IN ORDER TO PREVENT THE ENTRY OF NOXIOUS, POISONOUS OR POLLUTING SUBSTANCES INTO HEADWATER STREAMS**

4.3.7 Control of abstraction and irrigation

The results of the Stage 3 study of the "Faunal Richness of Headwater Streams" project (Furse et al. 1995a) and of Countryside Survey 1990 (Barr et al. 1993) showed that many headwaters were liable to dry out, particularly in lowland Britain.

Some streams may be naturally intermittent and their specialised fauna may reflect this. Extreme climatic conditions may also lead to drought. However the Stage 3 study showed that abstraction from headwaters, usually for irrigation, was a commonplace activity.

The NRA has a variety of powers to control abstraction under the provisions of the Water Resources Act 1991. Procedures for doing so, and also for regulating impoundment, are set out in the Water Resources (Licences) Regulations 1965 (SI 1965/534). Generally, it must take such action as it considers necessary to conserve, redistribute, augment and secure proper use of water resources.

In order to do so it may request the Secretary of State to set minimum acceptable flows for inland watercourses and, at times of climatic extreme, may also request the Secretary of State to issue either "emergency" or "ordinary" drought orders.

More routinely, abstraction the NRA controls abstraction by a licensing process akin to that applying to consented discharges. Thus the NRA may grant refuse or conditionally or unconditionally grant the right to abstraction. The same system also applies to the investigation and abstraction of small quantities of groundwater. The NRA may subsequently vary consent conditions, particularly when drought orders are in force. From time to time the NRA may also serve conservation notices to control the dewatering of streams.

Over recent years decisions on the permitted amount of water to be abstracted have been based on the "Ho-Hum" model (Drake and Sherriff 1987), so called after its principal formulator, **Howard Humphreys**. This system is currently under commissioned review and the newly recommended guidelines are likely to place more considered emphasis on biotic factors (William Halcrow & Partners Ltd 1995).

- **THE NRA SHOULD TAKE FULL ACCOUNT OF THE FINDINGS THAT HEADWATERS ARE IMPORTANT SOURCES OF BIODIVERSITY OF RIVER CATCHMENTS IN UNDERTAKING THEIR DUTIES UNDER THE WATER RESOURCES ACT 1991 TO GRANT ABSTRACTION LICENCES**
- **no licence to abstract should be granted which is likely to significantly decrease the biological condition of any receiving headwater**

- **THE WAY IN WHICH THE NRA DETERMINES THE QUANTITY OF WATER THAT MAY BE ABSTRACTED UNDER ANY ONE LICENCE, AND THE TIMING OF THAT ABSTRACTION, SHOULD TAKE GREATER COGNIZANCE OF THE ECOLOGICAL REQUIREMENTS OF THE NATURAL BIOTA OF THE SITE THAN IS ALLOWED FOR IN THE CURRENT "HO HUM" MODEL**

In seeking to control abstraction and to maintain adequate flows the NRA must contend with many abstractors with an entrenched right to abstract which cannot be revoked under circumstances of normal usage. This is known as the Licence of Right and such licence was granted, under section 33 of the Water Resources Act 1963, to all persons who had an entitlement to abstract at the time of its enactment. These licences remain valid until such times as they lapse by default.

The NRA also needs to be aware of the extent of another source of abstraction outside their immediate control. Currently small abstractions, <20 cumecs d⁻¹, are exempt from the licensing process if they are used by riparian owners for agricultural purposes other than spray irrigation.

- **the NRA should instigate a research programme to evaluate the quantity of abstraction from headwaters which is outside their current powers to regulate and the impact of these abstractions on the discharge of headwaters and the condition of their biotic assemblages**

In order to alleviate low flows caused by circumstances outside the control of the Authority:

- **THE NRA SHALL MAINTAIN A PROGRAMME OF ACTION FOR THE ALLEVIATION OF LOW FLOWS IN HEADWATER STREAMS**

An appropriate action programme exists and is presented in the NRA Water Resources Strategy document (National Rivers Authority 1993b).

4.3.8 Control of impoundment and culverting

Small impoundments were commonly found on the headwater streams sampled by Furse et al. (1995a). Common reasons for impoundment are to facilitate abstraction, to water livestock or to create ornamental garden pools for aesthetic purposes. In addition impoundment may be caused by the construction of culverts to carry stream flow.

Powers to control impoundment are divided vested with the NRA under sections 23 of the Land Drainage Act 1991 (ordinary watercourses) and section 109 of the Water Resources Act 1991 (main rivers). The two sections provide for a system of licensing under which the NRA may refuse or grant permission for the proposed impoundment to proceed.

Most headwaters are classified as ordinary watercourses and the Land Drainage Act 1991 is largely the more applicable. In these cases the NRA, through their functions in flood defence committees, operates in conjunction with the relevant Land Drainage Board, where the latter has the power to control the approval of structures. The relevant terms of the section are that no person shall, without the consent in writing of the drainage board concerned:

- erect any mill dam, weir or other like obstruction to the flow of any ordinary watercourse or raise or otherwise alter any such obstruction
- erect any culvert that would be likely to affect the flow of any ordinary watercourse or alter any culvert in a manner that would be likely to affect any such flow

The terms of section 109 of the Water Resources Act 1991, although somewhat different in their wording, effectively set out the same system of control over the same sorts of operation in main rivers.

The NRA is legally obliged to grant a licence to any reasonable proposals which will not endanger the flow of the river or possibly cause any risk of further flooding. However, under sections 12 and 13 of the Land Drainage Act 1991 and sections 16 and 17 of the Water Resources Act 1991 the NRA has a duty to refuse a licence if the work involved is likely to be detrimental to the environment or, in the case of the Land Drainage Act 1991, prejudicial to the interests of fisheries.

- **THE NRA SHOULD TAKE FULL ACCOUNT OF THE FINDINGS THAT HEADWATERS ARE IMPORTANT SOURCES OF BIODIVERSITY OF RIVER CATCHMENTS IN UNDERTAKING THEIR DUTIES UNDER THE WATER RESOURCES ACT 1991 TO GRANT A LICENCE TO ANY PERSON TO IMPOUND OR CULVERT ANY HEADWATER STREAM**
- **no licence to impound or culvert any headwater stream should be granted which is likely to significantly decrease the biological condition of any receiving headwater**

Under section 85 of the Water Resources Act it is an offence to discharge poisonous, noxious or polluting materials into any controlled waters, including groundwaters. Many works associated with the construction of consented impoundments or culverts involve materials such as silt, cement, concrete, oil and petroleum spirits.

The NRA has issued guidelines to the construction industry to help prevent pollution arising from works in, near or liable to affect watercourses. Prior approval must be obtained from the NRA for all temporary construction works which may interfere with the bed or banks or flood channel of any watercourse or is within 8m of any bank of any main river.

- **the NRA shall vigorously enforce statutory regulations and its own guidelines on the carrying out of any works involved in the construction of any impoundment or culvert in, over or under any headwater stream**

4.3.9 Control of channel modification and land drainage

Furse et al. (1995a) showed that reduction in the biological condition of headwaters was strongly associated with each of channelisation and the number of inlet pipes, of whatever type and function, which entered the watercourse.

Control of channel modification and land drainage in most headwaters and their catchments is vested with the Internal Drainage Boards. This control is exercised under the terms of the Land Drainage Act 1991 as amended by the Land Drainage Act of 1994. The Act of 1991 and the preceding Land Drainage Act 1976 provided the IDBs and the water undertakers with the power to set such byelaws as they saw fit to maintain effective drainage where these are not covered directly by the licensing procedures.

Where no Internal Drainage Board exists, the Land Drainage Act 1991 provides local authorities the permissive powers. It also provides for the NRA to function as the Internal Drainage Board where appropriate.

- **THE NRA SHOULD LIAISE WITH AND GUIDE THE INTERNAL DRAINAGE BOARDS AND THE WATER UNDERTAKERS IN ORDER TO CREATE AND ENFORCE SUCH LOCAL BYELAWS AS ARE APPROPRIATE TO PROTECT HEADWATERS FROM SUCH FORMS OF CHANNEL MODIFICATIONS AND LAND DRAINAGE ACTIVITIES AS MAY LEAD TO A REDUCTION IN THEIR BIOLOGICAL CONDITION**
- **through direct action, or in liaison with Internal Drainage Boards, the NRA should refuse to grant, or allow to be granted, any consent to undertake such channel or bank modification or land drainage work as would be detrimental to the environment or liable to lead to a significant reduction in the biological condition of any headwater stream**

NRA also exercise control over drainage works where they involve the release of noxious, poisonous or polluting agents, which are controlled under section 85 of the Water Resources Act 1991. Where a statutory nuisance, including silting up, is caused, the Public Health Act 1936 and the civil law applies (Garbutt 1992).

The role of the NRA and private individuals in enforcing criminal and civil law in respect of section 85 pollution and common nuisance are dealt with in earlier sections as are those drainage consequences associated with abstraction, impoundment and culverting.

4.3.10 Control of forestry activities

The NRA are often consulted but are not statutory consultees in forestry planning. As such they often have the opportunity to make early objection to any proposal liable to reduce the biological condition of any headwaters likely to be affected by a forestry proposal.

They may also invoke the powers vested in them by the Water Resources Act 1991 or the Land Drainage Act 1991 in order to prevent pollution or to alleviate low flows caused by forestry activities.

- **the NRA shall use its powers, as consultees in the forestry planning process to prevent any development taking place which is liable to lead to significant reductions in the biological conditions of headwaters**

4.3.11 Control of refuse disposal

In Stage 3 of the current study it was shown that large instream litter, of fertiliser bag size and upward, was present in 13% of the study streams upstream of the biological sampling point and that an average of 0.11 refuse tips, other than organic farm waste, were found within 20m of the water's edge per headwater (Furse et al. 1995a).

Where the instream litter or refuse tips are likely to impound flow or to lead to noxious, poisonous or polluting material entering a headwater then these may be dealt with by the NRA under the Land Drainage Act 1991 or the Water Resources Act 1991. Individual refuse may be deemed a nuisance under the Public Health Act 1936 and subject to prosecution under civil law.

The powers to create byelaws granted to Internal Drainage Boards and water undertakings by Land Drainage Acts of 1976 and 1991 and the Water Act 1945 may again be invoked to control waste dumping.

- **THE NRA SHOULD LIAISE WITH AND GUIDE THE INTERNAL DRAINAGE BOARDS AND THE WATER UNDERTAKINGS IN ORDER TO CONTROL, THROUGH THE USE OF BYELAWS, ANY UNAUTHORISED DUMPING NEAR HEADWATERS OR GROUNDWATER SOURCES**

However the most effective way to deal with dumping is likely to be through the Environmental Protection Act 1990 which seeks to prevent waste products causing "harm" to ecological systems.

- **the NRA should vigorously prosecute any person who causes a headwater or groundwaters supplying headwaters to be polluted as a result of dumping waste material adjacent to a watercourse, spring, well or borehole**

4.3.12 Control of poaching by livestock

In the Stage 3 study it was shown that poaching of riparian land by livestock was commonplace (Furse et al. 1995a). This is likely to impact upon the stream through modifications in its drainage characteristics and the deposition of silt to the detriment of its biological condition.

Poaching of headwaters is best regulated through local byelaws.

- **THE NRA SHOULD LIAISE WITH AND GUIDE THE INTERNAL DRAINAGE BOARDS AND THE WATER UNDERTAKINGS IN ORDER TO CONTROL, THROUGH THE USE OF BYELAWS, ANY GRAZING OR KEEPING OF LIVESTOCK ON RIVER BANKS WHICH IS LIABLE TO BE DETRIMENTAL TO THE DRAINAGE SYSTEM OR SIGNIFICANTLY REDUCE THE BIOLOGICAL CONDITION OF ANY HEADWATER STREAM**

4.4 Improvement

4.4.1 The general strategy

The strategies of awareness and control outlined in the previous section provide a framework for national improvement in the biological condition of headwaters.

The strategies represent the two-pronged approach of "carrot" and "stick" where the "carrot" approach should be seen as the preferred option. Exceptions to this approach would be where the pollution is or has been so severe as to cause a catastrophic impact upon the biota, including fishlife, of the headwater or to be so persistent as to indicate an unwillingness of the polluter to take voluntary action to prevent it.

The "carrot" is seen as the development of good land management practices which both ecologically sound and economically beneficial and also prevent the erstwhile polluter from liability to prosecution. This may also be supported by financial incentive schemes.

The "stick" applied to catastrophic and persistent polluters should be vigorous enforcement of all available statutory controls. Where statutory powers permit, the principle of "polluter pays" should also be enforced to retrieve the costs of prosecution and remediation.

- in order to create a greater willingness amongst landowners, land managers and governmental and non-governmental organisations to act to improve the biological condition of headwater streams the NRA should implement the programme of awareness recommended in section 4.1 of this report
- wherever possible the NRA should encourage voluntary action to affect improvement in biological conditions and should seek to achieve this through the implementation of the programme of collaboration recommended in section 4.2
- where improvement in the biological condition of headwaters cannot be achieved by voluntary action, or where chronic or catastrophic pollution leading to invertebrate mortality occurs, the NRA should exercise its statutory powers of control in order to obtain the required improvement
- **THE NRA SHOULD INVOKE THE POWERS OF "POLLUTER PAYS" GRANTED TO THEM UNDER STATUTE LAW IN ORDER TO RETRIEVE THE COSTS OF IMPROVING THE BIOLOGICAL CONDITION OF HEADWATERS WHERE VOLUNTARY ACTION TO DO SO IS NOT TAKEN BY THE POLLUTER**

4.4.2 Catchment management plans

The prime mechanism for implementing a headwater protection strategy should be through catchment management plans.

- **THE NRA SHOULD INCLUDE A STRATEGY FOR IMPROVING THE BIOLOGICAL CONDITION OF HEADWATER STREAMS IN ALL CATCHMENT MANAGEMENT PLANS**

For maximum effect, the catchment management plans should direct most effort at those streams or taxa that are most at risk from habitat degradation and those which can most easily be improved.

- by reference to published information and their own headwater data-base, catchment management plans should identify those headwaters considered to be most at risk of degradation, particularly from agricultural practices
- catchment management plans should identify those headwaters supporting, or likely to be capable of supporting, taxa which have special national or local conservation status by virtue of their limited distribution and threat of extinction
- catchment management plans should identify those headwater types which are themselves nationally or locally rare and support, or are likely to support faunal assemblages which are distinctive by virtue of their rarity, typicality, representativeness and/or their fragility
- catchment management plans should identify all headwaters within their scope which have special conservation status by virtue of either their own intrinsic worth or through being located in an area which has its own special character or through being within the boundaries of a protected zone or an agricultural incentive scheme

These headwaters can include those in National Nature Reserves, SSSIs, Local Nature Reserves, RAMSAR sites, Special Protection Areas, Sites of Nature Conservation Interest, National Parks, Norfolk Broads, Areas of Outstanding Natural Beauty, wildlife reserves, Environmentally Sensitive Areas, Water Protection Zones, Nitrate Vulnerable Zones, Nitrate Sensitive Areas, Country Stewardship Scheme areas or Water Fringe Areas scheme areas.

- **catchment management plans should identify those headwaters of particular importance as spawning and nursery grounds for fish**
- **catchment management plans should identify those headwaters where improvement in biological condition is most easily affected or provides the greatest benefit in terms of conservation of important taxa or biotic assemblages**

Having identified those streams likely to be in either greatest need of improvement, of greatest conservation value or most amenable to cost-effective recovery, appropriate remediation and recovery plans need to be stated which are fully integral with all other catchment interests which must be served by the management plan.

- **catchment management plans should identify the agricultural, industrial, domestic and recreational land use practices operating within the sub-catchments of headwater streams**
- **CATCHMENT MANAGEMENT PLANS SHOULD IDENTIFY WHICH LAND USE PRACTICES ARE MOST LIKELY TO BE HARMFUL TO THE BIOLOGICAL CONDITION OF HEADWATERS, HOW THAT HARM IS CAUSED AND WHAT IMPACT THE HARM HAS UPON THE STREAM AND ITS BIOTA**

The most immediate threats to the majority of headwaters, by virtue of the rural character of their catchments, is from agricultural activities and land drainage practices. Furse et al. (1995a) highlighted the negative relationship between the biological condition of rural streams, as indicated by Ecological Quality Index values, and many of these activities.

In that report they showed that poor quality headwaters occurred in all landscape types and that indicator taxa could be identified whose presence or absence was indicative of decreasing biological condition.

- **catchment management plans should identify those other potential threats to the biological condition of headwater streams, such as acid precipitation or highway run-off, which may be operating and what impacts they may have**
- **CATCHMENT MANAGEMENT PLANS SHOULD IDENTIFY THE SPECIFIC ACTION PLANS AND POLICIES WHICH ARE NEEDED TO CONTROL HARMFUL IMPACTS UPON HEADWATERS**
- **headwater action plans should be based on pro-active pollution prevention**

Statutory and non-statutory guidance on those practices in need of control and the most effective mechanisms of control are available to the NRA from external sources and from within the NRA through their own publications, reports and pollution prevention guidelines.

Comprehensive statutory guidance is provided by the Water Prevention of Pollution (Code of Practice) Order 1991, the Control of Pollution (Silage, Slurry and Agricultural Fuel Oil) Regulations 1991 (SI 1991/324) and the Sludge (Use in Agriculture) Regulations 1989 (SI 1989/1263).

Non-statutory guidance is provided through a wide variety of publications (Table 4.2) too numerous to list in full.

Table 4.2 Non-statutory codes and other publications offering advice relevant to the formulation of action programmes to improve the biological condition of headwater streams. Publications listed here are not cited in the reference section.

PUBLICATION TITLE	AUTHORS
Effluent Storage on Farms	Health and Safety Executive (HSE) 1981
Slurry Storage Systems	HSE 1986
Code of Practice for Design, Construction and Use of Reception Pits and Storage Tanks	British Standards Institute (BSI) 1989
Farm Waste Storage - Guidelines on Construction. CIRIA Report number 126	Construction Industry Research and Information Association 1991
Code of Practice for Design and Construction of Chemical Stores	BSI 1989
Weed Control and Environmental Protection	HMSO 1992
Storage of Approved Pesticides. Guidance for Farming and Other Professional Users	HSE 1988
Code of Practice for the Safe Use of Pesticides on Farms and Holdings	MAFF/HSE 1990
Guidelines on the use of Herbicides on Weeds in or Near Watercourses	MAFF 198?
Code of Practice on the Use of Pesticides in Forestry	Forestry Commission 198?
Forests and Water Guidelines	Forestry Commission undated
Fertiliser Recommendations for Agricultural Crops	MAFF 1988
Code of Practice for Agricultural Use of Sewage Sludge	DoE 1989
Agricultural Development and Advisory Service (ADAS) brochures and publications	ADAS (various)
Various Farming and Wildlife Advisory Group (FWAG) brochures and publications	FWAG (various)
Various National Rivers Authority (NRA) brochures and publications	NRA (various)

- **CATCHMENT MANAGEMENT PLANS SHOULD BE BASED ON THE "NEEDS" OF THE RIVER AND SHOULD BE BASED ON THE RESULTS OF CAREFULLY CONDUCTED STRATEGIC RESEARCH**
- **catchment management plans should indicate the likely benefits of their headwater improvement plans, the timescale over which those benefits may accrue and the costs of making those improvements**
- **headwater improvement plans should be coherent throughout the catchment and designed to meet an integrated overall management strategy, taking due cognizance of all other relevant interests of economic development, social needs and land drainage requirements**

4.4.3 Riparian protection (buffer) zones

Action plans to increase the protection afforded to headwater streams and to thereby improve their general biological condition will commonly include recommendations regarding riparian protection or buffer zones. Whilst riparian zones cannot be regarded as a panacea for all stresses impacting on headwaters, and whilst specific agreement on their optimal design and functioning are still subject to research, **the value of establishing protection zones, free of potential sources of environmental perturbation is now almost universally accepted.**

Thus the Water Prevention of Pollution (Code of Practice) Order 1991 recommends a wide range of potentially harmful agricultural activities which should not take place within 10m of any stream and at least that far, and often further, from any spring, well or borehole.

The use of riparian protection zones is similarly advocated by the Forestry Commission in their Forests and Water Guidelines (Forestry Commission undated) although no optimal single width is recommended. In their guidelines to the construction industry on works in, near or liable to affect watercourses, the NRA require to give prior approval to any work which is within 8m of any main river.

Within the scientific literature views on the design and width of riparian protection zones are varied but between 10 and 20m is generally recommended (Vought et al. 1994).

In Stage 3 of the current project (Furse et al. 1995a) it was shown that, on average, only 5.5% of headwater stream length was protected by a riparian or buffer zone of 10m or greater and that 75.6% of banks were buffered by a riparian zone of less than 1m width.

- **THE NRA'S CATCHMENT MANAGEMENT PLAN'S PROVISIONS FOR HEADWATER STREAMS SHOULD INCLUDE THE OBJECTIVE OF DEVELOPING RIPARIAN PROTECTION ZONES OF AT LEAST 10M WIDTH ALONG AS MUCH OF THE STREAM NETWORK AS POSSIBLE**
- **the riparian protection zones should not be subject to any form of economic agricultural activity nor to any of those practices recommended not to occur in the Water Prevention of Pollution (Code of Practice) Order 1991, the NRA's "Guidelines to the Construction Industry on Works in, Near or Liable to Affect Watercourses" and the Forestry Commission's "Forests and Water Guidelines"**
- **no dumping of waste material should be permitted within any headwater protection zone**

The special importance of riparian zones is recognised by the Chairman of the NRA, Lord Crickhowell who is quoted by Tickell (1995) as "advocating a National Riparian Zone encompassing floodplains, important catchment areas and riparian corridors in which conservation and water quality interests would be paramount".

- **as part of its strategy for improving the biological condition of headwaters the NRA should continue to fund research on the optimal design of riparian zones to best achieve this objective**

4.4.4 Financial incentives

In order to enlist the voluntary support of the farming community financial incentive schemes should be more widely applicable. Until recently, despite the fact that farmers had been required to set aside substantial areas of land for non-agricultural use, no set aside schemes had been specifically targeted at creating riparian zones or allowed such riparian strips to be counted as set-aside land under the definition of the schemes.

A move towards targeting came with the launch of the MAFF Water Fringe Areas scheme in 1994 which provided financial incentives to specifically create buffer zones. However, the initial scheme is very limited in its application and covers just six river catchments. More recently new set-aside regulations are coming into effect which will allow riparian zones to be included.

- **THE NRA SHOULD PRESS THE MINISTRY OF AGRICULTURE FISHERIES AND FOOD FOR EXTENSION OF SCHEMES, SUCH WATER FRINGE AREAS SCHEME, WHICH SPECIFICALLY PROVIDE FINANCIAL INCENTIVES FOR CREATING RIPARIAN ZONES IN ORDER TO IMPROVE THE BIOLOGICAL CONDITION OF RIVERS, INCLUDING HEADWATER STREAMS**
- **THE NRA SHOULD PURSUE A POLICY OF LOBBYING TO OBTAIN A "NATIONAL RIPARIAN ZONE" FOR THE PROTECTION OF HEADWATERS AND OTHER WATERCOURSES**

4.4.5 Advisory services

Promoting the use of riparian zones and other land use management practices appropriate to the improvement of the biological condition of headwater streams must be an important component of any catchment management plan and should stem from a co-ordinated national strategy.

In section 4.2 the importance of the advisory services was strongly emphasised. Three organisations have a particularly strong role to play, the Agricultural Development and Advisory Service; the Farming and Wildlife Advisory Group and the NRA itself through their Pollution Control and Environmental Protection Officers.

Each of these organisations is in direct contact with the farming community and offer a wide range of, often free, services advising on the best way to manage agricultural land for the protection of the environment whilst not constraining, and often promoting, the economic viability of business.

In any action programme for the improvement of headwaters it is essential that regular liaison is maintained between these organisations in order to develop a common method of approach. Strong links also need to be maintained with the representative organisations of the land-owning community, the National Farmers' Union, the Country Landowners Association since their collaboration and links with those who tend the land are also crucial to the success of any co-ordinated strategy.

Equally central to the success of any catchment management plan are the statutory advisory committees to the NRA who are now participating partners in the development and monitoring of the plans.

- **THE AGRICULTURAL ADVISORY SERVICES, ADAS AND FWAG, SHOULD BE FULLY INVOLVED IN THE DEVELOPMENT OF CATCHMENT MANAGEMENT PLANS TO PROTECT HEADWATERS WHICH SHOULD REFLECT THE CO-ORDINATED ROLE THAT THEY AND THE NRA'S OWN ADVISORS WILL PLAY IN THE IMPROVEMENT OF HEADWATER STREAMS**
- **in a similar manner the landowners' and land managers' representative organisations should be involved at all stages in the development, documentation and implementation of the plans to improve headwaters and their role clearly defined in the documentation**
- **important elements of the strategy should be to promote riparian set-aside opportunities and other agricultural incentive schemes and to seek to establish the development of continuous riparian zones on headwaters**

4.4.6 Collaborative action plans

A feature of collaborative plans to protect and improve headwaters are the special targeted schemes. An example of the joint NRA, FWAG, Countryside Commission and Internal Drainage Board scheme to create and improve wetlands in Lincolnshire was given earlier (section 4.2.4). Many other examples exist.

In the Upper Thames catchment the NRA and landowners are working together to improve riparian zones in order to create suitable new habitats for otters (Tickell 1995). In the Yorkshire area the NRA and FWAG are working together to improve riparian habitats in areas of land within the Country Stewardship scheme.

The Yorkshire region also provides an example of the way in which the Local Authorities and the NRA can collaborate to improve the environment near water. In this case North Yorkshire County Council and Northumbria & Yorkshire region of the NRA are working together to promote the protection and development of barn owl populations, habitats and landscapes.

4.4.7 Restoration schemes

- **whenever possible catchment management plans should include special collaborative schemes between the NRA and other organisations, targeted at the improvement of specified headwater streams or headwater taxa of special conservation importance**
- **CATCHMENT MANAGEMENT PLANS SHOULD INCLUDE SPECIFIC HEADWATER RESTORATION SCHEMES, AGREED WITH LANDOWNERS, IN WHICH HEADWATER IMPROVEMENT POLICIES CAN BE TESTED, MODIFIED AND REFINED THROUGH PRACTICAL EXPERIENCE**

Associated research programmes with the "Faunal Richness of Headwater Streams" project (Clarke 1994, Tapia and Furse in preparation) showed that the habitat requirements of many headwater taxa were extremely specific. Many taxa were confined to very short reaches of a stream or were very strongly associated with an individual meso-habitat such as gravel, silt, detritus or individual stones and sticks.

- **headwater restoration schemes should be based on habitat diversification and riparian protection and planting policies**

4.4.8 Planning and licensing controls

Planning and licensing processes provide the NRA with powerful tools with which to protect and ultimately improve the biological condition of headwaters. Not only can the NRA influence which planning developments are granted approval, through their role as statutory consultees, but the Water Resources Act 1991 and the Land Drainage Act 1991 provide them with the power to control discharges, abstraction and impoundment through a system of consents and licences.

- **CATCHMENT MANAGEMENT PLANS SHOULD CLEARLY STATE THE NRA'S POLICY TOWARDS PLANNING AND CONSENT LICENSING IN HEADWATER STREAMS**
- **policy should be based on the paramountcy of protecting and enhancing the biological condition of headwaters**
- **CATCHMENT MANAGEMENT PLANS SHOULD INCORPORATE THE CONCEPT OF CONSTRAINT AREAS WHERE NO FURTHER DEVELOPMENT UNDER NRA CONTROL IS TO BE PERMITTED**
- **all headwater streams liable to be affected by any planning submission or licence application should be subject to investigation of their biotic assemblages in order to assess their conservation importance prior to decisions being made related to those submissions and applications**
- **WHERE APPROVAL OR CONSENT IS GIVEN TO PLANNING PROPOSALS OR TO DISCHARGES, ABSTRACTION OR IMPOUNDMENT CONDITIONS SHOULD BE IMPOSED CLEARLY STATING THE MINIMUM ACCEPTABLE BIOLOGICAL CONDITION THAT MUST BE MAINTAINED AND THE SPECIFIC TAXA WHOSE PRESENCE MUST NOT BE JEOPARDISED BY THE APPROVAL OR CONSENT, TOGETHER WITH THE SPECIFIC ACTIONS REQUIRED OF THE APPLICANT TO MEET THESE CONDITIONS**
- **minimum acceptable flows to protect and enhance biotic assemblages should be attached to individual headwaters and no abstraction licence should be granted which does not make provision to maintain these levels of discharge**
- **where existing abstraction licences, including licences of right, lead to discharge levels below the minimum acceptable flow of a given headwater then every opportunity should be taken to revoke those licences as the opportunities present themselves**
- **CATCHMENT MANAGEMENT PLANS SHOULD BE USED TO PROMOTE WATER-LEVEL MANAGEMENT PLANS BASED ON MINISTERIAL DIRECTION FROM MAFF**

4.4.9 Evaluation

The effectiveness of catchment management plans is reviewed by Catchment Management Monitoring Groups including NRA officers and members of the statutory advisory groups to the Authority. They are the "de facto" owners of the plan and responsible for its successful implementation. In order to exercise this responsibility they need clear performance targets against which to measure that success and adequate information to make judgement.

5. A STRATEGY FOR EVALUATION

5.1 Introduction

The principles and practice of a headwater conservation strategy were outlined in the preceding chapters.

Emphasis was placed on the need to be able to evaluate the success of the policy. Evaluations need to be made at a number of levels of resolution; nationally, regionally, at catchment level and for individual watercourses, depending on the level of the strategy which is being implemented. Evaluation is dependant, in turn on the performance targets or indicators set by the NRA to measure the effectiveness of their strategy.

- **THE NRA NEED TO SET CLEAR AND PUBLICLY STATED CRITERIA FOR MONITORING THE EFFECTIVENESS OF THEIR HEADWATER CONSERVATION STRATEGY**
- **evaluation criteria need to be set for all levels of resolution from the national headwater sampling network to individual streams under restoration**
- **evaluation criteria need to be set in consultation with other interested parties including national government, statutory advisory committees and participating partners in special action programmes**

5.2 Monitoring of performance

5.2.1 The National Headwater Sampling Network and General Quality Assessment

In section 3.1 it was recommended that a national headwaters sampling network should be established as part of the GQA and that this should be backed by a corresponding national data-base.

Assessment of biological condition of headwaters, based on macro-invertebrate assemblages was to be expressed using Ecological Quality Indices (EQIs). The index values, in turn, were to be derived from a headwater version of RIVPACS (Furse et al. 1995a, Wright et al. 1993).

Assessment of river habitat quality should be based on the Habitat Quality Index now being developed by the NRA.

- **EVERY FIVE YEARS, OR AFTER EACH GQA, WHICHEVER IS THE SOONER, THE NRA SHOULD PUBLISH A SEPARATE HEADWATERS REPORT LISTING THE BIOLOGICAL CONDITION AND THE RIVER HABITAT AND CHEMICAL QUALITY OF EACH NATIONAL HEADWATER SITE AND THE CHANGES THAT HAVE OCCURRED SINCE THE PREVIOUS REPORT**

New procedures have recently been developed, based on known data collection and processing errors, for assessing whether any two EQIs are significantly different in value (Furse et al. 1995b). These procedures may be used to assess whether there has been a significant change in the biological condition of a given headwater based on samples collected five years apart.

Although a Habitat Quality Index (HQI) has yet to be fully developed and associated statistical tests will take longer to devise, the ability to index habitat quality will soon be in place. Thus it will be possible to judge the direction of change of site HQIs over a five year period. Change in chemical quality over the same time scale can be assessed using the CLAM model (Warn 1990) and other statistical procedures developed by the NRA (National Rivers Authority 1994c).

- **ONCE THE FIRST SET OF HEADWATER SITES IN THE ROLLING PROGRAMME HAVE BEEN SAMPLED FOR THE SECOND TIME, THE NRA SHOULD PRODUCE ANNUAL REPORTS DETAILING THE CHANGES IN THEIR BIOLOGICAL CONDITION AND HABITAT AND CHEMICAL QUALITY**

These reports should provide breakdowns of results on a national, regional and landscape type (moorland, woodland, herb/grass, pasture and arable land) basis. They will provide the NRA with the first mechanism for assessing the success of its headwater conservation strategy.

- **THE NRA SHOULD SET TARGETS FOR OVERALL LEVELS OF IMPROVEMENT IN THE BIOLOGICAL CONDITION AND THE RIVER HABITAT AND CHEMICAL QUALITY OF HEADWATERS TO BE ACHIEVED OVER PREDEFINED PERIODS**

The first evaluation period should be after the first six years of the rolling programme of national headwater sampling. At this stage the first block of sites will have been sampled twice. After that annual evaluations will be possible for each successive block of sites until the tenth year when all sites will have been sampled twice. Quinquennial reports and evaluations will be then be possible for year 15, 20, 25 and so on when each site will have been sampled three, four and five times etc.

- **performance targets should be determined by the NRA but a minimum level of 10% of sites showing significant improvement in their biological condition should be set for the first two samplings of each headwater site in the national headwaters sampling network and a further 10% improvement between the second and third sampling**
- **separate performance targets should be set for each region and for each dominant landscape type, each of which should be $\geq 75\%$ of the overall national performance target**
- **the NRA should establish a research programme to evaluate the performance characteristics of the Habitat Quality Index and development of statistical techniques for detecting "true" changes in habitat quality**

5.2.2 Catchment management plans

Catchment management plans must incorporate integrated proposals to improve the biological condition of headwater streams, as outlined in section 4.4. Most of these proposals may be evaluated by appropriate performance indicators.

- **THE NRA SHALL SET A SERIES OF PERFORMANCE INDICATORS TO EVALUATE THE EFFECTIVENESS OF THE HEADWATER IMPROVEMENT MEASURES SET OUT IN CATCHMENT MANAGEMENT PLANS**

Performance indicators could include fixed timetable targets for some or all of the following, depending upon the specific objectives of individual catchment plans:

- the number of headwater sites, in addition to the national network, which have been sampled for biological condition and river habitat and chemical quality
- the number of headwater sites showing improved biological condition and river habitat and chemical quality
- the number of headwater sites whose fisheries status has been investigated
- the number of farm visits undertaken by NRA staff to provide advice on the protection and improvement of the biological condition of headwater streams
- the number of farmers adopting farm management plans which include provision for protecting and improving headwater streams
- the uptake of agricultural schemes to develop riparian set aside
- the known length of headwater bank length whose riparian protection zone width has been increased to at least 10m
- the number of headwater streams for which minimum acceptable flows have been set and facilities established to monitor those flows
- the number of headwater streams whose discharge has been increased through the legitimate revocation of abstraction licences
- the number of water-level management plans established
- the number and area of planning constraint zones established which include headwater streams
- the number, length or area of headwater streams and their catchments which have been created as any of the following; Water Protection Zones, Nitrate Vulnerable Zones, Country Stewardship schemes, Water Fringe Areas
- the number of headwater stream restoration projects undertaken
- the number of collaborative headwater conservation schemes established with other interested organisations
- the number of sites whose macro-invertebrate samples have been identified to species level in order to assess their conservation value
- the number and length of headwater streams which have been created as, or as part of any of the following; Sites of Special Scientific Interest, Local Nature Reserves, Special Protection Areas, Sites of Nature Conservation Interest
- the number and cost of research projects undertaken to improve or provide the necessary information to direct improvement of headwater streams

5.2.3 Headwater restoration schemes

HEADWATER RESTORATION SCHEMES SHOULD BE UNDERTAKEN IN CONJUNCTION WITH SELECTED LANDOWNERS TO EVALUATE THE EFFECTIVENESS OF VARIOUS EXPERIMENTAL TECHNIQUES.

River restoration schemes should be used to diversify the available habitat of streams and their riparian corridor through the re-establishment of natural stream morphometry and discharge regime and bank profile and vegetation type. Riparian protection zones of at least 10m width should also be created as a buffer between the stream and adjacent agricultural activity. All detectable sources of degradation of biological condition should be eliminated.

The Stage 3 study of agricultural impacts (Furse et al. 1995a) showed that the biological condition of streams was generally poorest in dairying and lowland arable catchments such as are found in the Dorset Stour and Cam respectively.

In the pastoral catchments, such as the upper Stour the agricultural features most strongly correlated with poor biological condition were dairy yards, silage clamps and slurry lagoons.

In the Cam catchment, which was almost exclusively arable, poor biological condition was associated with three separate phenomena, nutrient enrichment, channel modifications and low flow (Furse et al. 1995a).

- **THE INITIAL RANGE OF HEADWATER TYPES USED TO EXPERIMENTALLY TEST RESTORATION TECHNIQUES SHOULD INCLUDE STREAMS FLOWING THROUGH INTENSIVE DAIRY LAND AND LOWLAND ARABLE LANDSCAPES**
- **the introduction of other restoration projects should not await the results of the experimental studies because it is assumed that such schemes will inevitably lead to ecological improvement and the experimental studies will be designed to optimise, rather than verify this**

The earlier stages of the current study showed that acid streams in upland, moorland Yorkshire were particularly species-poor and it is uncertain whether this represented the natural fauna of these sites or whether land management practices, particularly bracken control, and acid precipitation were affecting water chemistry.

- **THE IMPACT OF DIFFERING BRACKEN MANAGEMENT STRATEGIES AND CONTROLLED LIMING OF UPLAND ACIDIFIED CATCHMENTS SHOULD BE TESTED IN HEADWATERS IN THE NORTH YORKS MOOR NATIONAL PARK**

The evaluation of river restoration schemes should involve measures of improvement in quality parameters and species diversity.

- **IN ORDER TO EVALUATE THE SUCCESS OF RIVER RESTORATION SCHEMES IN ENVIRONMENTAL TERMS, THE NRA SHOULD ESTABLISH SEPARATE PERFORMANCE TARGETS FOR INCREASE IN BIOLOGICAL CONDITION AND RIVER HABITAT AND CHEMICAL QUALITY**
- **where the streams being restored do not support fish populations but are capable of doing so, the return of fish to live and to spawn should be used as performance indicators for the success of the scheme**
- **comparable bird, small mammal and botanical surveys should be undertaken before and after the restoration process and the increase in diversity of these animal groups should be used as a performance indicator for the success of the scheme**
- **the degree of satisfaction of the riparian landowners and land managers should be regarded as another performance indicator**

5.3 Consultation and discussion

The development of catchment management plans should be an iterative process involving not only NRA officers, their statutory advisory committees and the water undertakers but also all those other parties with a legitimate interest in the subject. These should cover the broadest possible spectrum including local government officers and elected representatives, the professional and voluntary conservation organisations (Table 4.1), individual landowners and land managers and their national associations, the informed academic community, developers and the general public.

- **IN DEVELOPING HEADWATER IMPROVEMENT AND RESTORATION STRATEGIES AS PART OF BROADER CATCHMENT MANAGEMENT PLANS THE NRA SHOULD CONSULT AS WIDELY AS POSSIBLE WITH ALL ORGANISATIONS AND INDIVIDUALS WITH A LEGITIMATE INTEREST IN THOSE STRATEGIES**

However it is not sufficient to consult during the development phase. Those consulted should also be involved in the evaluation process. In the case of the statutory advisory committees this is already formalised practice through the Catchment Management Monitoring Groups. Beyond this opportunities should be created for more general appraisal of the effectiveness and user-appreciation of the plans. Consultations and discussions should include some that are internal to the NRA and others that involve external parties.

- **the NRA should hold regular, in-house, inter-disciplinary discussions to monitor the effectiveness of their headwater conservation strategy at national, regional and catchment level**
- **evaluation of the headwater improvement action programmes for individual catchment management plans should be a regular agenda item for meetings of the Catchment Management Monitoring group at which members of the statutory advisory committees should represent the routine link between the Authority and the user community**
- **the NRA should organise annual discussion forums at which members of the farming and land-owning communities, the conservation agencies and other interested governmental and non-governmental organisations can consider the effectiveness of the Authority's headwater conservation strategy**
- **the NRA should organise periodic scientific conferences to discuss the findings of most recent scientific research and inter-operational practice regarding the ecology of headwaters and their management and conservation**
- **the NRA should modify and update its national headwater conservation strategy and catchment management plans in response to the conclusions of internal meetings, external discussion forums and scientific conferences**

5.4 Cost-benefit analysis

The calls on the NRA's financial resources and that of its successor environmental agency will be many and varied. The Authority must at all times be aware of the costs and benefits of each of their activities. This is no less the case in respect of conservation strategy where one of their key objectives is to exercise suitable financial control and scrutiny of expenditure.

- **IN EVALUATING THE SUCCESS OF THEIR HEADWATER CONSERVATION STRATEGY THE NRA SHOULD AT ALL TIMES BE AWARE OF THE RELATIVE COSTS AND BENEFITS TO THE AUTHORITY OF IMPLEMENTING EACH COMPONENT ELEMENT, INCLUDING THOSE OF INDIVIDUAL CATCHMENT MANAGEMENT PLANS**
- **wherever legitimate to do so the NRA should seek voluntary implementation, by farmers and other landowners, of their plans to improve the quality of headwaters and their riparian zones through environmentally sensitive land management practices**

- where necessary the NRA should implement the policy of "polluter pays" to recover the costs of their headwater conservation strategy and catchment management action programmes
- the benefits of the strategy should be expressed in terms of improvements in biological condition and river habitat and chemical quality, the protection and development of fisheries and in particular the use of headwaters as spawning and nursery grounds, the conservation of rare taxa and taxon assemblages, the maintenance and enhancement of catchment biodiversity and the satisfaction of those who manage the landscape and/or use it for recreational purposes and appreciation of its landscape and countryside characteristics
- realised benefits should include those accrued by larger streams in receipt of water from headwater sources, particularly as these apply to fisheries
- the possible economic benefits to farmers of environmentally sensitive management plans should also be considered because many such schemes provide sustainable economic activity for considerably reduced economic investment, particularly in agri-chemicals
- benefits to the public health should be considered
- the political benefits of implementing European policy and directives should form part of the analysis

Assessing environmental benefits in monetary terms is always a difficult process but is one commonly faced by the NRA. The problems are addressed in their in-house Economic Appraisal Manual (National Rivers Authority 1993i) from which selected passages are quoted:-

For costs and benefits to be real and included in the analysis, they must satisfy two criteria. Firstly they should actually occur if the action goes ahead .. and .. should the benefits be associated with a service or function then that service should be desired

The identification of environmental costs and benefits should be based on the results of environmental assessment work.

In practice, environmental costs and benefits are rarely quantified in monetary terms .. and .. this failure to make values ... and to place them on an equal weighting with other factors is cited by many to be the reason for existing levels of environmental quality degradation, including the loss of valuable habitat and conservation areas.

Monetary valuation of environmental effects will not always be possible. In these cases, it will still be important to include an indication of the magnitude and significance of environmental effects for evaluation purposes.

It must be remembered, however, that in any decision where the costs are measured in monetary terms and compared against environmental effects, the decision on whether or not an action is justified implicitly assigns money values to the environmental effects.

The manual then goes on to outline the techniques that are available to the NRA and how they may be implemented in practice.

- **IN ASSESSING THE COSTS AND BENEFITS OF THEIR HEADWATER CONSERVATION STRATEGY THE NRA SHOULD, AS FAR AS POSSIBLE, APPLY THOSE PRINCIPLES AND PROCEDURES LAID DOWN IN THEIR ECONOMIC APPRAISAL MANUAL**

In making their costs benefit analysis the NRA should seek to compartmentalise the various elements of their conservation strategy in order to assess which provide the greatest benefit for the effort expended.

- **ANY COST BENEFIT ANALYSIS OF THE NRA'S HEADWATER CONSERVATION STRATEGY, AT WHATEVER LEVEL OF GEOGRAPHIC RESOLUTION, SHOULD SEEK TO ESTABLISH WHERE THE GREATEST BENEFIT CAN BE ACCRUED FOR THE LEAST EXPENDITURE AND THE STRATEGY SHOULD BE DIRECTED TO REFLECT THE CONCLUSIONS DRAWN FROM THE ANALYSIS**

6. A STRATEGY FOR RESEARCH

6.1 Introduction

The Faunal Richness of Headwater Streams project has now clearly demonstrated the conservation importance of these watercourse and the extent to which many of them are of poor biological condition. In particular the study has shown the major contribution these streams make to the total biodiversity of river catchments.

The current document is based on the findings of the research programme and provides an initial outline of the steps that the NRA need to take to further the conservation of these streams and to protect their indigenous flora and fauna.

However, the research has been extensive rather than intensive in character in order to reflect the national responsibilities of the NRA. As such it has presented a general overview of the importance of headwaters and the extent of their degradation in a broad range of landscape types subjected to a wide range of land use practices.

Inevitably this approach has identified a series of additional questions. These can be divided into three broad categories; general ecology, the impact of specific land use practices and operational techniques. The categories fit well with the principal aims of the NRA's corporate strategy for research and development (National Rivers Authority 1993h).

- *improve the operational efficiency and effectiveness of the NRA*
- *ensure that its policies and practices are based on strategic scientific and technical assessment of the problems which lie ahead*

The need to base operational practice on sound research was re-iterated in section 4.4 in relationship to the development of catchment management plans.

- **THE NRA SHOULD PROMOTE FURTHER RESEARCH ON HEADWATER STREAMS IN ORDER TO BETTER UNDERSTAND THEIR ECOLOGY, HOW THEIR FLORA AND FAUNA ARE IMPACTED BY LAND USE ACTIVITIES AND WHAT OPERATIONAL TECHNOLOGIES ARE APPROPRIATE TO THEIR GENERAL MANAGEMENT AND THE CONSERVATION OF THEIR BIOTA**

6.2 General ecology

The proposed research is related to the need to understand the factors responsible for promoting species richness in headwaters, the autecology and habitat requirements of headwater taxa of special conservation importance and the value of headwaters as spawning and nursery grounds for fish.

- **THE NRA IS RECOMMENDED TO UNDERTAKE RESEARCH ON THE FACTORS WHICH LEAD TO AN UNDERSTANDING OF LONGITUDINAL ZONATION AND OTHER FACTORS WHICH CONTRIBUTE TO SPECIES RICHNESS IN HEADWATERS AND THEIR SIGNIFICANCE TO BIODIVERSITY AND TO THE DISTRIBUTION OF CONSERVATIONALLY IMPORTANT TAXA**

Research at the IFE (Clarke 1994, Tapia and Furse unpublished) has shown that headwaters display strong longitudinal zonation and that many species occur in only very short sections. Furthermore many of these show strong affinities with particular meso-habitats.

Stage 2 studies (Furse et al. 1993) indicated that headwaters are very varied in their species richness and that particularly rich sites tended to be along geological ecotones. It was also shown that many characteristic headwater taxa appeared to be confined to a small number of streams although this may be due to zonation effects.

In view of these findings and the major contribution that headwaters make to catchment biodiversity, it is important to understand the causes of species richness in headwater streams in order to best manage and restore them to ensure their conservation value and to safeguard the rare and endangered taxa associated with them.

A research proposal with these objectives was outlined section 5.3 the Stage 3 project report (Furse et al. 1995a, pp141-142).

- **the NRA is recommended to undertake research on the ecology of rare and conservationally important taxa**

This proposal extends the general approach to maintaining taxon richness covered by the previous recommendation. It is targeted at understanding the habitat requirements of individual headwater taxa of special conservation value with a view to protecting existing populations and extending the range of streams they occur in through sympathetic habitat management.

- **the NRA is recommended to undertake research on the resilience of headwater taxa to low flows and drought**

A key element of the conservation plan for headwaters is to maintain adequate flow to maintain populations of the main plant and animal species.

In extreme cases many streams have dried completely due to a mixture of climatic conditions and groundwater and instream abstraction. However several small streams, such as chalkland winterbournes, are naturally intermittent and have developed a specialised fauna, including several of conservation importance. Even in these cases extended intervals of drought may be sufficiently severe to eliminate populations.

Setting acceptable flows in headwater streams is not a well developed art because of the paucity of ecological research in these systems. The recommended research is advocated in order to better understand the minimum acceptable duration and quantity of flow required in headwaters of different kinds including both those which are naturally perennial and those which have always been intermittent.

- **it is recommended that research is undertaken on the fauna of the land-water interface**

Many of the taxa, including those of conservation importance, that have been recorded in recent headwater studies (Furse et al. 1991, 1993, 1995a, Barr et al. 1993) have been Diptera. Many other dipteran species have been captured, but cannot be identified beyond genus level, or sometimes even beyond family, because of lack of adequate taxonomic keys. Many of these species will be identifiable from adult material.

It is probable that many of these taxa, as larvae, inhabit the damp, semi-aquatic areas at the land-water interface of small watercourse. In order to better appreciate the true conservation value of headwaters further research on this type of habitat is required supported by the development of improved taxonomic information on the species involved.

This type of research may more appropriately be sponsored by the conservation agencies than the NRA but the Authority should consider the possibility of jointly funding such a programme.

- **IT IS RECOMMENDED THAT THE NRA UNDERTAKE RESEARCH ON THE IMPORTANCE OF HEADWATERS AS HABITATS AND SPAWNING GROUNDS FOR FISH**

The headwater conservation strategy detailed in preceding chapters contains few firm recommendations about the conservation of fish populations. This is because little co-ordinated information has been collected on the role these small streams play as habitats, spawning grounds and recruitment areas for fish species.

It is recommended that this lack of knowledge is remedied by a **national programme of fisheries investigation which should be complementary to and linked with the current macro-invertebrate studies in order to derive maximum benefits from existing data-sets.** Such a programme would allow stronger headwater fisheries conservation policies, including stream restoration practices, to be built into catchment management plans.

6.3 The impact of specific land use practices

A variety of land use practices have the potential to impact on the biological condition of headwater streams. Furse et al. (1995a) showed that streams in all types of landscapes were ecologically degraded and poor quality was negatively correlated with many sources of potential perturbation generated by farming activity.

The physical presence, in headwater catchments, riparian corridors and stream channels, of many obvious sources of potential perturbations were easy to record in field surveys based on a single day's visit. These included things such as dairy yards, manure heaps, impoundments and culverts.

Other potential perturbations of a diffuse nature were undoubtedly under-recorded because they were not happening during the visit or had not taken place sufficiently recently for evidence of their occurrence to persist. In this category are factors like fertilisation and liming and the application of a variety of agri-chemicals such as pesticides, herbicides and fungicides. In the same way, direct evidence of erosion was difficult to quantify.

Each of these activities have the potential to impact streams through the movement of chemicals or particles off the land and into watercourses. Agri-chemicals and nutrients may enter watercourses directly through run-off or indirectly via groundwater sources.

The mechanisms and rate of transport will depend on a variety of factors including the rate, time and distance from the stream of the application, the topography of the land, the existence, if any of riparian protection zones and the prevailing climate immediately before, during and after application. Many of these factors will also influence the erosive processes.

A major factor in the transport of chemicals and sediment from soil to land will be the nature and type of the soil in the catchment. The physical and chemical characteristics of soil are each important in determining the transport rates and processes, both directly to the stream or to the groundwater.

Some streams will be more vulnerable to certain agricultural practices than other according to the edaphic characteristics of their catchments. Soils thus have an important bearing on developing headwater conservation policies related to best land management practices.

Within the stream the chemicals will differ in their impact according to their affect on biochemical oxygen demand, toxicity, concentration, persistence and bio-accumulation. Particle transport into the stream may reduce habitat biodiversity through silting-up and contribute to the persistence of agri-chemicals in the stream sediment. Each of these factors may impact upon the headwater stream biota and reduce catchment biodiversity.

- **THE NRA ARE RECOMMENDED TO UNDERTAKE RESEARCH ON THE ROLE PLAYED BY SOILS IN THE TRANSPORT OF CHEMICALS AND SEDIMENT PARTICLES INTO HEADWATER STREAMS AND THE IMPACT THESE HAVE UPON THE HABITAT STRUCTURE, SEDIMENT AND WATER CHEMISTRY AND BIOTIC ASSEMBLAGES OF THE STREAMS**

A research proposal, of this kind has been jointly submitted to the NRA by the Institute of Freshwater Ecology and the Soil Survey and Land Research Centre (Furse et al. 1995a, p140) and includes the development of vulnerability/risk models. This proposal provides a framework for a range of additional possibilities.

- **the NRA are recommended to undertake research on the impact of nitrate and phosphate enrichment on the flora and fauna of headwaters**

This is of importance in the development of ecological criteria for establishing Nitrate Vulnerable Zones.

- **the NRA are recommended to undertake research on the persistence, accumulation and biological impact of pesticides**
- **the NRA should undertake research on the impact of bracken control on the biological condition of moorland headwaters**

Furse et al. (1995a) provided evidence to suggest that there might be a link between the cover of bracken in moorland catchments and the biological condition of headwaters. On average, the more bracken that was present in catchments, particularly in the North Yorks Moors, the better the quality of the stream was.

This evidence was far short of conclusive but was sufficient to justify further research to establish whether a causal mechanism is operating and, if so, what that mechanism is.

- **the NRA should undertake research on the impact of channelisation and realignment of headwaters upon their flora and fauna**

Furse et al. (1995a) showed that nearly 60% of headwaters in the Cam catchment were channelised or re-aligned and that in arable headwater catchments of the other three river systems studied the equivalent figures were all of the order of 30%.

The affects of channelising headwaters are likely to be reduction in instream and riparian habitat diversity and an increase in siltation of the stream bed.

Channelisation/realignment was the strongest vector of the canonical correlation analyses of biological condition of headwaters and the frequency or occurrence of potential perturbations of that quality. The channel modification practices were negatively correlated with Ecological Quality Index values based on macro-invertebrate assemblage composition.

- **the NRA is recommended to undertake research on the impact of riparian livestock grazing on the condition of the river banks of headwaters and upon the habitat diversity and biological condition of the streams**

Another finding of the Stage 3 study was that 4.3% of all bank length was poached by livestock. The effect of this damage may be largely mechanical since there was almost no correlation between the quantity of stream poached and Ecological Quality Index values. However, as in the case of the role of bracken, further more detailed study is required.

The importance of poaching of river banks to both terrestrial and aquatic habitat quality and biotic assemblage composition thus needs to be further investigated in order to determine what recommendations should be included in the headwater conservation strategy, beyond the general policy of developing non-agricultural riparian protection zones.

6.4 Operational techniques

The headwater conservation strategy presented in this report is broad-based and often generalised. Some specific practices are outlined in other statutory and non-statutory codes of practice (see section 4.4.2). Other recommendations need to be tested by further research and practical trials.

In particular, the forthcoming Council of the European Union directive on the ecological quality of water will require improved procedures for setting standards in headwater streams based on comparisons of observed biological assemblages and those expected to occur if "ecological quality" is good.

This principal is already well developed in the United Kingdom through RIVPACS (Wright et al. 1993). However, headwater streams are not as well catered for in RIVPACS as larger sites further from the stream source.

For that reason a form of RIVPACS was developed during Stage 3 of the current project in order to evaluate the biological condition of headwater streams. The new system was based on 214 headwater sites and appeared to work well in most situations. An exception to its apparent effectiveness may be acidic moorland streams where it is unclear whether the sites in the system truly represented the best attainable quality of this type of watercourse.

Another limitation of the headwater prediction system is that it has not been developed as an operational system and its current application is cumbersome and largely inaccessible for routine use. The effectiveness and accessibility of the system both need further development and testing in order to gain the widespread use that is needed to reliably assess the biological condition of headwaters and to set suitable biological WQOs (Water Quality Objectives).

- **THE NRA SHOULD TAKE URGENT STEPS TO DEVELOP APPROPRIATE OPERATIONAL TECHNIQUES FOR ASSESSING THE BIOLOGICAL CONDITION OF HEADWATERS AND DETERMINING SUCH BIOLOGICAL WATER QUALITY OBJECTIVES AS MAY BE LEGALLY REQUIRED**

A proposal to develop a headwaters module for RIVPACS was presented by Furse et al. (1995a) in section 5.3, p142 of their Stage 3 report.

- **a necessary step in the development and testing of an operational headwater module for RIVPACS will be a synoptic macro-invertebrate survey of headwaters in other regions of the country than the four test catchments used in Stages 2 and 3 of the project**

A survey of this kind will provide the necessary data to extend the system in areas of weakness and to evaluate the reliability of the system using good quality macro-invertebrate data from real trial sites. It will also provide further evidence to establish the degree of headwater degradation on a national rather than local level.

- **the NRA should continue to undertake research on the optimal design of buffer or riparian protection zones**

Optimizing buffer or riparian design is a common and important theme of the NRA's R&D strategy. Existing research programmes should be complemented by studies on headwater streams. Design evaluation should include performance indicators based on the habitat quality of the river corridor, riparian plant, bird and mammal communities and the biological condition of streams as expressed by their biotic assemblages.

- **THE NRA SHOULD UNDERTAKE A SERIES OF RESTORATION PROJECTS ON DEGRADED HEADWATER STREAMS AND RESEARCH THE EFFECTIVENESS OF THE SCHEMES**

Development of optimal design of riparian protection zones is one of a number of elements comprising a complete restoration scheme. Elimination of all sources of pollution, channel re-structuring and naturalisation, silt removal and flow enhancement are other techniques that should be tested.

Each restoration project should be thoroughly researched and evaluated, using performance criteria such as those suggested above for riparian zone designs.

The development of proven techniques for the restoration of small watercourses will be a major advance in the implementation of a broad-based and effective headwater conservation strategy.

6.5 Research priorities

The NRA's research priorities in headwater streams are seen to be:

- **the implementation and evaluation of headwater restoration projects**
- **the operational development of a headwaters module for RIVPACS**
- **an evaluation of headwater streams as habitats, spawning grounds and recruitment areas for fish**
- **an understanding of the role played by soils in the transport of agri-chemicals and sediment into streams and the consequences for the habitat diversity and biological condition of those streams**
- **sources of macro-invertebrate species richness in headwaters and the implications for the restoration and management of streams for conservation purposes**

7. SUMMARY OF MAJOR RECOMMENDATIONS

The principal recommendations made in this report are reproduced here in summary form.

7.1 Monitoring and surveillance

7.1.1 Development of a national headwater data-base

The NRA needs to develop greater awareness, organisation use and dissemination of the headwater data they already possess, through the development of a national headwaters data-base.

They should take steps to extend their data-holding through a co-ordinated national headwater sampling programme.

Macro-invertebrate sampling should be the principal means of assessing the biological condition of headwaters.

River Habitat Surveys should be undertaken at all headwater General Quality Assessment (GQA) sites.

7.1.2 Development of procedures for the assessment and reporting of the condition of headwaters

The principal procedure for using macro-invertebrate data for reporting on the biological condition of headwaters is through the use of Ecological Quality Indices (EQIs).

An operational module of RIVPACS based on entirely on single season headwater samples should be developed for determination of EQIs.

The principal procedure for general reporting on the habitat quality of headwaters should be the same as that adopted throughout the River Habitat Survey of 1995.

The principal procedure for general reporting on chemical quality of headwaters should be the same as that adopted throughout the GQA system.

Having developed strategies for collecting, storing and assessing headwater data it is essential that the strategy is consolidated by accessible reporting.

7.2 Protection and remediation

7.2.1 General

The NRA's corporate strategy must include a discrete plan for the conservation and management of headwaters.

A practical management strategy for the protection and remediation of headwater streams should operate at both regional and national level.

All catchment management plans must take specific account of the conservation importance of headwaters and the environmental threats posed to them and the rivers they feed.

7.2.2 Awareness

The summary report on "The Faunal Richness of Headwater Streams" should be widely circulated at all levels of the NRA.

A general "headwaters fact file" should be produced for internal NRA information and for circulation to external organisations and individuals.

The importance of headwaters and the problems affecting them needs to be known to those statutory committees that advise the NRA and form a practical link between the authority and the views and concerns of the public.

The NRA should organise headwater seminars and/or conferences targeted at the water industry, local and national government and statutory and non-statutory conservation organisations.

The NRA should request the statutory conservation agencies to make available the numbers, length, distribution and protection status of headwaters in designated conservation sites.

Publicity on headwaters should be sought through radio, television and popular publications.

7.2.3 Collaboration

The NRA should seek to develop programmes of co-operation and collaboration with landowners and land managers in order to best manage headwaters without the use of legal constraint.

The NRA should mount special regional campaigns directed towards better management of headwaters by farmers through voluntary plans of action.

The NRA should seek endorsement from the National Farmers' Union and the Country Landowners Association for its measures to protect headwaters and conserve their biota.

The NRA and the agricultural advisory services, the Agricultural Development and Advisory Service (ADAS) and the Farming and Wildlife Advisory Group (FWAG), should mount joint, or complementary, exhibitions on the conservation and management of headwaters for display at agricultural shows and events.

ADAS and the NRA should actively work together to encourage landowners to participate in the Water Fringe Areas Scheme, with special emphasis on headwater streams, and jointly monitor the economic and environmental benefits of participation.

The NRA should provide material and financial support to FWAG specifically targeted towards headwater protection, including the production of an informative and practical advisory booklet.

The detailed guidelines for the prevention of pollution to watercourses provided by the code should form the basis of the NRA's own strategy on the protection of headwaters in agricultural catchments.

The NRA and the conservation agencies should work together to extend the coverage of headwaters receiving conservation protection.

Each conservation agency should be encouraged to include a headwater policy statement in their corporate strategy documentation and initiate headwater protection programmes as objectives in their annual work plans.

The NRA and the conservation agencies should collaborate to seek the inclusion of headwaters as a special category in the United Kingdom Biodiversity Action Plan and thus draw attention to their contribution to faunal biodiversity and the potential threat they are susceptible too due to agricultural and other activities.

The NRA and the Association of Local Planning Officers should seek to establish and disseminate common guidelines for the granting or refusal of permission for developments which might impact upon the biological condition of headwaters.

The NRA and the water companies should work together to formulate and implement a special campaign to improve all sewage and waste water treatment works whose effluent may be liable to degrade the biological condition of headwaters

The detailed guidelines for the protection of headwaters provided by the Forestry Commission should form the working basis of the NRA's own strategy in forested areas.

7.2.4 Control

Where education and voluntary action are insufficient to protect headwaters and their biota then the NRA should fully exercise their statutory powers in order to achieve their objectives.

The NRA should fully exercise the powers granted to them under the Town and Country Planning Acts of 1971 and 1990 to object to any proposed development which is likely to have unacceptable consequences for the biological condition of any headwater stream.

The NRA should include a headwater-specific section in the planning liaison standard paragraphs being developed at regional and national level or specific headwater related paragraphs in other individual sections.

The NRA should identify those headwater catchments that it deems in need of special protection from pollution from agricultural waste products and exercise its duty of consultation with the Secretary of State for the Environment in order to inform him of the case for designating those catchments as water protection zones.

No discharge consent or licence to abstract, impound or culvert any headwater stream should be granted which is likely to significantly decrease its biological condition.

The NRA shall maintain a programme of action for the alleviation of low flows in headwaters.

The procedure which the NRA uses to determine the quantity of water that may be abstracted under any one licence, and the timing of that abstraction, should take greater cognizance of the ecological requirements of the natural biota of the site than is allowed for in the current "Ho Hum" model

The NRA should liaise with and guide the Internal Drainage Boards and the water undertakers in order to create and enforce such local byelaws as are appropriate to protect headwaters.

7.2.5 Improvement

The NRA should include a strategy for improving the biological condition of headwater streams in all catchment management plans

Catchment management plans should identify which land use practices are most likely to be harmful to headwaters, how that harm is caused and what impact the harm has upon the stream and its biota

Catchment management plans should identify the specific action plans and policies which are needed to control harmful impacts upon headwaters

Catchment management plans should be based on the "needs" of the river and should be based on the results of carefully conducted strategic research

Catchment management plan for headwater streams should include the objective of developing riparian protection zones of at least 10m width along their banks.

The NRA should press the Ministry of Agriculture Fisheries and Food for extension of schemes, such Water Fringe Areas scheme, which specifically provide financial incentives for creating riparian zones to improve the biological condition of rivers.

The NRA should pursue a policy of lobbying to obtain a "national riparian zone" for the protection of headwaters and other watercourses.

Catchment management plans should include specific headwater restoration schemes, agreed with landowners, in which headwater improvement policies can be tested, modified and refined through practical experience.

Catchment management plans should incorporate the concept of constraint areas where no further development under NRA control is to be permitted.

Catchment management plans should be used to promote water-level management plans based on ministerial direction from MAFF.

The NRA should invoke the powers of "polluter pays" to retrieve the costs of improving the biological condition of headwaters where voluntary action to do so is not taken by the polluter.

7.3 Evaluation

7.3.1 Monitoring performance

The NRA need to set clear and publicly stated criteria for monitoring the effectiveness of their headwater conservation strategy

Every five years, or after each GQA, whichever is the sooner, the NRA should publish a separate headwaters report listing the biological condition and river habitat and chemical quality of each national headwater, rolling programme site and the changes that have occurred since the previous report.

The NRA should set targets for overall levels of improvement in biological condition and river habitat and chemical quality of headwaters to be achieved over predefined periods.

Headwater restoration schemes should be undertaken in conjunction with selected landowners to evaluate the effectiveness of the techniques involved.

For evaluation of the success of river restoration schemes in environmental terms, the NRA should establish separate performance targets for increase in biological condition and river habitat and chemical quality.

7.3.2 Consultation and discussion

In developing headwater improvement and restoration strategies as part of broader catchment management plans the NRA should consult as widely as possible with all organisations and individuals with a legitimate interest in those strategies.

7.3.3 Cost-benefit analysis

In evaluating the success of their headwater conservation strategy the NRA should at all times be aware of the relative costs and benefits to the Authority of implementing each component element, including those of individual catchment management plans.

In assessing the costs and benefits of their headwater conservation strategy the NRA should, as far as possible, apply those principles and procedures laid down in their economic appraisal manual.

Any cost benefit analysis of the NRA's headwater conservation strategy, at whatever level of geographic resolution, should seek to establish where the greatest benefit can be accrued for the least expenditure and the strategy should be directed to reflect the conclusions drawn from the analysis.

7.4 Research

7.4.1 General

The NRA, sometimes in collaboration with other funders, should promote further research on headwater streams in order to better understand their ecology, how their flora and fauna are impacted by land use activities and what operational technologies are appropriate to their general management and the conservation of their biota.

7.4.2 Research priorities

The NRA's research priorities in headwater streams are seen to be:

- the implementation and evaluation of headwater restoration projects
- the operational development of a headwaters module for RIVPACS
- an evaluation of headwater streams as habitats, spawning grounds and recruitment areas for fish: this project should be linked to the current headwater research programme in order to maximise the benefit of existing information
- an understanding of the role played by soils in the transport of agri-chemicals and sediment into streams and the consequences for the habitat diversity and biological condition of those streams, including the development of vulnerability/risk models
- sources of macro-invertebrate species richness in headwaters and the implications for the restoration and management of streams for conservation purposes

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