Project 342

Programme Area Review of Fisheries R&D

E D Le Cren

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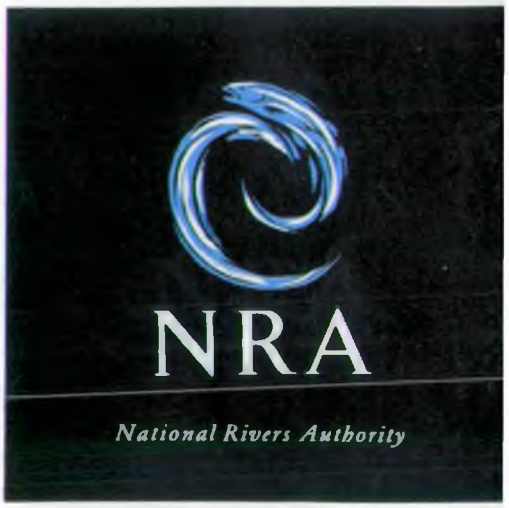

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EXECUTIVE SUMMARY

This review is directed at assessing the relevance, effectiveness, efficiency and application of the NRA's R&D programme in fisheries from its inception up until August 1994.

I have based my judgments and recommendations partly on discussions with the Head of R&D, Fisheries R&D Commissioner and Topic Leaders, several Project Leaders and Contractors, the Head of Fisheries and various other Head Office and Regional officers. My main source of information, however, has been the Project Initiation Documents (PID's) and reports (mostly R&D Notes, but also some Project Records, R&D Reports and interim & progress reports) for the 33 projects which have been wholly or partially completed (See Appendix I). A very large part of the 3400 pages that these reports total were read, and marks given for the aspects: objectives, work by contractor, reports, uptake and value for money. A few changes in emphasis and minor amendments have been made as a result of discussions during drafting and at the Delivery Meeting on 29 Sptember 1994.

The overall average mark was 'satisfactory' or 'good'; those few projects that were less than successful tended to be those where the PID and objectives had been poorly thought-out and defined or were far too ambitious, or the science done by the contractor was poor; often both were to blame for failure. The much larger proportion of projects that were good or excellent were those where the objectives were well defined and attainable and the contractor experienced and skilled. A few of the early projects were inherited from DoE, others were devoted to finding out regional practices that had been inherited from the Regional Water Authorities, literature surveys, or desk studies as a preliminary to larger projects. Some of these were useful; others did not add much to information that was already known or readily available. Several projects were aimed at developing the technology used in fishery activities – estimating fish stocks, counting migrants, surveying habitat features etc. Most of these were successful and will, when fully taken up, significantly enhance the effectiveness and efficiency of operations and management.

The uptake of the results of R&D may be its weakest aspect, and was discussed at the delivery meeting. Perhaps the impetus of projects tends to end with the implementation plan; management may not feel involved enough in R&D, or appreciate its responsibilities in implementation and the effort that is needed to put new ideas into effect; memos and reports may remain unread amongst the large amount of paper that officers receive; the final development phases may often need to be done with the aid of field staff who will use the new methodology? I recommend that further attention be paid to uptake issues.

The overall R&D system for assessing needs over the range of fishery activities, identifying and attaching priorities to those projects that will be rewarding, and commissioning and managing the rolling programme appears to be well done (with support from R&D personnel) by a small group of dedicated fishery scientists, for whom it is only a part-time job. They deserve more assistance and recognition and less bureaucracy. There should be much more recognition of the essential role of science in fishery management throughout the function and more involvement of managers at all levels in the R&D programme. It is essential that fishery policies and objectives and their supporting R&D are fully integrated one with the other.

The overall balance of the programme is good and is likely to respond to changes in need and the further development of fishery management policies and objectives that has recently begun. For migratory salmonids, recent advances in basic knowledge and technology should enable the application of R&D towards significant improvements in management. Advances in the management of coarse fish will have to await more basic understanding of their ecology, behaviour and detailed habitat needs; a suite of well-defined R&D projects is required for this. The further development of technology and habitat survey (*e.g.* 'Habscore') in aid of monitoring, survey and research is warranted. Law enforcement might benefit from operational

research in bailliffing. Now that the NRA has a successful programme to enhance water quality, more effort should be given to improving the *physical* features of rivers. To this end there is a need for more fisheries involvement in inter-functional R&D aimed at returning rivers into a more natural state; this would benefit flood defence, water quality, and conservation as well as fish stocks.

The overall expenditure on fisheries R&D is probably less than is appropriate for such a science-based business; a greater investment in R&D is needed if NRA's obligations to fisheries are to be properly met. NRA should also reconsider the contribution it makes towards strategic and basic research on fish now that the universities and NERC are much less able to support it – in spite of the Government's 1993 White Paper *Realising our Potential*. Partnerships and liaison with governmental and non-governmental organisations and universities in the UK and Europe should be increased.

NRA's well-motivated and professionally skilled fishery scientists are a major asset; they should be nurtured and their personal scientific expertise developed by increasing their opportunities for outside contacts, collaborative and in-house research, and the publication of papers. This will help to avert a tendency for the NRA's fishery officers to be inward-looking and also enhance the belief in science throughout the function.

The Government's requirement for competitive tendering leads to poor value for money; not only because it enhances the risk that cheap but inadequate contractors may be chosen, but also because it engenders jealousies over intellectual copyright, prevents the free flow of information and thus slows down the overall advance of science, and makes inter-institute collaboration much more difficult . This, and other rules under which the NRA is required to operate, are much greater restraints on the effectiveness and efficiency of its R&D than any internal weaknesses. The NRA should exercise the flexibility that is allowed and try to devise new ways of contracting out R&D that will encourage collaboration (such as that proposed in a NRA–NERC concordat) and make the best use of the national 'brainpower'. There should also be further effort put into trying to simplify R&D administration with less reliance on detailed procedures and more on the delegation of well-defined responsibilities. There should also be an effort to make all documents – technical as well as administrative – shorter, more readable and with more emphasis on the important conclusions.

In conclusion, I found much to admire in the NRA's fisheries R&D. In general I can report that, under the constraints under which it is required to operate, the NRA has a well selected and balanced programme that is efficiently managed and has the potential to be effective in benefiting its fishery activities and management responsibilities, especially as the policies and objectives for these latter become developed. The programme has improved over the past five years and has promise for the future. Most of the internal weaknesses that are present have already been recognised and my comments and recommendations apply largely to details, changes in emphasis or new developments. In the full report I list 54 recommendations in five groups for the internal attention of the NRA; the five leading recommendations are given on page 18.

1. INTRODUCTION

1.1 Background and purpose of Review

The National Rivers Authority has Statutory Duties to maintain, improve and develop fisheries and to carry out research and development in support of its core functions, of which fisheries is one. When it was created in 1989, the NRA inherited research and development (R&D) projects from both the Department of the Environment (DoE) and the Regional Water Authorities. Since then it has been developing both its own fisheries strategy and R&D programme to support that strategy. This review, carried out by an independent fishery biologist who has had experience in both research and its management, is part of the policy of assessment of the NRA's R&D to ensure that it delivers the intended benefits to the fishery function effectively and efficiently. It has been carried out with reference to the ROAME criteria for R&D assessments. The review is directed at the whole programme of national R&D in fisheries since the start of NRA up to August 1994 – nearly five years, the procedures by which R&D projects are chosen, commissioned and managed, the thirty or so individual projects that have been carried out, and the present balance and future of the programme. (An extract from the terms of reference for this Programme Area Review are given in Appendix II.)

Fisheries management is a science-based activity, and relies very heavily on understanding the biology of fish, especially their population ecology, and the river and lake environment in which they live. Management also involves technology-based activities such as the operation of automatic counters for migratory fish and electrofishing equipment, or the application of statistics and computers towards efficient sampling and surveying and the proper analysis and interpretation of numerical data. Relationships with anglers and commercial fishermen may need economic and social information for good policy decisions; and the efficient deployment of law-enforcement staff such as bailiffs may benefit from operational research.

The NRA's fisheries function operates alongside the other functions – flood defence, water quality, water resources, recreation & navigation and conservation, each of which have their own R&D programme. These other functions obviously affect fisheries – fish are greatly influenced by their physical and chemical environment, and, wisely, it is now NRA policy to integrate the functions to a much greater degree than has been the case in the past. This will influence the R&D programmes, and several of the projects reviewed here have links with those in other programmes, and a few cross-functional projects have already been commissioned.

Science and development operate as a continuum from basic, 'blue skies' research at one end of a spectrum to the application of technology or engineering at the other. It is NRA policy to carry out research that is aimed at direct benefits to its own activities and operations, and to rely on other organisations to carry out the basic and strategic research that is essential to the underpinning of its own R&D. In the UK, this basic and strategic research, which is fundamental to the management of fisheries, is carried out by the universities, NERC institutes and grant-aided associations, and in the Ministry of Agriculture, Fisheries & Food (MAFF) and Scottish Office Agriculture & Fisheries Department (SOAFD) laboratories. While UK laboratories have made substantial contributions to international basic and strategic research in aquatic and fishery sciences in the past, their eminence has suffered a decline over recent years, in spite of the Government's 1993 White Paper *Realising our Potential* and its Technology Foresight initiative; and, in the future, more reliance may have to be placed on research done abroad. Certainly, in planning its R&D programme, the NRA must take into account the availability of the basic and strategic understanding that provide an essential under-pinning to this programme, and also be aware of relevant R&D worldwide.

The NRA is a public agency and, as such, is required by government to conform to strict rules in its administration, especially those that involve the expenditure of public money on contracts with outside bodies. Most of the bureaucracy commented upon in this report is thus the result of the need to comply with rules that are imposed upon the NRA by the DoE and Treasury.

1.2 Review procedure.

When commissioned to carry out this review, my first task was to gain, through discussion with the Fisheries R&D Commissioner and Topic Leaders, an idea of how the 'system' worked. This process has been enhanced throughout the review by further discussions with the same officers and with project leaders in the regions and a selection of senior staff at the Head Office. I was supplied with the Project Initiation Documents (PID's) for nearly all the individual projects, and with the reports from most of them. These reports were mostly R&D Notes - the edited and shortened 'published' versions of the R&D Project Records aimed at the end user, though frequently I was able to read the latter as well. For the projects that had not yet been fully completed, I read draft, interim or progress reports. All these reports, together with the PID's were the basic data on which I had to make my judgments, and reading them occupied a good deal of the time available – they totalled some 3400 pages. The proper assessment of a scientific paper or report requires critical attention to the detailed description of the methodology, results, analyses and interpretations; sound judgments cannot be made just from the summary. I did not read every page – and there was some repetition – but only a small percentage of the total could be ignored or just skimmed.

A list of these projects is given in Appendix I. I was asked to assess each project and give it marks, using a system that would be approximately compatible with the system being used by Science Connections Limited (SCL) for their parallel reviews of three other R&D programmes. Accordingly, I marked the projects for the five aspects: objectives and PID, the contractor's work, the report(s), uptake from the project, and value for the NRA's money. On the principle that the distribution of marks should approach a Normal curve, I used the grades: very poor, poor, satisfactory, good, and excellent. These can be given the numerical equivalents: 1, 3, 5, 7, and 9, respectively. Where parts of an aspect of a project varied in quality, I used intermediate marks; *e.g.* poor/satisfactory - or 4; good/excellent - or 8.

In making my assessments of **objectives**, I took into account the relevance of these to the NRA's fishery activities and responsibilities, the reasoning behind the project argued in the PID, the clarity and precision with which the objectives were stated for the benefit of the contractor, and whether there was a good chance that the objectives could be fulfilled (taking into account the time and money available). I judged the **contractor's work** from internal evidence provided in the reports, supplemented in a few cases by information from the project leader. Here I looked for scientific competence, the use of the best and most relevant methodology and experimental protocol, a thorough interpretation of the results, and fulfilment of the customer's contractual requirements. I examined the **reports** largely as I would a paper submitted for publication, looking at their organisation, the accuracy, brevity and clarity of the writing (and whether it was good English), and whether they provided the information in a form easily accessible and useful to the NRA. Unfortunately, it proved difficult to get much information about **uptake** from the results of the individual projects, so rarely was it possible to give this aspect a mark (though general aspects of uptake are discussed). I assessed the **value for money** of each project on the basis of the quality and relevance of the output in relation to what it had cost the NRA; where there had been collaboration with another organisation this was usually only a proportion of the total cost.

As well as specifically arranged meetings with the Fisheries R&D Commissioner and topic and project leaders, I have taken every opportunity of contact with project leaders and other fishery officers, contractors (including the IFE), and various other individuals connected with NRA R&D or the world of fishery science, to discuss issues relating to the review. I also had several

more brief discussions by telephone, and wrote to six contractors asking for answers to twelve specific questions about their projects and relationships with the NRA as a customer. I discussed liaison between the Fisheries R&D programme and those of other functions with two officers at Head Office, and also had a useful discussion with the Head of Fisheries. Finally, the drafting of this report has substantially benefited from discussions with the Head of R&D, the External Advisor on Fisheries, and the Commissioner for Fisheries R&D. The final version of this report has also taken into account the discussions at the Delivery Meeting including comments from the regional FRCN managers and two members of the NRA Board.

The shorter version of this report omits the assessments of each of the individual projects, an introductory section on the limitations of my review, and a small number of comments relevant only to internal arrangements within the NRA. Apart from a few minor clarifications in wording, it is otherwise identical to the full report.

2. THE PROGRAMME OF R&D PROJECTS; 1989 - 94

Basic details of all 33 of the projects that I have reviewed are given in the Appendix I; these include a few projects that have begun only recently. As far as I am aware, the list is a complete one, though a few new projects may have been authorised recently but not yet put out to tender or started. Only those for which I was able to read at least an interim report have been assessed.

My own simple classification of the projects shows that 16 of them were directed at what may be called the **'operational technology'** of fishery management. They included projects on the development of fish counting or tracking instruments, the use of grass carp for weed control, the statistics of population surveys etc. Nine of the projects have led, or probably soon will lead, to the production of practical manuals. In two or three cases there were recommendations for further development of the technologies. None of these projects involved any really original research or new technologies, but several included statistical, electronic or engineering development. Most of this large group of projects were initiated by precise and relatively simple statements of their objectives, and were carried out with success by contractors who were chosen because they already had proven experience in the type of work.

Five of the projects were essentially reviews by outside contractors to determine **what the NRA already did**; for example the survey of studies of salmon migrations in the regions using radio-tags, or the protocols used following fish kills in the different regions. Some of such surveys were probably an inevitable result of the need for greater integration and harmonisation after the separate Regional Water Authorities came together into the NRA, and the need to adopt 'best practices' nationwide.

A major part of ten of the projects, and part of some others were **literature reviews**. It is clearly wise for the up-to-date literature on a topic to be surveyed before a more expensive R&D project is launched. However, in some cases professional fishery scientists should have been aware of much of the information already, or known where to find it in other recent reviews. Several (but not all) of the reviews lacked a proper critical assessment and collation of the papers read, and any interpretation into concise conclusions that would be of direct value to NRA fishery officers. Whether this was the fault of the detailed liaison between the project leaders and the contractors, or a failure on the part of the latter is not clear; in some cases the literature review may have been carried out by an inexperienced research student. Though a few of these literature reviews may have aided the design of subsequent R&D projects (or later phases of the same project), several of them seem to have been of limited value.

Seven of the projects involved **strategic or basic research,** though in nearly every case, the results were relevant to the NRA's fishery management activities. A further six projects investigated the **relationships of fish to their environment** or the effects of man-made influences; most of these, too, involved original research, and were directly applicable to management problems. Several of both types of project recommended further research projects or quite specific management actions, but uptake from these less immediately and obviously useful projects seems to have been more difficult than from the more directly technological ones.

3. THE ORGANISATION OF FISHERIES R&D

3.1 The constitution of the programme

At its start, the NRA inherited R&D projects from the DoE and the RWA's; since then systems for developing an R&D programme for each function have been evolving towards a much more structured organisation. The overall needs for fishery R&D and the ideas for worthwhile projects originate from three sources: a) the FRCN managers group, b) various review groups (sometimes called 'working groups' or 'task groups'), and c) the R&D group (the commissioner and his three topic leaders). Some ideas also come from contractors or others outside the NRA. At present, individual fishery officers are neither encouraged nor discouraged to suggest projects; I suggest that they are given positive encouragement, as the value of stimulating the initiation of ideas from young and lively minds that are engaged daily in executing fisheries activities should not be neglected.

An *NRA Fisheries Strategy* was published in 1993 and fisheries activities reviewed in 1994, but most of the detailed development and clarification of the various aspects of those fishery policies and objectives have yet to be completed. A start has been made with the publication (in September 1994) of a draft of *A National Strategy for the Management of Salmon*.. Ideally these detailed fishery strategies should become the basis for the development of an R&D programme to support them; but meanwhile many of these needs have been anticipated. It should also be realised that the process of drawing up management strategies does, in itself, require R&D input. Indeed, there is a need for a much greater integration between R&D and management so that the latter becomes infused with science throughout the function.

There appears to be an appropriate formal system for drawing up the rolling programme of projects via the 'topic investment appraisals', and the receipt of input from the function managers group and review groups; but there is still scope for all the managers (at all levels) throughout the fisheries function to become much more involved in formulating the R&D programme. There is evidence that the process of putting priorities on the possible projects has greatly improved from the NRA's early days; there does now seem to be an overall strategy to the evolving programme. This should improve further as results from some of the earlier studies that involved literature surveys and preliminary ('scoping') studies come to fruition and as there is more clarification of management objectives. The successful development of methodological technology; *e.g.* for measuring migration (with fish counters), surveying physical habitat features (via 'Habscore') or estimating fish populations in a greater range of waters (via electrofishing and hydroacoustics), should also enable more ambitious research projects and more accurate surveys to be envisaged. I was impressed by the quality of the latest topic investment appraisals that I saw, and by the thinking behind them. They did seem to provide an effective way of selecting priorities from a range of possible projects so as to constitute a balanced programme to meet varied needs. The External Advisor plays a useful role; other outside scientists could be consulted more frequently and the financial and procedural mechanisms for doing this kept as quick and simple as possible.

However, if the success of the R&D group is to be maintained and developed, it is very important that these R&D managers should have adequate time to think, and to keep up with the latest ideas in their science. I have discussed with several people the present policy that employs as leaders of R&D people who are, at the same time, active as managers or scientists in the regions. This practice has the great advantage of ensuring that the organisers of fisheries R&D are people that are close to the problems of fishery management on the river bank; and I endorse this policy. However, it does mean that the R&D commissioner and topic and project leaders have a limited amount of time and mental effort available to spend on their R&D work; it surely takes up much more than the 10% envisaged by the Chief Scientist. I am also concerned that the R&D group do not have enough contact with the world of science outside the NRA - both in the UK and abroad. The group would be significantly helped by the provision of an assistant, perhaps an 'R&D Coordinator for Fisheries', who could relieve them of many of the administrative chores of their job; and I strongly recommend this. They would also be helped by a reduction in the paper-led bureaucracy that slows down their work and by more delegation of well-defined responsibilities.

3.2 The management of R&D projects

3.2.1 The Project Initiation Document (PID). The rolling programme of fisheries R&D and its component topic programmes receive annual approval. Each individual project within these programmes has a 'life-cycle' from identification, through financial authorisation, the execution of the actual work through to its uptake. In the formal procedure, nine 'control points' are identified; some of these would seem to be unnecessary. However, a critical early stage is that of the PID, when the reasons for a project and its objectives have to be stated. I read the PID's for nearly all the projects, and found that they varied greatly in detail and also in the quality of their argument. If there is an overall programme drawn up by the topic leaders which has already been agreed and approved, it should not be necessary to argue the case at length from first principles, including the Statutory Duty of the NRA to manage fisheries, again in the PID.

However, it is important that the objectives should be spelt out clearly, with the specific objectives being component parts of the overall objective; they should neither enlarge nor restrict the overall objective. In some of those I examined, there was conflict or confusion between the general and specific objectives. The wording was often obtuse, too; of the type that might have been written by a lawyer rather than a scientist well versed in lucid English. In some short 'desk' studies, more time should have been allowed for the collection of data and their interpretation into succinct and focussed conclusions. For example, contractors frequently found that it took much longer to get information from the regions than had been envisaged, the schedule then allowing little time for interpretation and thought.

There is also a need for the more explicit recognition that many projects will require a 'development' or 'adaptation' phase when the results are processed into a form that will fit into a the needs of practical application (which also may differ from one region to another). The contractor cannot be expected to complete this phase on his own; usually it will have to be done in collaboration or in-house. Such a development phase will also help to stimulate uptake.

3.2.2 The contracting out of projects. I was repeatedly told that, if there were good reasons for choosing a preferred contractor, or a contractor who did not submit the cheapest tender, this was acceptable in spite of a general policy of putting R&D projects out to tender. However, I was also told that, in practice, this was very difficult to achieve. This policy is one that clearly worries many R&D managers in the NRA, as well as many contractors. As it also begets several wider fundamental problems, I will discuss it in greater detail later.

There are also instances where the best expertise for carrying out a project lies within the NRA. Rarely, however, are time and resources readily available for national R&D projects to done in house. I feel that ways should be explored so that internal expertise could be exploited on R&D more frequently; perhaps sometimes together with outside organisations in cooperative projects?

The effective management of many common species, such as most of the coarse fish, is still limited by a lack of basic understanding of their biology and ecology. Knowledge of their habitat requirements, population dynamics, behaviour and the factors that limit their populations will need the work of skilled researchers over many years to obtain. This will require a long-term strategy on behalf of the NRA and effective collaboration with other organisations. The lessons learnt from some of the larger projects in the past suggest that new procedures for planning, initiating and running such longer-term multi-faceted projects may have to be devised. It is important that the necessary flexibility in procedures is both present and easily exercised if such suites of projects are to be successfully managed.

3.2.3 The detailed management of projects. This is carried out by Project Leaders chosen from among the regional fishery staff. It is clear from evidence from both officers within NRA and contractors, that the quality of this management has varied greatly according to the individuals involved. The NRA has now produced an *R&D Project Management Manual* (R&D Note 249) and also instituted training sessions for R&D project leaders. However, the manual is a complex 220 page document dealing almost entirely with procedural matters, though it does contain one sentence requiring project leaders to have good relationships with contractors. It is essential for there to be good informal (as well as formal) dialogue between the contractor – the person actually doing the research – and the project leader, so that the contractor will know exactly what is expected of him and can discuss immediately and openly any problems that may arise. It is apparent that many project leaders and contractors do have excellent relationships; but occasionally this has not been the case, and, in one or two instances, it contributed significantly to the failure of a project.

One of the functions of the project leader is to ensure that there is regular reporting of progress and that interim and final reports are of the type and standard required. There seems to be a tendency for progress reports to be required more frequently than may really be necessary; perhaps more flexibility should be exercised? Once the project leader is assured that the project is under way successfully and making progress, he should require formal written reports only about every six months. He should also make it clear that progress reports should be short and sweet. Several contractors complained about the time they had to spend on progress reports; this was partly because they had not been told that they could be brief. (It also appeared that the regions demanded more frequent reports for OI contracts than did the national R&D for their projects.) Reports should also be read and promptly commented upon; this helps to maintain the morale of contractors. The project leaders are also responsible for seeing that the final project record meets requirements and for editing drafts of it. They should ensure at an early stage that the contractor knows the kind of report that is needed and that it should be well written, succinct and reach clear conclusions that meet the customer's needs.

Several of the projects I examined involved practical cooperation between the contractor and regions in the NRA, for example in the provision of historical data, or assistance with sampling. Sometimes there appeared to be smooth cooperation, but quite frequently regional staff were unable to spend sufficient time and effort helping a strange outside contractor. In some of these cases the project leader should have acted as a more effective intermediary, and ensured, through his line manager or the regional fisheries manager, that there was good liaison at the start of the project.

The selection of project leaders is thus a critical aspect of the overall management of R&D. Project leadership is a task that requires dedication and a good deal of time, so an inherent

enthusiasm for the subject of the project and a sense of 'ownership' is one of the first requirements. The chosen person should also have an understanding of the nature of research and how it is conducted, as well as knowledge of the NRA activity that the project is aimed at supporting. Project leadership can also be beneficial to the career development of a fishery officer, so appropriate young individuals should be given the opportunity to experience it; though it is also wise not to burden particular individuals with repeated or multiple responsibilities of this kind. It is important that project leaders should have the necessary support and guidance from the topic leader, without too much interference; one or two contractors complained that they had had conflicting advice from their topic and project leaders.

3.2.4 Uptake. I have already stated that I had difficulty in getting much information about the uptake of the results of projects, except to learn that many people were aware that it was a weak feature in the NRA (and in other organisations). For many of the projects it was also too early to assess uptake as it had barely begun. The R&D end point of many of the projects that I examined was the production of an R&D Note. Sometimes these were in the form of a manual for managers' or field-workers' use, but often they were a summary of the results of the research with some emphasis on how they might be used or what further R&D was recommended. In the latter case, and with all preliminary ('scoping') studies, uptake is the responsibility of the R&D management group; the suggestions should be fed into the next round of the topic investment appraisal, and in several instances this had been done. In the instances where the R&D Note could beneficially influence management, responsibility for action seems less clear, even when the formal procedure of drawing up an 'implementation plan' had been carried out.

Dissemination of R&D Notes, or R&D Digests or other documents is the responsibility of the R&D organisation, and many regional R&D Coordinators evidently make a real effort to distribute documents widely and inform all relevant officers about them through the *R&D Newsletter* etc. However, the total amount of written matter that is circulated within the NRA may discourage recipients from spending time reading and digesting much of it. I have already commented on the length of many R&D Notes, and the fact that many are poorly written; certainly I found few of them attractive to read. It was noticeable that, in the many literature reviews in project reports that I read, cross-references to R&D Notes were very rare (even though some would have been very relevant); clearly they are not read by contractors.

The NRA usually offers positive encouragement, or even a contractual obligation, to contractors to publish scientific papers derived from contract work, and several do. However, the pressure of work on university and institute scientists is now such that they often have to launch into a new money-winning contract before writing up the last one. Moreover, career advancement now often depends as much on the contract money that an individual brings in as on the papers they publish in scientific journals.

Various possible explanations were made to me for the apparent lack of adequate uptake from R&D. Uptake is supposed to be initiated by the project leaders, but, after seeing a project through its other final stages, some of them may be reluctant to expend yet more effort on another stage. Individuals who may otherwise be excellent project managers may not have the rather different skills needed to persuade their colleagues to make use of a new procedure or piece of information. I recommend that new R&D output and its uptake should be a regular item on the agenda of the quarterly meetings of the FRCN managers group as it is they who have the prime responsibility for the effective uptake of most R&D output.

Many projects require a further development phase, and, where appropriate, this should be done in-house and involve the field staff who will use the new method. Where research findings will definitely result in changes in management practice, meetings are now held with regional representatives at the draft final report stage. This is already proving to be a help in gaining acceptance of R&D output by managerial customers. It is important that the potential

users of an R&D project, as well as the project leaders, should feel some 'ownership' in it from an early stage. More belief in the value of science and closer integration between management and R&D throughout the function would also help greatly. However, without much more understanding of the situation, I am unable to give further advice; yet clearly uptake is an aspect of fishery R&D management that requires attention. I recommend that there is further consideration of the issues affecting uptake with the aim of finding out why it is not as effective as it might be and recommending measures to make it better.

It is also interesting that I received several comments about tardy uptake from contractors. Many naturally have a continuing interest in what is done with the results of their labours (even after they have received the final payment), yet often they hear nothing more from NRA. Some would like to be involved in the uptake process and willing to give advice and even some help with it. This is part of the general policy of 'cultivating the contractors' that I will discuss more fully later (see section 4.5.2).

3.3 Inter-functional liaison

I had some discussion with water quality and water resources staff at Head Office; from them and from other sources, I gained an idea of the extent to which there was inter-functional liaison over the planning and execution of R&D. There appears to be generally adequate contact at Head Office between fisheries, water quality and conservation R&D managers, but links with the more engineering-related functions of water resources and flood defence would benefit from further attention. The water resource managers, who are very involved in abstraction licensing, would value much more specific advice from fishery scientists on the water-flow needs of fish. The development of better surveys and the 'Habscore' approach to the physical river environment (for salmonids quite soon; for coarse fish probably later) should lead to better information becoming available.

The conservation function, with a much smaller R&D programme, has apparently had more success than fisheries in persuading flood defence engineers to start to make rivers more 'friendly' for wildlife. There is a great deal of scope in this direction for sound R&D on the physical habitat requirements of all the fish species, and similar developments in more 'natural' river engineering are likely to benefit the conservation of wildlife, water quality and the 'de-synchronisation' of floods at the same time as improving fish stocks. A practical start in work of this kind has been made by the River Restoration Project; the NRA should develop more substantial cross-functional R&D (and management) programmes in this topic, involving fisheries as well as the other functions. Specific R&D projects on the needs of wildlife and fish (see **4.1.2.**below) could be linked to this programme. Now that many of the scientific aspects of water quality improvement are within sight of solution, it is the *physical features* of rivers that are most urgently in need of R&D to support their return to a more pristine condition.

3.4 Regional Operational Investigations

It was not within my remit to review these, but it is clear that a considerable amount of 'research and development' takes place in the regions. Some of this is truly site related and is of little relevance outside that site or region. However; I did gather that some operational investigations (OI's) were comparable in size and significance to some of the national R&D projects and their output was applicable to situations in other regions. One of the national projects was, in fact, an investigation of what was going on in a particular R&D subject in the regions. It concluded that several of these studies did have relevance in a wider context, but that some were poorly reported upon and their results never disseminated. Every persuasive effort should be made to encourage the regions to report details of all their OI's to a central register and to disseminate results that might be of wider interest or use, and I gather that such a register is being assembled at the moment.

4. DISCUSSION

4.1 The balance of the overall fisheries R&D programme

4.1.1 Migratory salmonids. The 1994 paper from the Head of Fisheries, *Review of Fisheries Activities*, gives valuable information on the effort expended on different major activities, and between migratory salmonids and other species. Our general understanding of the biology and ecology of salmon and sea trout is greater than that of coarse fish (though a good deal is known about non-migratory brown trout). However, the immediate potential for the application of existing knowledge through the development of new management tools, *e.g.* Habscore, or more widespread counting of migrants, is clearly much better for salmon and sea trout than it is for coarse fish, where much basic ecology has still to be researched. The present programme for migratory salmonids, including those new projects recommended by the results of Projects 438 and 443 (in R&D Notes 202 & 318), will do much to meet the foreseeable needs of management.

4.1.2. Coarse fish. For coarse fish, however, much remains to be done. While further development and uptake of the results of projects such as those on hydroacoustics and electrofishing in large rivers will aid monitoring, they will also enable more effective researches into the population dynamics of several species to be started. I believe that progress in understanding the ecology of these coarse fish in larger rivers and the factors that limit stocks will be advanced fastest by a number of relatively small but long-term and intensive projects. These should include work on all stages in the life history and on behaviour in relation to the physical habitat and the influences of other species such as predators. For example, modern evidence and theory suggests that fish have evolved behavioural mechanisms that enable them to 'judge' the benefits of feeding against the risks of predation in different kinds of habitat. Their presence at a particular time in a particular 'micro-site' may thus depend upon behaviour more than longer-term ecological factors. Such research will also require a much finer scale of spatial study than is traditional in past research that has generally worked at a scale of 100+ m reaches. For example, The Freshwater Biological Association has, and still is, supporting basic research of this kind on coarse fish fry in the River Ouse, using electric 'point-sampling'. Extension of the 'Habscore' technique (or something similar) to coarse-fish waters may well be appropriate in this context. I commend the current review of the present coarse fish project and its division into a number of separate smaller projects, some of which will need to be quite basic in their approach and may require longer-term commitment than is at present usual. It may be appropriate to explore new ways of commissioning out the detailed management of this suite of projects; *e.g.* commissioning an outside organisation to do it.

4.1.3 Monitoring. The large share of expenditure that goes on monitoring provokes the question as to whether R&D could make it more efficient. Several R&D projects are directed towards this; *e.g.* electrofishing and hydro-acoustic techniques and developments in the counting of migrants, as well as better statistical design for surveys and the development of Habscore so that abundance can be linked to physical habitat quality. Thus when the results of the present programme are taken up, they should lead to increases in both the effectiveness and the efficiency of most monitoring and survey activities.

4.1.4. Law enforcement. A very great share of expenditure goes on enforcement – both licence checking and the prevention of poaching. Though a review group may come up with practical suggestions towards making both more efficient, there may also be room for original research and external advice on such matters as the operational deployment of bailiffs or the long-range detection and observation of poachers. A 5% saving in the costs of enforcement would be large relative to the expenditure on a number of other activities.

4.1.5. Other activities and species. Stocking is quite a significant item of expenditure for both coarse fish and salmonids. As habitat improvement increases there may be less need for fish rearing and stocking by the NRA. As there are present projects aimed at assessing the value of stocking and the best ways to carry it out, it would not seem to justify any more R&D expenditure. Habitat improvement may increase as an activity when R&D on the habitat needs of fish and better surveys can give clearer indications as to those kinds of improvement that will be most fruitful. There is scope now for well monitored experiments in habitat improvement in salmonid streams; but in lowland rivers such work should probably await more basic information on the physical habitat needs of coarse fish. In the long run there is very considerable potential for the improvement of those rivers where engineering works for water abstraction, water mills, navigation and flood prevention over the centuries have rendered them much less hospitable to fish. This will be likely to require substantial R&D supported by the flood defence, conservation, and navigation functions as well as fisheries (See section **3.3** above). The fisheries function should take a more active role in these cross-functional projects than it has in the past.

The first phase of successful project on the conservation of *Coregonus spp.* has been completed. Other rare species, such as the shads, smelt and spined loach, should receive some research into their biology and conservation, and there is a need for more basic understanding of the genetics of many species, so that possibly unique sub-specific stocks can be identified and protected. The development of fishery policies may need to be supported by R&D on the social and economic aspects of fisheries and anglers as 'customers'.

4.2 The strategic and fundamental foundation for fisheries R&D

As stated in the Introduction, the NRA funds only R&D that is directly related to its practical functions and relies on other organisations (in the UK and abroad) to provide the essential fundamental science on which NRA projects depend. However, it is clear that progress in meeting the R&D needs for some of the NRA's fisheries responsibilities awaits the arrival of quite basic understanding in fish biology. I reached this opinion after my study of past and current NRA research, but it was also put to me by several NRA officers. With the increasing financial pressures on the research activities of the universities and the declining resources for basic work available to the Institute for Freshwater Ecology (IFE) and other NERC institutes, these organisations are much less able able to finance programmes of basic and strategic research into fishery biology (and the other environmental sciences); particularly those that rely upon secure long-term support. Such expertise in freshwater fishery science as is still available in Britain has also become dispersed over a large number of small university departments or consultancies, very few of which of which can support a 'school of fisheries' or carry out any substantial research on their own. The NRA needs to take note of this situation. For some projects it may be necessary to commission one of the larger organisations and encourage them to sub-contract out small facets for which expertise lies elsewhere.

At present the NRA may be reluctant to commit itself to more than a token support (*e.g.* its research fellows) for basic or strategic research, but I believe that it should reconsider this policy and explore ways in which it can make a more significant contribution. It already has collaborative projects with NERC in other disciplines; perhaps these could be extended into strategic fishery science? More collaborative projects directly with the IFE or universities is one possibility; each organisation contributing a share of the costs. The US Fish & Wildlife Service has a number of 'Collaborative Research Units' in university departments. The F&WS pays the salaries and costs of two or three scientists; they enjoy honorary faculty status in the university and may do a little teaching or supervision of graduate students, but spend most of their time on their own strategic research. They occupy laboratory and office space within the departmental building and are in daily contact with the faculty and students with mutual benefit to all. That is another excellent model that might be explored. The NRA could also add a small number of more fundamental projects to its normal programme; for example in coarse fish

ecology and behaviour, the genetics of non-salmonids, the biology of rare species and perhaps epidemiology.

4.3 The overall amount of fisheries R&D.

Probably less than £750k is being spent on the national fisheries R&D programme in the current financial year; to this should be added a little spent from regional resources. This amounts to about 5% of the total expenditure on the fisheries function. This total R&D expenditure does not appear to have been decided as a result of any deliberate policy. There is no comment on the total R&D expenditure, or whether it is at at an appropriate level – too much or too little – in the Chief Scientist's 1993 position paper *The NRA's Research and Development Programme*. It must be realised that the effective management of a multi-species population of fish requires a level of understanding at least an order of magnitude greater than that needed for the physical or chemical aspects of river management. Thus, because freshwater fishery management is so strongly research based, I believe that 5% is too low a proportion of total expenditure to devote to R&D. It has been argued to me that some of the not inconsiderable expenditure on monitoring can be considered as a contribution to R&D. However, this is considered essential as an operational activity; moreover, some past R&D projects that have attempted to make use of the regions' past data obtained from monitoring, have eventually found the information of limited value. (This may change in the future as the quality and compatibility of monitoring improves as a result of R&D currently being devoted to it.)

Taking into account the NRA fishery function's needs for R&D on operational activities and the implementation of policies, as well as the recommendations from recently completed R&D projects, the present budget seems to me to be inadequate. Fisheries could also benefit substantially from cross-functional R&D towards catchment management and the restoration of more natural physical features in rivers. I have also said that the fundamental science base for some aspects of NRA R&D is already becoming inadequate, and not being properly supported. It is likely that NRA will have to devote money to strategic studies, such as those on coarse fish ecology and behaviour that it previously considered too basic to be within its remit. I believe that several successful science & technology based industries spend a greater proportion of their turnover on R&D than does the NRA.

4.4 Relationships with other organisations.

4.4.1 MAFF. MAFF has several statutory responsibilities for freshwater fisheries, so has important administrative links with the fishery function of NRA. There is now an annual liaison meeting concerned with the relationships between the R&D programmes of each organisation; which is apparently working effectively. There have also been several cooperative projects, *e.g.* in the radio-tagging of smolts, and these have been successful and fruitful. Continuations of some collaborative projects, and one where MAFF is the contractor, are parts of the present programme, but complications to this successful collaboration may develop when the MAFF Fisheries Laboratory becomes an Agency. Already, a few bureaucratic problems arise because of the nature of the two organisations; it is to be hoped that, in the future, the administrators can collaborate as smoothly and effectively as do the scientists. I can see nothing but benefit to all concerned for there to continue to be warm formal and informal relationships between MAFF and the NRA.

4.4.2 Other UK governmental and non-governmental agencies. The salmon and sea trout fisheries are of greater importance to the economy in Scotland than they are in England, and substantial, high quality research in salmon is conducted by the Scottish Office Agriculture & Fisheries Department (SOAFD). There is contact between the NRA and the Scottish laboratories (indeed, one of the latter was a contractor for a small but excellent NRA

project), but I have the impression that this is not as close as it might be. Similarly, the Department of Agriculture for Northern Ireland (DANI) has an R&D programme for fisheries with which the NRA should have links. The Atlantic Salmon Trust (AST) has an honorary scientific advisory panel that meets once a year to exchange information on salmon and sea trout research, and organises some very useful workshops – to which NRA scientists have made significant contributions. The Panel also has active members from the Republic of Ireland who add significantly to the information exchange. Informal liaison through an non-governmental organisation such as the AST can sometimes be more fruitful than those through official channels and should be actively encouraged. The NRA's contract with the Freshwater Biological Association for advice, information and library services is apparently much less used by fisheries than by the other functions. There is also scope for links with universities; perhaps informally by a region or area with their nearest university.

4.4.3 Overseas organisations. In theory at least, the NRA is already affected by Directives etc. emanating from the European Commission, so EC liaison over inland fisheries will doubtless increase in the future. European countries share our species of fish (though they have a richer fauna) and most have good freshwater fisheries and fishery research . Such countries include not only those those that have a long tradition of first class R&D such as the Scandinavian countries, but also those like the Czech Republic, Poland, Slovenia and Portugal, where there are now some excellent and active fishery researchers. Some of these may be potential R&D contractors. The European Inland Fisheries Advisory Commission (EIFAC) is the official international body for freshwater fisheries in Europe. The NRA has been active in its deliberations on occasion in the past, and I feel that NRA fishery scientists should take every opportunity to make use of it as a liaison body, and play an active part in its management and programme towards improving its usefulness. Perhaps the NRA should initiate an R&D project to survey the freshwater fishery programmes of all the principal European countries with a view to greater cooperation, some mutual planning of R&D programmes to avoid overlaps, and a more active exchange of the output from R&D in Europe?

The United States is very active, at both the Federal and State levels, in freshwater fishery research and management. Several of the NRA's R&D projects are based on American ideas, or use American technology; Canada, too, has an outstanding record in fishery research. Several important fish species or genera (and the English language!) are shared with North America, so it would not be inappropriate for NRA staff to visit North America, or, for example, attend the annual meeting of the American Fisheries Society. New Zealand and Australia too, have contributions to make to effective practices in fishery management and R&D.

4.4.4 Professional and scientific societies. The predecessors of the NRA were instrumental in founding the Institute for Fishery Management (IFM), and it is firmly established as the professional organisation for NRA fishery staff; it appropriately receives NRA support, and should continue to do so. The Fisheries Society of the British Isles (FSBI) is the scientific society for fishery biology. As well as organising an annual symposium, it publishes one of the leading international journals in this field, the *Journal of Fish Biology*. NRA scientists have played a role in the FSBI, but seem to attend its symposia only when the topic is conspicuously relevant to fishery management; this is a pity, as it is important for NRA officers to try to keep abreast of the latest thinking in fish biology and make personal contacts with other biologists. The same applies to several other scientific organisations and their meetings.

4.5 Commissioning arrangements.

4.5.1 Contracting and tendering. I am not aware of the detailed procedures for putting R&D projects out to tender, but it is clear that they have effects that are worrying to both NRA officers and contractors. The pressures to accept the lowest tender have certainly led to the

NRA getting poor value for money in some instances. It is also evident that the whole system of competitive tendering has serious effects upon the national scientific establishment and output. Basic and strategic science have, until recently, flourished under traditions that encouraged scientists and their institutes to be open in the exchange of information. Only when a new idea or finding was ripe for publication, but had not yet appeared in print, did its author restrain himself from telling everyone about it. But, now that the continuing existence of institutes or university departments, and the livelihoods of their staff, depend upon winning contracts, all scientists have to be careful to keep information and ideas to themselves and exercise intellectual copyright whenever possible. As well as this, contractors spend a significant part of their effort and resources submitting tenders – only a few of which prove successful, or seeking devious ways to enhance their chances of getting commissions or grants. All this increases the costs of the research that they do manage to do. There is also less time between contracts for scientists to 'write up' and publish their findings; and promotion may nowadays depend as much on 'money brought in' as published papers. All this decreases significantly the efficiency and value for money with which research is now carried out in Britain. It also decreases the effectiveness of inter-institute cooperation, and makes it more difficult for the NRA to organise collaborative projects involving more than one institute.

The rate of advance in R&D depends as much on the available scientific brainpower as it does on available money. Thus, it is in the NRA's interest to be able to exploit this brainpower in the most efficient way, and not spend time in such activities as writing tender documents that may prove fruitless. Maybe, there is little that an organisation such as the NRA can do to change rules imposed from above, but it should make every effort to explain to those who draw up these rules how much national money and brainpower they are wasting. The NRA should discuss with the DoE, MAFF and the Office of Science and Technology how best to interpret government policy on competitive tendering so as to avoid its worst effects on R&D. Perhaps there is more flexibility in the operation of the rules than is apparent at present? If so this should be made clear to all concerned.

4.5.2 Collaborative projects. Some of the most successful NRA projects have been those that involved collaboration rather than straight contractual commissions. Several of them have certainly provided the NRA with good value for money – the collaborating organisation providing much experience, expertise and practical work at very little cost to the NRA. Further, scientists generally work much better at things in which they have a real interest rather than tasks that just earn them money. I suggest that the NRA should use every opportunity and administrative ingenuity to get more of its fishery R&D done with collaborative rather than contractual arrangements. For example, it might be possible to get the IFE to devise a suite of interlocking projects in coarse fish ecology that would be carried out by several different organisations, each contributing its particular expertise. Some might be done by the IFE itself, another aspect by one of the universities with particular strength in fish behaviour, while yet another organisation might work on the physical features of coarse fish habitats, or developing the application of Habscore to lowland rivers. I am not necessarily proposing a specific arrangement, but just attempting to illustrate the kind of collaborative organisation that would be the most scientifically effective way to meet one of NRA's pressing needs, and stress the advantages of flexible administrative and financial arrangements. I understand that the NRA and NERC are already exploring such collaboration; if a 'concordat' can be agreed this would be excellent. It is likely that such a set up would also bring in work supported from money outwith that provided by the NRA, and thus be good value-for-money for it.

4.5.3 The nurturing of contractors. R&D is not an item, like groceries, that can be bought off the shelf from the nearest convenient and inexpensive supermarket. University departments and research institutes that supply most of NRA's research needs require time and resources to build up and maintain their expertise, and NRA has both an interest and a responsibility to see that these organisations flourish. As noted above, organisations that are strong in fishery science are now very thin on the ground in Britain. NRA should make sure

that it invites tenders for competitive contracts from all those laboratories that may be best fitted to carry out each particular project. Those who are unsuccessful should be told why; this is usually, but apparently not always, the case. At the end of a project, contractors should be invited to help in the uptake process; or, at least be kept informed about its progress and given credit when it has been a success. Advice and ideas about the R&D programme or suggestions about future NRA projects from individuals and organisations should be welcomed. NRA officers may be able to offer practical help to researchers over other work which they are pursuing. I am sure that most NRA officers do follow these practices, many of which are just good manners; but I have learnt that this is not always the case.

The most successful commercial and industrial companies frequently 'cultivate' their suppliers. They choose a potentially good supplier of items to retail, or components to build into a product, and then give them long-term contracts under strict conditions of quality and price, but, at the same time give them positive and practical help with R&D, modernisation to increase productivity and the like. They find such an arrangement much better value in the long run than repetitively going out to tender. NRA might adopt analogous practices.

4.6 The management of NRA fishery scientists.

In carrying out this review I have been struck by the enthusiasm, intellectual calibre and general professionalism of many of the NRA staff who are involved in fisheries R&D. However, I have also learnt about some of their worries and become aware of the scientific isolation felt by some of them. An outsider cannot fail to get an impression that the NRA is a rather inward-looking organisation. In several of the sections above I have recommended more contacts between the NRA and outside organisations; here I want to emphasise this in the context of career development for NRA fisheries staff. They cannot be good managers of R&D projects if they are not good scientists, up to date with the latest developments and confident in their relationships with outside scientists.

They are supposed to have opportunities to go to scientific meetings, have a little time for their own small R&D projects and author an occasional paper to a journal. But apparently the pressures of their principal tasks, often with the added burden of some R&D administration, leave them with little time or energy for such things. I suggest that more attention be paid by senior managers to the need to nurture their staff. It is not a waste of time or money to send all scientists to at least one appropriate scientific workshop or symposium of their choice every year; or to expect them to contribute an original paper to a journal every year or so. Junior scientific staff should be given such opportunities as well as those in middle or senior management; if anything they will benefit more. The suggestions for more in-house R&D and cooperative projects would also help NRA staff to keep in contact with the outside world and author papers. A reduction in administrative burdens and the streamlining of bureaucracy would also allow them more time for science.

Such development of NRA fisheries scientists would also contribute to the much greater integration of management with science that is needed throughout the fishery function. Indeed, the NRA as a whole should do more to develop a culture infused throughout with the realisation that it is a science-based business.

5. RECOMMENDATIONS.

The full report lists a total of 49 suggestions for action by the NRA under the following five general recommendations:

- The realisation that the NRA's fishery management can be fully effective only if it is strongly based on science must be promoted throughout the function.

- Fisheries R&D and management must be more closely integrated with one another and develop in concert.

- The crucial role of the project leader in the management of R&D projects should receive greater recognition, and the project leaders should be given enough time and guidance for them to fulfil their role effectively.

- The processes by which the results of R&D are taken up and made full use of should be further reviewed so as to ensure that all issues are identified and improvements made.

- Every effort should be made to simplify the procedures involved in the administration of R&D.

APPENDIX I. LIST OF INDIVIDUAL PROJECTS

The following information is given for each project that was reviewed:

Project number, then code number in the NRA function, topic, year & no. system (except for first four projects inherited from DoE),
Dates of the start and finish,
Title,
Project leader (with regional abbreviation),
Contractor (with organisation and principal investigator; WRc = Water Research Centre, FBA = Freshwater Biological Association, IFE = Institute for Freshwater Ecology, U = University, HIFI = Humberside International Fisheries Institute),
The R&D Note or other report resulting from the project (where the project had not ended by August 1994, the latest progress or interim report that was available and was read for the review is given).

24, – ; 1987-90; Fish stock management in the UK; n/a ; WRc, Gulson; R&D P-24.

72, – ; 1987-90; Effects of water quality on freshwater fish populations; n/a ; WRc, Mainstone; R&D P-72.

123, – ;1989-92; Strategic ecosystem studies of large, slow-flowing rivers; Linfield (A); FBA, Pinder; R&D Note 40.

124, – ;1988-91; Turbidity and plant growth in large, slow-flowing rivers; Linfield (A); FBA, Marker; R&D Note 41.

152, D02(90)02; 1990-93; River quality and fishery status (River Torridge); Bray (SW); WRc, Gulson; draft rep.7/93. (Joint project with MAFF).

211, D02(90)03; 1990-92; Grass carp for aquatic weed control; Hickley (ST); U. Liverpool, Eaton; R&D Note 53.

229, D01(90)03; 1990-93; Fish Health Indices as a marker of surface water quality; Owen (A); NRA Brampton Fish Lab, Barnes; draft R&D Note 6/94.

244, D01(90)03; 1990-94; Development of a fisheries classification system; Bailey (Y); WRc, Wyatt; R&D Note 206.

249, D01(90)02; 1990-93 (+ extension); Status of rare fish; Cragg-Hine (NW); IFE, Winfield; draft rep. 8/94.

250, D03(90)02; 1990-93; Hydroacoustic methods of fish survey; Butterworth (T); Royal Holloway & Bedford Coll., Duncan; R&D Note 196.

256, D01(90)01; 1990-93; Eel and elver stock assessment; Churchward (ST); U. Westminster, Knights; R&D Project Record 256/13/ST.

296, D02(90)04; 1990-91; Review of NRA radio-tracking studies; Mills (NW); SOAFD Marine Lab., Hawkins; R&D Notes 33 & 34.

304, D03(90)03; 1991-91; Fish pass design and evaluation; Fewings (S); IFE, Carling; R&D Report 5.

307, D02(90)05; 1991-92; Diversion and entrapment of fish at water intakes and outfalls; Armstrong (T); Solomon; R&D Report 1.

312, D02(90)07; 1991-95; Acoustic tracking of salmon and sea trout smolts; Milner (W); MAFF Fisheries Lab., Moore; MAFF rep. on phases 1 & 2. (Joint project with MAFF).

325, D03(91)01; 1991-94; Development of fish stock assessment methodologies and methods; Forbes (A); WRc, Wyatt; R&D Note 292.

326, D03(90)04; 1991-92; Effectiveness of riverine habitat improvement; Wortley (A); IFE, Mann; R&D Note 105.

334, D03(91)02; 1991-94; Electric fishing of deep rivers; Hickley (ST); HIFI, Cowx; draft R&D Note 5/94.

338, D02(91)02; 1991-94; Habscore; Milner (W); WRc, Wyatt; Interim rep. 7/92.

370, D03(90)01; 1991-94; Design and use of fish counters; Aprahamian (NW); NRA (NW); Progress rep, 5/94.

377, D02(91)03; 1992-92; Fish kills; Winstone (W); WRc, Wyatt; R&D Note 195.

397, D02(91)04; 1992-93; Body burdens in fish; Sedgewick (ST); WRc, Johnson; R&D Note 193.

404, D01(91)02; 1992-95; The use of catch statistics to determine stock size; Aprahamian (NW); Environmental Advisory Unit, O'Hara; 2nd. interim rep. 3/94.

429, D02(91)01; 1992-96 (Phase 1 ending 94); Coarse fish in lowland rivers; Cresswell (N); HIFI, Cowx; draft R&D Rep. 12/93, Literature review, draft R&D Rep. 6/93.

438, D01(92)02; 1993-93; Genetic aspects of spring run salmon; Gough (W); U. Coll. Cork, Cross; R&D Note 202.

440, D03(92)03; 1993-94; Survival and dispersal of stocked coarse fish; Axford (Y); WRc, Wyatt, Interim rep. 6/94 (not available for review).

443, D01(91)03; 1993-94; Sea trout investigation; Winstone (W); Solomon; R&D Note 318.

452, D02(92)02; 1993-95; Impact of piscivory by stocked trout on game populations; Walsingham (NW); WRc, Mainstone; 1st interim rep. 10/93.

461, F02(92)03; 1993-93; Species management in aquatic habitats - avian piscivores; Hogger (N); WRc, Gulson & Inst.Terrestrial Ecology, Marquiss; R&D Project Record 461/8/N&Y.

486, D03(93)03; 1993-97; Assessing salmon stocks using a hydroacoustic counter; Gough (W); NRA (W); no report yet.

500, D03(93)01; 1993-94; Mawle (HO); Fishkill Consultancy Services, Harris; draft rep. being edited 8/94, not seen.

503, D03(92)01; 1993-94; Fish tracking developments; Purvis (W); MAFF Fisheries Lab., Potter; no report yet.

511, D03(93)04; 1994-94 (+ extension); Effects of retention of fish in keep nets; Rowden (HO); IFE, Pottinger; Interim rep., 3/94. (Half the cost from the National Federation of Anglers).

Appendix 11

Extract from Terms of Reference - Points to be addressed in Review

Annex A - Points arising at Project and Programme Level

(a) Project Level

1.0 Effectiveness

- Were the R&D objectives achieved and the specified outputs produced?
- Have the anticipated benefits been achieved? If not are they still desirable?
- Is the output likely to bring these anticipated benefits
- What was the quality of the R&D in terms of its contribution to scientific knowledge?
- What would have happened if the project had not been done?

2.0 Efficiency

2.1 R&D efficiency

- Was the R&D well managed:
  (a) by the NRA in processing and supervising the R&D?
  (b) by the contractor undertaking the R&D?
- Did the R&D work build effectively on the available base of present knowledge?
- Were the R&D objectives achieved in the most cost-effective (including use of collaborative funding) and direct manner?

2.2 Uptake efficiency

- Has the uptake process been well managed?
- Has uptake been (or is it being) achieved in the most cost-effective and/or appropriate manner?

2.3 Overall cost-effectiveness

- Has the NRA achieved (or is it likely to achieve) value for money from the overall project?

3.0 **Follow-up**

- Identify/confirm any necessary actions to improve effectiveness.
- **Identify/confirm requirements for uptake of R&D output to achieve overall project objectives and intended benefits.**
- Identify lessons to be learnt and actions needed to disseminate these.

Not all of the above would need to be covered on any one project.

(b) Points arising at Programme Area level

1.0 **Effectiveness**

- Have the programme objectives been achieved (or are they being achieved), and the specified outputs produced? If not, why not?

- Have the anticipated benefits defined in the Investment Appraisals been achieved (or to what extent are they in process of being achieved)?

- How well is the programme targeted to the NRA's corporate objectives relating to Fisheries? (include Fisheries Strategy; Fisheries Review; other policy documents)

- What is the scientific quality of the programme (in terms of both utilising up-to-date scientific understanding and being well structured and managed)?

2.0 **Efficiency**

- How efficient has the programme been as a means of achieving the objectives (and how well have the rationale and objectives been defined)? Consider:

  (a) appropriateness of selected projects in relation to programme objectives;
  (b) R&D management issues (including project planning);
  (c) Research Contractor procurement and performance;
  (d) Uptake activities.

- Is the NRA achieving reasonable value for money (return on R&D investment) from the overall programme?

3.0 **Follow-up**

- Identify any further actions to achieve effectiveness of existing programme. Consider:

  (a) additional R&D stages to existing projects;
  (b) new projects;
  (c) additional uptake of existing/past project outputs;
  (d) changes in management or procurement strategy.

- Identify any desirable major shift in the programme objectives to improve targeting towards NRA corporate objectives or other opportunities.

- Identify any generic lessons to be learnt from 1.0 or 2.0 above, and actions needed to disseminate these.