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MAKING THE MOST OF YOUR FISHERY RESEARCH VESSEL

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PREPARATION OF THIS DOCUMENT

In recent years FAO has received requests from member countries for assistance in the management, operation and use of fishery research vessels.

This paper is intended to be of guidance to owners of research vessels, Directors and staff of fisheries institutions and, in particular, all scientists called upon to go to sea to pursue fishery research. It deals in detail with how the scientist could make the best use of vessel time through thorough planning, selection of equipment, cooperation with others and knowing the capabilities of the assigned vessel. The paper also stressed good overall vessel and programme management but it does not deal with ownership in detail as this is covered in a separate report entitled "The Ownership and Management of Fishery Research Vessels" (FAO Fish. Tech. Pap. 237).

Author's note

This paper could not have been written without the help given to me by Captain Tom Sutton and Skipper Arthur Larner of FRV CLIONE (LT 421) during the 1960s and the comradeship during the 1970s of the late Captain Tom Finn of FRV CIROLANA (GY 156). Also the text owes much to the prodding of Dr J.A. Gulland FRS during his last year with FAO.

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Abstract

The high cost of obtaining information through the use of sea-going platforms highlights the desirability for optimum utilization of vessels services placed at the disposal of the scientific community. Long-term and cruise planning, monitoring and evaluation of results are discussed and the report demonstrates the need for close cooperation between the user and the vessel's managers. Also examined are various alternatives available for the acquisition of scientific information including the charter of commercial vessels and leasing of equipment.

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1. INTRODUCTION

A research vessel can be a source of satisfaction or of trouble for a fishery research institute and its director. It can lead to great satisfaction in that a specialized vessel can often collect important information which cannot be gained as effectively in any other way. It can become troublesome when owning a large and modern vessel is only a matter of prestige, or when an aid agency presents an institute in a developing country with a bright new vessel without the means of running it in later years. This is because, as Eddie has noted in the companion paper (Eddie, 1983), the annual cost of a fishery research vessel (FRV) over its 20-25 year life is 35%-55% of its construction cost, at constant prices (that is, not allowing for inflation or rises in real costs). Furthermore the annual maintenance cost of such a vessel even if it does not go to sea is almost as great. Consequently in these and other cases - when cuts are made across the board by central governments, for instance, as does happen from time to time - owning an FRV can easily produce despair in the director's office because it is a heavy burden on limited rosources.

When such a situation develops institutes find that either they cannot operate their vessel or vessels effectively or they have to cut back on other activities in order to do so. In short, their overall programmes of work become unbalanced. Clearly the ownership of an FRV must not, therefore, be entered into lightly. Eddie's (ibid.) main conclusion, in fact, as far as this paper is concerned, is that unless there is a clear need and financial support for the use of a research vessel for more than 200 days a year on average over a 5-year period, then the policy-makers should arrange either charters or short-term loans to meet specific scientific needs. Experience shows that the problems that come with managing a vessel of more than about 35 metres in length are simply too great in terms of money and time to make the effort worthwhile for shorter work programmes with nebulous aims. Smaller vessels undertaking principally day-long cruises may well be more easily managed, especially if an institute has someone on the staff who doubles in the role of scientist and sailor. Even in this case though care should be taken to see that "keeping the ship" does not become an end in itself when the scientific programme is being formulated.

Eddie (ibid.) has described the problems of owning and managing a fishery research vessel from the engineer's and administrator's viewpoints. The present report presents the scientist's point of view. It falls into two parts - first, it gives an outline of the kinds of observation that can be made from an FRV, how these fit into the general research programme, and the extent to which the use of such a vessel can be avoided by using other platforms to make the observations, or by making other, shore-based, types of observation. Second, assuming that many institutions will, in fact, need their own vessel, it describes the process of using it from planning the year's operation, through the work at sea, to working up and reporting on the results of the cruises. In the second of these main sections the material presented is distilled from the experiences of four generations of research workers at the Fisheries Laboratory, Lowestoft. Consequently it may seem at times to assume too much in the way of tradition, formal organization and a supporting infrastructure. It is thought, however, that the principles used are valid generally and that the methods adopted to carry them out can easily be tailored to suit the situations existing now elsewhere. It should also be remembered that when these guidelines were first written down the Lowestoft Laboratory comprised 20-30 people in all and the vessels being used were rudimentary compared with those in, for example, the present-day UNDP/FAO vessel pool.

2. WHAT SHOULD A FISHERY RESEARCH VESSEL DO?

Scientists can use an FRV to make a wide variety of observations. To judge the value of these observations, and the importance of being able to make them, they need to be discussed in terms of the general objectives of the piece of research involved, and this will be the main concern of this section. Before doing so it is useful to consider the actual process of taking the observations and the equipment involved in general terms, too, since this will determine to what extent, if at all, other platforms, such as chartered commercial fishing vessels, can be used.

2.1 Types of observations, in general terms

2.1.1 Surveillance duties

In the simplest case the ship requires almost no special equipment. This might seem outside the scope of this study, but there are occasions when an FRV is required merely as a platform. One such case might be the surveillance of foreign fishing activities. When the vessel already has a full programme of research, this can be a misuse of expensive facilities, but so long as these duties do not compete with more sophisticated work, and the use of an FRV allows simple observations (e.g., meteorology, surface water temperatures via a mechanical thermograph, towed Hardy plankton recorders) to be made at places and times not otherwise possible, these operations allow the heavy overhead costs to be spread more widely.

2.1.2 Normal fishing

A common use of an FRV is, very naturally, to catch fish with normal fishing gear. This may be to catch fish in good condition for tagging, or to bring live fish back to the shore for laboratory studies; for the latter the type of gear and (for some, but not all, tagging work) the time and place of fishing is not important. For nearly all other surveys though the time and place of fishing has to be controlled according to some preset design and for regular monitoring surveys, in particular, it is important that the design of the fishing gear, and the way that it is used, is kept the same from one year to the next. In some cases, e.g., when studying selectivity, it is important that the gear should be used in a way that is as close as possible to normal commercial practice. Tests on fishing gear can require, in addition to the use of ordinary fishing gear, extra equipment to monitor the behaviour of the gear and the fish.

Direct observations on fish are naturally a major element of work on board an FRV, but even in advanced institutions many of the observations will consist of little more than apparently simple matters such as recording the numbers (and where possible the weight) of each species caught, measuring of the length of all, or a sample, of each species, collecting otoliths, or scales for age-determination, and determining sex ratios and maturity stages, etc., of samples of the main species. The essential requirement for such operations is only a place on deck relatively clear of the warps for the scientists to work but this underestimates the rigours of the exercise. In practice a fish-room or wet-laboratory, with easy access to the fish pounds and a sorting table, should be provided if the rather tedious jobs that have to be done are to be done efficiently over the whole of a 3-4 week cruise. Increasingly more sophisticated observations and corresponding facilities are being called for, such as the quick freezing of samples for later analysis ashore, or observations on live fish for physiological studies. Provision of the necessary facilities to make these observations may be possible on something other than a fully equipped FRV, if the use of modular equipment or even containerized laboratories is considered. In both cases the basic advantage provided is that the equipment for one type of work - fish studies, say - can be easily removed between voyages thus leaving the commercial vessel ready for its normal work with a minimum of cost and effort.

In theory, therefore, an FRV offers little advantage over a normal commercial fishing vessel for most fishing work. In practice, though, it may be difficult to persuade a commercial fisherman, even when chartered, to fish exactly where and when instructed and to keep doing so throughout a cruise. The crew of an FRV, on the other hand, will get used to fishing a predetermined location even when they know there is little fish there. Even more importantly, perhaps, the existence of a properly planned wet-lab-fish pound area on an FRV will permit more and better work of all kinds to be done on a long-term (5-year minimum) basis.

2.1.3 Non-fishing operations

An FRV will also be required routinely to be able to stop on station and lower over the side oceanographic equipment of all kinds or to tow such gear usually at about 3-4 knots. The same equipment will be used by general oceanographic, i.e. non-fishery, research vessels operated by, for example, universities, navies and private companies.

Commercial fishing vessels can also handle some of this equipment via their trawl winches, net drums and power blocks. As instrumentation becomes increasingly sophisticated, however, and involves such things as the continuous simultaneous recording and preliminary analysis, whilst steaming or with depth when stopped on station, of a number of environmental parameters such as temperature, salinity, dissolved oxygen, turbidity, biomass, etc., or plankton sampling at predetermined intervals, so the possible use of one of them as an alternative to a full-time FRV for such work becomes less likely. In some cases, moreover, the equipment to be used is best provided as an integral part of the ship from the first. Acoustic surveys of pelagic fish stocks, for example, will need a precision echo-sounder, with an advanced transponder mounted on the underside of the vessel or on a special towed body or "fish", and an echo-integrater-cum-computer for rapid processing of the signals received. Gear trials, too, if they are to do more than just compare catches taken with different types of gear, can require an array of instrumentation to monitor the performance of the different parts of the gear, with perhaps acoustic equipment to watch the behaviour of the fish.

Taken all in all therefore non-fishery research vessels will be able to do the non-fishing operations and commercial vessels, with or without containerized laboratories, could do the surveillance work and some of the fishing programme of an FRV. However, only an FRV which combines, in effect, the roles of the oceanographic research vessel and the commercial trawler (Eddie, ibid.) can carry out - on one and the same cruise if needs be - the fishing and non-fishing operations. Consequently the value an institute attaches to this dual role should be an important factor in its attitude towards full-time ownership of an FRV as opposed to chartering of non-fishery research vessels and commercial vessels as required. These, however, are extreme positions, of course, since there is always the possibility of hiring an FRV from a pool or another country for a specified time and/or project to be considered.

2.2 Objectives of research

The previous section has suggested what kind of observations need to be taken from an FRV and the extent to which they might be made from other platforms. A more fundamental judgement on the desirability - or otherwise - of owning and operating such a vessel comes from a consideration of the objectives of those observations, and of the research programmes of which they are part. This consideration can indicate to what extent the same objectives might be achieved by taking other observations, e.g., sampling the landings of normal commercial fishing vessels and how far they, in fact, lie within the ambit of fisheries research as it is funded today.

2.2.1 Exploring new fisheries

In looking at potential new fisheries, a research programme can have one or more of three possible objectives - one qualitative - roughly whether there is an exploitable stock present in an area, and two quantitative - how much is present, and how big is the total annual sustainable yield, or how much can be caught per year or per season by a fishing vessel of a particular type. The distinction between the two quantitative objectives is important, and can be ignored during the planning of a survey only at the risk of getting results that are useless for both purposes. Estimates of standing stock, and hence of potential yield, can be seriously biassed upwards if the skipper of the survey vessel is allowed to choose to fish in what he believes might be the most productive areas; equally the catch rates achieved during surveys made to estimate standing stock will be less, and possibly much less, than those likely to be achieved by a commercial fishing boat which searches about and learns where and when fishing is best.

Some preliminary estimates for all three objectives can be obtained from an examination of the characteristics of the survey area (depth, nature of the bottom, currents, primary production, etc.), especially in comparison with other similar areas which are already being exploited, and for which good fishery information is available. The relevant data for the area of interest may often be already available from published literature, or in oceanographic or other databases. In other cases some data can be collected from an oceanographic research vessel *per se*. This type of approach is likely to be most useful for estimating the total potential yield along lines already established for several types of inland bodies of water. It will not provide an estimate of catch rates.

That requires a ship that can fish, but whether it has to be a fully-equipped research vessel depends on the techniques to be used. To estimate likely catch rates, the ship should, as far as possible, use the same gear and methods as are likely to be used by any potential new fishery. This would suggest chartering a commercial vessel, if necessary from outside the region if a completely new fishery is being studied. To estimate standing stock - which is normally the first and most significant step towards estimating potential annual yield, e.g., from the Gulland formula $Y = a MB_0$, or its variants (Beddington and Cooke, 1983) - the two main alternatives are surveying by trawls alone or by acoustic methods with their necessary complement of fishing stations (by mid-water or bottom-trawl or by purse-seine) for species identification and characterization purposes. Whilst a commercial vessel would again meet the first of these alternatives without much difficulty, the second would call for an acoustically-quiet ship that had the necessary equipment already installed or on which it could be mounted temporarily (Johannesson and Mitson, 1983). Hence rather more care would have to be taken in choosing the commercial vessel to be used in this case. These approaches should not really be considered as alternatives, perhaps, since they have very different advantages and disadvantages, and usually one or the other will be clearly best suited to the nature of the resource to be surveyed.

2.2.2 Monitoring of exploited fish stocks

This is becoming an increasingly important function of fishery research institutes as most stocks are heavily fished and administrators need detailed and up-to-date advice on their state in order to ensure rational utilization. There have been two distinct approaches to monitoring exploited stocks to date, viz. from records of the commercial fishery, or from regular surveys. The latter have most usually been done by trawls, especially for bottom fish (e.g., in the Gulf of Thailand, or off New England), but acoustic surveys have been used for pelagic fish (e.g., off Peru and Norway). Emphasis has shifted from one approach to the other, partly as the advantages or disadvantages of each receive attention, and partly from what seems largely a matter of fashion. This tendency may be increased by the fact that much of the regular monitoring carried out as part of programmes of international bodies (e.g., ICES and its Advisory Committee on Fishery Management), encourages the use of similar methods throughout a region. Current fashion, at least in the North Atlantic, is rather against the use of what was the most widely recommended method of monitoring stocks in the period 1935-65 - the analysis of catch and effort data from the commercial fisheries. Certainly there are serious pitfalls in the naive assumption that simply dividing catch by fishing effort will provide a consistent measure (FAO/UNDP, 1976). For this to hold the catchability coefficient, q, should be constant, or at least should not vary with change in fish abundance. This is seldom precisely true, and for purse seine fisheries in small pelagic fish, and probably others, q changes almost inversely with fish abundance, so that the catch-per-unit-effort remains almost constant, and is quite useless for monitoring changes in fish abundance. On the other hand there are many other fisheries in which the catch per unit effort, while perhaps not changing exactly in proportion to changes in abundance, does provide a reasonably good index of changes in abundance.

What commercial data is unable to provide is information on the smallest sizes of fish; the year-groups, that is, that have yet to recruit to the commercial fishery. This is because the fishermen may deliberately avoid catching - or discard when caught - the smallest, low-value, fish, or because the fish are below the selection range of the gear, or mesh size, in use. In any event these fish may be poorly and erratically represented in samples taken at the landing-place. Another factor which is becoming increasingly important in managed fisheries is the systematic mis-reporting of catches by fishermen in order to work the system in their own favour for as long as possible. However, commercial data does have an advantage over trawl survey data as far as the relative degrees of sampling variance are concerned. A typical trawl survey may comprise no more than perhaps 50 individual trawl hauls, and may be repeated three or four times a year. Commercial data may be based on the activities of perhaps a hundred vessels, making perhaps a total of a thousand hauls each per year; a difference in the total number of hauls of between two and three orders of magnitude. Since there is a large and apparently irreducible variance of up to a factor of two associated with individual trawl hauls, even when repeated under apparently identical conditions, this difference can be important when high precision is needed. Against this there is a great deal of uncontrolled (and often unknown) variability in the commercial data associated with possible modifications of the gear used and changes in fishing strategy from one species (or size) of fish to another in accordance, for example, with market changes.

2.2.3 Protecting the marine environment

From the early 1960s fisheries research workers the world over began to take an increasing interest in the intrinsic quality of the seas in which the fish stocks existed. This was due, in large part, to increased awareness at all levels of society in general of the potential dangers to the marine ecosystem posed by a combination of the newer chemicals arriving in solution in the sea and traditional waste-disposal practices of one kind or another. Governments - ever sensitive to new movements in the body politic - found money for such work and also found ready-made agencies in the shape of both fishery research and marine laboratories of a more general and academic kind. Consequently both types of institute greatly expanded their activities in various aspects of environmental and pollution monitoring over the next 20 years and the area of overlapping interests grew considerably.

As far as FRVs were concerned the most tangible result in many countries was that the numbers of non-fishing cruises grew year by year. Most of these cruises were associated with the monitoring of water quality over grids of stations covering dumping-grounds for colliery spoil or sewage sludge or associated with pipeline discharges from wastes or power stations. Others were the more traditional current measuring exercises that related now, however, not only to larval and young fish movements but also to the possible drift of oil and other pollutants.

There is little doubt that technically all the work associated with such cruises could be done from a research vessel designed for oceanographic or general biological work as opposed to one specially designed for fisheries work. However, since research vessels of any kind are costly items to build and run (Eddie, ibid.), and given the now long-term interest in protecting the marine environment that exists, it would appear to be sensible to build FRVs rather than other kinds of research vessels, with their very limited trawling capabilities, if any new vessels are to be built. The modern FRV can, because of the flexibility provided by containerized laboratories, meet most, if not all, possible national needs in the marine research field: the non-fishery research vessel cannot fish effectively and may need to be complemented therefore by commercial vessel charters. Given the permanently widened boundaries of the work now carried out under the umbrella of fisheries research in many countries it would appear sensible on this count, at least, to make sure that if a full-time vessel is to be shared between the marine scientific fraternity, it should be an FRV.

2.2.4 Summary

For short-term marine research of any kind with clearly defined objectives (e.g., determine the distribution and abundance of an unexploited stock or measure the area and discover the characteristics of a mud-patch lying off a waste-pipe of some kind) then a country can choose between maintaining a full-time FRV or using other platforms and approaches. In the longer term, however - and the longer term of 20-25 years has to be considered if a ship of any kind is to be built - when basic, long-term marine research with more diffuse objectives has to be considered, then the best policy would be to build an FRV that can be shared by all the marine institutes in a country and managed centrally if necessary.

2.3 Types of observations to be undertaken - in detail

Table 1 lists the areas of work that will probably need to be covered at least once in any given five year period by a modern fishery research institute. It is arranged in three broad sections and within them in increasing order of complexity so that, as a general rule, the further one goes down each sub-set the more important it is to have specialized facilities available for a cruise. The notes that follow outline the type of work to be expected under each heading both at sea and on shore before and after a

TABLE 1

Work that may be done from fishery research vessels

(i) BIOLOGICAL CRUISES

(a) Live fish samples

(b) Tagging cruises

(c) Exploratory fishing

(d) Fishing gear research without sector scanning sonar

(e) Localised fish distribution studies

(f) Sidescan sonar cruises of shellfish grounds and open-ocean fish tracking

(g) Groundfish cruises

(h) Acoustic surveys

(i) Young fish and larval cruises and development

(j) Metals and chemicals in fish and benthos. (Radioactive and non-radioactive)

(k) Fish behaviour studies involving sector scanning sonar and perhaps a second vessel

(ii) PHYSICAL AND CHEMICAL - THE ENVIRONMENTAL BACKGROUND - CRUISES

(a) Float tracking and diffusion exercises

(b) Moored current meter arrays

(c) Environmental surveys - temperature, salinity and chemistry (radioactive and non-radioactive) of the water and sediments

(iii) OTHERS

(a) Fisheries surveillance

(b) Fish processing

NB The further down each of the sections an item appears the more the need for a dedicated FRV to carry it out.

cruise. It is most important - and therefore it will be repeated several times in this text - to remember that a cruise is not finished when the ship has docked and is unloaded as far as the scientific staff is concerned. Their work is only finished when the samples or measurements that have been taken have been processed, vetted for quality, the "good" data analysed in whatever way is most appropriate, the results of this exercise written up and reported to other colleagues and then the "good" data archived carefully so that other people can use it at some future time if they want to. In this case "good" data is defined as the data set derived from the observations made via the application of calibration factors where appropriate, and the scientists' judgement that the techniques used did not unduly bias the observation process.

2.3.1 Biological observations

(a) Live fish samples

The purpose of these exercises is to bring back samples of live fish in good condition for experimental work in the institute. Observations of the behaviour of fish kept in tanks on the vessel will be considered under (g) below.

The prime requirements for this work are knowledge of the local fisheries so that the search time is cut to a minimum, the ability to rig and use fishing gear so that minimum damage is done to the fish or shellfish when they are caught, and space on deck for holding-tanks. Clearly all these features should be readily accessible in a local fishing fleet and short-term arrangements can be made to get the work done. The important house-keeping aspect of work to be remembered is that the vessel should be met on its return and the fish brought into the laboratory's holding facilities as soon as possible. Initially at least a member of staff should accompany the fisherman concerned but eventually even this element of supervision may be allowed to disappear as experience grows as to just what is needed.

(b) Tagging fish

The main differences between the work of tagging fish and "live fish" operations are that with the former it is important to know reasonably accurately where the fish were caught and released, and it is essential to keep good records of each tagged fish's species, sex, length, general condition on release and weight in some cases. The latter aspect means that it is necessary that at least one fishery research worker be on board the vessel during the cruise. The former aspect means that the commercial vessel used - if one is hired - should have its position-finding equipment checked out more carefully than under (a). In the initial stages of fishery investigations virtually any returns of tagged fish will give some potentially interesting information on movements, growth or fishing rate (fishing and natural mortality). The most important practical problem is to catch and release fish in good condition, and to use suitable types of tag (see Jones, R. 1979). Later tagging will only add useful information if it is properly designed to answer specific questions. This requires that the operations of the vessel, e.g., exactly when and where fishing is done, are carefully controlled; this is much easier with an FRV than with a commercial vessel. For the more delicate types of fish, the need to catch and release specimens in good condition may determine what vessels are best to use. For example, in the case of tuna success depends on very quick handling of pole-and-line caught fish for which an adapted commercial vessel works well, but for which many fishery research vessels would be unsuitable.

(c) Exploratory fishing

These observations have been discussed already in section 2.2.1. The practical point worth reiterating is that generally it may be politically and commercially advisable to use commercial vessels for this work in preference to a research vessel of some kind. This is because it makes sure, from the very first, that the local ships and gear are suited to any grounds and stocks found, and it broadens the experience of local fishermen. Given the costs of such exercises, though, it is important that the cruise programmes are drawn up clearly and formally agreed with the owners. It is also important to ensure that there is no doubt in anyone's mind that the fisheries scientists who go on the voyages decide the overall strategy and the shape of the day-to-day programme. Once a programme of work has finished it is essential that the results be made known as widely as possible within a fleet even if there is little good news to report.

The three main categories of the cruises that come under this general heading are:

- New explorations - just to see what is there. This is only important in a few areas now.
- Standing stock assessment. See 2.1.2 - not to be left to the unaccompanied commercial fisherman, since the data on catch rates only give unbiassed estimates of standing stock if the catches are made from predetermined (essentially random) positions, and
- Pilot fishing - to establish the feasibility of new fisheries in regard to gear, ground, season and likely catch-rates.

(d) Fishing gear research without sonar

These observations aim to provide an understanding of how nets, lines and traps actually behave when in use. If the institute has available a team of qualified divers, they will often be used both to observe the gear and to deploy sensors on it as required by the scientists and engineers. Special precautions over the safety of the divers need to be taken and it is recommended that the guidelines of the national "Association of Divers" should be followed in regard to the planning of these exercises. If guidelines are not available locally, they should be sought through the international scientific diving community.

Providing conditions of charter are formally agreed beforehand that make clear that the scientific team on board runs the programme, except when the safety of the vessel is in question, then a commercial vessel can be used in most aspects of gear research. Indeed, as with exploratory fishing, there are some definite advantages in having the industry directly involved from the first. Care should be taken when choosing the vessel to be used to see that there is enough room on board to house any recording instruments and diving gear needed but, all in all, this does not usually offer too many problems.

(e) Localised fish distribution studies

The observations to be made in this case consist of normal fishing stations with the total catch being sorted in general terms (see Annex 1 for possible basic log-book format) and then representative samples of the species(s) under review picked out of each haul for detailed assessment. A typical study, for example, is the comparison of the general condition and growth rates of cod found in a particular part of the North Sea to be living on and away from a region of pectinaria shells (Greer-Walker, pers. comm.). In this instance a grid of trawling and grab stations that covered the discrete pectinaria patch and extended to about 10 miles away from it was sampled, the former to provide the fish, the latter to confirm the nature of the sub-strate. The cod from the trawl were taken to a "wet" laboratory measured, sexed, aged, general feeding condition noted in the Scientist-in-Charge's i.e. the man responsible for the scientific aspects of the cruise (see 3.2 later) (SIC's) log-book - and the stomachs preserved for detailed examination later on land.

Hence nothing special is required as far as gear is concerned but reasonable facilities are needed for the examination of the catches. Ideally a covered area out of the worst of the weather, that has a workbench at optimum height which can be easily washed down, together with space for someone to stand and record the characteristics of individual fish are the minimum requirements. Temporary facilities might well be set up in the fish room of a commercial vessel before a cruise begins but care should be taken to see that people are not expected to do quite careful scientific assessments in dark, constricted areas badly sited in relation to the ship's motion during marginal conditions. The post-cruise shore work associated with, say, one week of sample-taking at sea may well extend over several months if stomach-contents have to be related to, for example, size and age of fish and/or time of day and position of capture.

(f) Sidescan sonar cruises of shellfish grounds and for open-sea fish tracking

These observations have been coupled together because, whilst the topics are different, the gear used is common to both. In the former case the sub-strate of known shellfish grounds, or surveys via sub-strate type for possible new grounds, are being explored. In the latter, fish - most commonly salmon or tuna to date - which have been tagged with long-life acoustic tags (Mitson and Storeton-West, 1971) on some previous FRV cruise, are being searched for and, when found, tracked for as long as possible in order to observe their behaviour in relation to, perhaps, tidal streams if present, wind and sea-state, night-day sequence, behaviour at full as opposed to new moon, etc.

Sidescan sonars - including the versions that give full colour presentation of the seabed being recorded, e.g., red for rocks, green for muds, etc. - are now relatively accessible and well-understood pieces of equipment that can be leased from firms who operate internationally. Furthermore the "fish" i.e. the transducer housed in a streamlined body, can be towed for long periods of time without needing much attention from relatively simple booms on small ships. All in all, therefore, chartered vessels - not even specifically fishing vessels - could be used to do sidescan sonar work for a fishery laboratory. The main requirements, in fact, are a covered area with reasonably good access to the winch and boom from which the "fish" is to be towed, an engineer who can keep the gear working properly and a scientist with some experience of analyzing the records and a clear problem to be tackled. Sweeping over an area to delimit a known shellfish ground can be done much more quickly via sidescan sonar than by grabbing or fishing.

(g) Groundfish surveys

These observations have been discussed in general in section 2.2.2. They consist of a fixed pattern of stations covering the sea-area of interest in a regular pre-determined way so that the results are not biassed by the natural tendency of the captain to fish where he thinks catches will be best. This may be done by having a mathematical grid, or by having stations selected, possibly within strata chosen according to depth zones and bottom type, by a random sampling process (Saville, 1977).

The results of surveys can be of immediate value when compared with the information obtained from the commercial fishery if, for example, certain species or sizes of fish are clearly under-represented in the commercial data. Such surveys become of even greater value when they have been continued over a period of years. Then they provide information on the trends in total abundance and species composition free of likely biasses in commercial catch-and-effort data that can arise from improvements in gear performance, shifts in preferences between species, etc. This means that, if at all possible, the same catching unit (i.e., combination of ship and fishing gear) should be used throughout the series of cruises so that at least one variable can be discounted. Consequently the existence of an FRV becomes a definite advantage in such cases given the pressures of timing in any one year and the other - more profitable - jobs that a commercial vessel might be doing just when it is needed for the groundfish survey at some time in a ten-year period. Similar pressures relate to a chartered fishery research vessel from a pool of some kind.

The work itself is relatively uncomplicated. If a large area is to be surveyed, clearance may have to be obtained to work in the exclusive economic zones (EEZs) of neighbouring countries before the cruise (see section 3.3), but once at sea the regime settles down to one of a number of fishing hauls with associated environmental measurements by day and night. After each haul the catch has to be counted, sub-sampled and processed so that a complete picture of the fish stock at that time and place is preserved. More details are provided in Holden and Raitt (1974) and Pauly (1983).

Computer storage of the details of each haul is useful but not essential. However, if all the data can be stored on the computer at sea - the steam-home often provides a good time for this to be done - then the land-based work of comparing the data set with those of previous years can be done very quickly and the latest estimate of the overall state of the stocks fed into current policy discussions within a week or so of a cruise ending. Such facilities also permit checks to be made at sea via an array of graphical techniques of the distributions being encountered during the cruise. This allows the ship's track to be adjusted if necessary to look in more detail at apparent anomalies, and questions asked about peculiarities in the original records while the information is still fresh in the minds of the people concerned. The software needed to computerize all aspects of groundfish surveys has been painfully developed already by several institutes and no one should contemplate beginning their own version until they have checked out the range of what exists already via the international fisheries science grapevine.

(h) Young fish and plankton sampling

These observations have been linked because the gears used have elements in common and the strategy adopted in general in carrying them out is the same. Indeed it is much the same as that for groundfish surveys but the requirements on the vessel are more demanding.

The aim of the work is to ascertain the characteristics of the plankton - including for the sake of argument "young fish" - distribution of a given sea area during the cruise. The timing of such cruises is obviously most important and several may be needed to cover an entire plankton bloom. The reasons for such studies are various and include, in order of increasing age of the fish to be sampled:

(i) providing an estimate of the standing stock of adult fish via the egg numbers found and the relationships between mean fecundity and the sex-ratios in the fishery (Smith and Richardson, 1977; Lockwood, 1978). The basic approach has recently been modified to make it applicable also to multiple spawners (Alheit et al., 1984).

(ii) providing information on larval abundance, growth and mortality rates, and the relation of these parameters to environmental conditions, abundance or density of adult stock, etc. This information is likely to provide insight into such fundamental questions of fishery science as the stability of fish stocks, and the stock/recruitment problem (Harding et al., 1978); Sharp, 1981; Bakun et al., 1982).

and (iii) providing estimates of recruitment to an adult fishery from the "young fish" numbers for use at working groups evolving Total Allowable Catches (TAC's) (Daan et al., 1981).

The extra demands on the facilities to be afforded by the vessel are, essentially, that there should be slip-ring winches for the plankton samplers, good handling facilities for moving these expensive items of gear inboard and outboard and reasonable laboratory space for doing some initial sorting of the samples at sea. The young fish surveys also call for derricks that allow small, specialized trawls, e.g. Isaacs Kidd mid-water trawl, to be deployed easily. Advantage is taken of some plankton surveys to study egg and larval development on board ship. This calls for temperature-controlled baths to be taken to sea and linked up with facilities such as running sea water and a steady electric current. Again, therefore, a premium is being placed on the rather special attributes that would be built into the design of a research vessel of some kind as opposed to a normal fishing vessel.

Note, however, that while a research vessel of some kind is called for, one that is leased would be readily acceptable. Whatever type of vessel is chosen it is most important, given the fact that the findings from samples, or even sub-samples, are multiplied-up to apply to large geographical areas, that the flow characteristics of the plankton sampler being used are carefully ascertained beforehand (Harding and Arnold, 1971), and that calibrations of the flow and environmental sensors are made before and after each cruise.

(i) Acoustic surveys

Since the early 1970s the acoustic assessment of pelagic fish stocks has become an important and routine technique to fish stock management specialists all over the world (Johannesson and Mitson, ibid.). This work involves recording the presence of fish on an echosounder, and fishing or purse seining for them to positively identify the species and then steaming round a grid which, in effect, covers the survey area as fully as time and weather permit with the echo integrators running; fishing stations being undertaken at various times to maintain the positive identification previously made.

After the cruise, or in real time with the latest equipment, factors can be supplied by the electronic engineers which, when multiplied by the amount of trace found, provide an estimate of the fish biomass recorded. Clearly much depends on the preparation and calibration of the equipment and its maintenance from day-to-day during the cruise. The gear could be set up on a chartered vessel but there is little doubt that an FRV, with its more refined acoustic characteristics and greater space and facilities to house the specialized equipment, is to be preferred. Whether or not a vessel might be leased from, say, the UNDP/FAO pool, for a season or series of seasons should always be considered especially if technicians with the relevant expertise could be hired with her.

(j) Metals and chemicals in fish and benthos - radioactive and non-radioactive monitoring studies

For some years now studies of the uptake of pollutants of all kinds by the fish and benthos found on and in the vicinity of dump-sites and outfall pipes have been undertaken by scientists employed in various fishery institutes. The field observations consist in this case of trawl or grab surveys over a grid of stations that covers the area of interest. Relatively precise position fixing is most important in small-scale studies but a whole range of areal scales extending even to ocean-monitoring on an opportunistic basis has been investigated. As is usual with all grids the recording of the whole sample taken at any one station should be done meticulously via, at least, ad hoc tables in the SIC's log-book (Annex I). The sub-sample (fish or benthic species) of particular interest will be preserved probably for assessment on shore after the cruise has finished.

Some assessments may have to be done on board ship, however, and in this case space to work, innate cleanliness of part of that space at least and reliable electrical facilities will be called for. Containerized laboratories could be used aboard commercial vessels; their overheads and transport costs would be far less than those of an FRV. If an FRV was available the work would be done in the wet laboratory mainly via instrumentation packages taken on board for the cruise. The basic concept of dedicated spaces on an FRV for "wet" and "dry" activities respectively might be in peril in this case because space tends to be at a premium and again a containerized laboratory might be felt to be the most appropriate way out of the dilemma.

Usually baseline studies have to be undertaken, and then the situation monitored for several successive years, before the routine interval needed between surveys on a long-term basis can be identified with some degree of confidence.

(k) Studies involving specialized gear designed into an FRV

Observations in this class are relatively few in type. Perhaps the best-known example is that of the high-frequency sector scanning sonar built into the FRV Clione used with acoustic tags of various kinds to study the behaviour of individual fish (Mitson, 1984). The instrument is costly and actually fitted into a tube that runs through the ship about one-third of the way aft. Clearly a vessel of some kind had to be available to the institute at Lowestoft before this programme could be properly put in hand. Recent technical developments have led to newer versions of the equipment becoming available that would not involve the need for such a basic design change in the ship's structure as in this particular instance but the class should be noted for the sake of completeness of this discussion.

2.3.2 Physical and chemical observations - the environmental background

Most fishery research institutes find themselves involved with studying the physical and chemical environments in which fish live in some detail. This work, by definition, calls for observations to be made at sea from season-to-season and year-to-year and can be as much a call on sea-time as most of the biological lines of study. The very large trawl winches and fishing decks of an FRV that distinguish it from a non-fishery research vessel - but make it very similar in general working-area design to a commercial fishing vessel - are luxuries rather than necessities in this case. Hence the possibility increases in principle with these types of cruises that other vessels could be used by an institute on a short-term basis, as was noted in section 2.2.3, but they would need to come from the class of surveying/oceanographic research vessels because of the specialized winches and cranes often needed.

With most of these cruises there is a good deal of preparatory work to be done with the instrumentation before going to sea, and a need for dedicated areas on the ship where recorders etc. can be mounted with safety. The results these days tend to be computer-printed output, magnetic tapes or discs or samples in bottled or powder form that have to be analyzed on shore. Quite often a three-week cruise can lead to a set of observations and samples that take the best part of a year to analyse, assess and write up.

(a) Float tracking and diffusion studies

This work is done to assess the rate at which a patch of pollutant of some kind or of eggs and larvae may be expected to grow. All scales of magnitude from world ocean diffusion via dissolved chemical constituents to studies in bays and estuaries have been undertaken under the auspices of fishery research. The latest, most ambitious concepts, are:

- tracking surface-piercing, open-ocean floats via satellite;

and - tracking deep (2500 m) floats across ocean basins via moored listening stations.

Dye-diffusion experiments enjoyed something of a vogue in the period 1965-75 and at least one large-scale experiment, involving up to seven ships and the tracking of a dye patch 200 kilometres or so in one dimension, took place and has been written up (Weidemann, 1973). The aim in this case was to get a definitive set of diffusion coefficients that could be used by other workers in the innumerable, smaller scale, experiments that take place each year around proposed and existing sewage or chemical outfall pipes. The general position has been reviewed by Okubo (1980).

The main facilities needed to make these observations are derricks and winches to lift the floats (which can reach 5-7 metres in length when out of the water) over the side and deck space to house the dye container if that approach is used. The dye in solution has to be pumped over the side well clear of the ship. The shipboard tracking gear may take the form of either a normal radar set giving bearings and distances to a surface marker, or a pumped water supply fed through a fluorometer for dye detection or the towing of an acoustic "fish" to pick up signals from some types of the more sophisticated floats. Precise position-fixing of the ship is essential for this type of work. Clearly, though, a fishery institute might well use a navy, coastguard or civilian survey/research vessel to carry it out.

(b) Moored station arrays

Since the early 1960s oceanographers in general have been laying arrays of unattended moored stations around sea areas to monitor various properties over a wide range of time-scales. Technically water speed, direction, temperature and depth and wave height and frequency have been most successfully measured in this way but light and dissolved oxygen have also been built into instrumentation packages at times. Fishery oceanographers have been in the forefront of this development because of the long-recognized need to provide their chemical and biological colleagues with much more detail about water movements and water mass characteristics than was possible before, say, 1964. The hope was - and remains - that the detail now available will enable workers to identify more clearly the different time-scale and degrees at which the physical, chemical and biological environments interact.

The main attributes needed by the ship used for this work are a derrick serving a flat, clear area of deck, a winch or capstan for paying out the wires making up the station, a means of lifting gear over the side into the water and holding it there until the weight can be taken by the winch or capstan and a dry, sheltered area in which the instruments can be worked on. Position-finding at both the launch and recovery phases of the operations is of critical importance (Ramster and Talbot, 1974). In the last five years deep ocean stations (more than 4000 m deep) have become commonplace and the technique has been used by fishery institute workers involved with assessing the suitability of ocean sites for the disposal of low-level radioactive wastes (Dickson et al. 1980).

Clearly, again, survey vessels or non-fishery research vessels could be - and are - used for this work though experience has shown that FRVs with their large capacity winches and big fishing decks do it very well indeed. The point to be taken is that a full-time FRV is not an essential pre-requisite.

(c) Water mass observations of all kinds

The most traditional branch of fishery oceanography is that of taking the water temperature at various depths in the water column and collecting samples of water at that depth in some way. Analysis of the samples leads to the determination of its salinity, dissolved oxygen and nutrient content and also to the detection of pollutants of all kinds. A grid of stations is generally worked so that the areal distribution of the various physical and chemical properties can be ascertained and compared with plankton or fish distributions taken at the same time if possible (Harding et al., ibid.). In recent years the Conductivity-Temperature-Depth (CTD) probe and associated Niskin bottles have replaced the traditional water bottle cast to a large extent and are now being replaced themselves by packages with even more sensors. Continuous monitoring of surface water or of water pumped from some depth layer is also carried out routinely.

The temperature and salinity surveys that form the background to many biological studies can easily be done on a mixed discipline cruise although they do call for a midships sampling position if possible and a dedicated winch for either the bottles (non-slipring type) or the CTD (slip-ring winch needed). Hence if an FRV is needed for the biological work these extra observations can be made with little extra cost. So, too, can environmental surveys concerned with monitoring the spread of a radioactive isotope of some kind round a sea area. Groundfish surveys and 137-Caesium budget studies of the North Sea have been very successfully carried out on a joint basis for several years now (Kautsky, et al., 1980).

In other cases, though, e.g., hydrocarbon detection, there is a premium on ultra-cleanliness in at least one part of the ship and dedicated cruises or discrete containerized laboratories are preferred. The institute has to choose, therefore, between only partly using the facilities built into an FRV on such cruises or becoming involved with short-term hire of a non-fishery research vessel with the appropriate laboratory space.

2.3.3 Other observations

(a) Fisheries surveillance

With the implementation of the United Nations' convention on the law of the sea, exclusive economic zones (EEZs) of 200 miles width have become an accepted fact. This has meant that fishery institutes may be called on, not only for scientific advice as to how the stocks should be exploited, but also for operational assistance in seeing that they are properly patrolled. Some countries use Navy vessels for protection or surveillance duties within their EEZs whilst others leave it to their coastguards or specific fishery protection squadrons. The attributes which set FRVs apart from other vessels do not make them obvious candidates for such work, but in emergency or from the need for sheer economy they may well double in such a role. Consequently an institute may find itself sharing a vessel with another department of state and, at times, this could be to its advantage insofar as the detailed management and financing of a large part of the programme may be off its hands. The disadvantage is, of course, that just at the wrong moment scientifically the vessel may be needed for surveillance duties and these tend to have the higher short-term priority.

(b) Fish processing

In all countries development programmes in the processing of fish at sea have been undertaken by fishery research institutes. In the main these have involved evaluating ways of freezing or chilling fish at sea to best advantage and they call for routine catching capacity and - in some cases - large-scale experimental machinery below-decks. Consequently access to a dedicated vessel over, say, a two-year period at least is preferable for this type of work if it is to be done out of public funds, though a converted commercial vessel ought to be quite adequate for the purpose. In fact this phase of fishery research appears to be over to a very large extent and it is mentioned here simply to round off the uses of FRVs that have occurred to date. The overheads of running ships for fish processing studies alone are very great indeed and generally now, when the need to do any work arises, short-term chartering of the most appropriate - and available - commercial vessel occurs.

3. PLANNING THE ANNUAL CRUISE PROGRAMME

3.1 The management team

Eddie (ibid.) has proposed that the management team for an FRV should consist of:

(i) The fleet manager (FM), who is ultimately responsible for the sea-going programme. Eddie argues that this position should be held by the director, his deputy or a senior administrator because of the central place in the financial and scientific structures of the institute occupied by the very existence of the FRV.

(ii) The marine engineer superintendent (MES), who is the senior professional in the team. He has the main technical responsibility for seeing that the vessel is ready for sea.

(iii) A clerical assistant or assistants - depending on the number of vessels - who will work under the MES and look after the administrative details relating to the ship, and

(iv) The "ship's husband" who will also work under the MES, but look after, in this case, the more practical matters such as mustering the crew, making sure stores are loaded on time, preparing trawls, etc.

These proposals, together with the caveats that there may be the need to amend them to take in local styles of administration and the idea that a Deputy MES would be useful, provide the starting-point for this section of the present report. The possible changes that need to be made as far as the scientific community is concerned relate to the background of the Fleet Manager and the possible provision of a "fleet support team" (FST) that deals solely with scientific gear (see section 4.1.1 below). It is also worth noting that in some fishery institutes staff recruited from deck officers rather than engineering grades have successfully performed the role allotted by Eddie to the MES. For this reason the post will be designated Marine Superintendent (MS) in this text.

Experience suggests that the position of fleet manager should be held by either the director, his deputy or a senior manager as Eddie proposes. This is because the job calls for, above all else, personal experience of sea-going cruises against which problems that may occur in the future can be judged and, at the same time, an appreciation of the way scientists think and feel that can only come from having been of that fraternity for a considerable time. It is not a job, therefore, for a senior administrator in the usual sense, i.e., a pay, rations and rent man. Ideally, in fact, the fleet manager should go to sea for at least one cruise a year so that he keeps himself aware of sea-going conditions and problems.

The guidelines provided here apply - though in varying degrees - whether the vessel used is wholly-owned, chartered or borrowed from an international pool. In general the simplest case, from the scientists' point of view, will be that in which the vessel is wholly-owned and managed by one institute. Figure 1 shows diagrammatically a possible structure of the fleet management team (FMT) in a moderately large research institute with probably more than one good-sized research vessel. In such institutes each of the positions described are full-time jobs for different people. However, even in the smallest institutes, if a research vessel - of whatever size - is operated, these distinct functions will have to be carried out. It is important in both cases for there to be clear understanding of who is responsible for each function, even if the individuals concerned also have other responsibilities.

3.2 The position of the individual scientist

The individual scientist who wishes to do some work at sea will usually link up with the sea-going programme initially through some kind of submission of a possible project to a more senior and experienced scientist i.e. his line manager who, it is assumed, will be responsible for a related group of projects (the group leader in this paper). Often these days such submissions are made formally at a set time each year and built into an overall programme of work both on land and at sea by the senior management team - however this is formulated locally. In some institutes, for example, it may well consist simply of the director, in others it may be a small group chaired by the director. Whatever the format used the various "bids" for shiptime come up through the structure (see section 3.5) and should be carefully assessed at each stage.

The main reason for this cautious approach is the fact that work at sea builds up its own momentum. Not only is <u>any</u> cruise very costly but often it appears quite naturally to the scientist doing the work that another cruise is needed to finish the job properly - and he can cite the expense already incurred as a reason for being given more sea-time. Hence there is a need to have carefully thought-out programmes of work from the first with, if possible, various "milestones" that can be used by the senior management team to assess the progress made before the proposal for another cruise has to be considered.

Once a scientist has been allotted a cruise on an FRV he will, more likely than not, want to be present while the work is done and, in fact, actually decide the work programme from day-to-day. His decisions will be mainly influenced by the results obtained so far, the likely weather over the next 24-36 hours, his relationship with the Master, the relative priorities he attaches to the work that remains to be started and whether or not he is a good sailor. This latter aspect may seem almost too obvious to state, but in fact it is of great importance. Only those who have worked at sea can know the shattering effect of ship's motion - especially in the early days of a cruise - on a scientist's outlook and motivation. Everything tends to be too much trouble and appears three or four times harder to do than it is on land so that ideally the man designated SIC of a cruise should already be known to be capable of working well at sea under all conditions. Fortunately one of the spurs that makes people overcome such problems most easily is the knowledge that their work - and possible their career prospects - depend on the results obtained. Consequently more often than not the SIC should be a scientist with a direct interest in the successful outcome of work to be undertaken.

3.3 The planning schedule

Formal planning of an FRV's annual programme is necessary because it is the only way of ensuring that practical aspects such as the need to maintain the vessel properly or gain permission for it to work in a foreign EEZ if required, are matched as efficiently as possible with the need, scientifically, to be in a particular area at a particular time. The very existence of an FRV demands a degree of formality in the organization of resources not needed quite so much in some other types of research institute.

However, given the quite dramatic changes that do occur in some fish stocks from year to year and in the sudden arrival, as national and even international news items of pollution "hot-spots" - the AMOCO CADIZ oilspill for example - it is important to maintain as flexible an approach as possible to planning procedures. The institute director should be prepared, therefore, to authorize changes in agreed schedules to meet sudden developments but he should weigh carefully the balance between, say, upsetting the sequence in a set of data painstakingly built up over 2-3 years for the sake of deploying his FRV in a politically prominent short-term role where the value of the actual science being done is more problematical. Similarly SIC's should be prepared during their cruises - which have, ideally, carefully thought-out schedules - to break away from them if some phenomenon is encountered that ought to be observed in detail to the best of the facilities available at the time. A good case in point, here, was the presence in 1981 of some dead fish in the trawl at a few stations off the Danish coast when FRV Cirolana was engaged in a North Sea groundfish survey. Time was taken out of the general programme to work this particular region in greater detail than was initially planned and, with hindsight, a link to a plankton bloom was postulated (Pope and Portmann, 1982).

Bearing in mind this need for flexibility, and assuming first that financial (FY) and calendar (January-December) years are in phase, and second that there is a need to progress the financial estimates and the proposed sea-time programmes together, Annex 2 suggests a fleet manager's theoretical calendar. The result of following it would be that the FRV would be scheduled a year in advance as of January of any given year and - barring accidents - funds would be available to support it during that period.

The prominence given in this proposal to the need for processing applications to work in foreign EEZs may come as something of a surprise. The proportion of the work of an FRV that would be required, according to scientific criteria, to be done in the EEZs of neighbouring countries will vary with the nature of the scientific programme, and the geography of the region being investigated: collection of live fish can be done, in most cases, entirely in national waters but following the drift of eggs and larvae off the coast of a small country with a strong coastal current will often require moving into the waters of an adjacent country. The geography of the North Sea means, for example, that little research carried out by the Lowestoft laboratory can be wholly confined to British waters (Lee and Ramster, 1981). In many other areas there is less need for such extensive work in other zones, but there are few fishery research institutes, if any, which on scientific grounds alone can confine all their activities to national waters. Often such work will be arranged as part of a joint programme of research, possibly through a regional scientific or fishery organization such as ICES.

However when there are international agreements at the scientific level, it is a fact of life that the formalities have to be carried out. Departments of foreign affairs work very slowly in the main, but also attach great importance in some cases to the conventions on such matters that are rapidly achieving the status of precedent or "case" law. It follows that fishery institutes have to deal with the work involved efficiently and systematically if the machinery of inter-governmental consultation is to be made to produce in time the permission to do the work that is needed. The consequences of not doing so can, in the short-term, consist of a vessel being taken over for a while by a foreign navy or customs officer or of being refused permission to enter a harbour. They are therefore both annoying and inconvenient. In the long term they may develop into a general lack of sympathy between the relevant departments in each state that effectively bars an FRV, for example, from ever following a patch of fish eggs and larvae into another state's EEZ so that the science itself is less good than it should be.

The mechanics of processing the application forms which - regionally at least - are now taking on standard formats are given in Annex 3 with examples taken from north-west Europe. In this case it is suggested that the requests should be processed in sequence at monthly intervals. Some institutes prefer to deal with all Year 2 cruises in the two months or so following the circulation of the agreed programme towards the end of Year 1. The choice is a matter for local decision, but the latter system does seem to create more paper-work and hypothetical problems. Annex 3(a) shows the form that foreign institutes have to complete and send, via their respective departments of foreign affairs, to the United Kingdom's foreign and commonwealth office at least three months before a research vessel of any kind wants to work in the British EEZ.

One of the main advantages of using Annex 2 as a guide to planning an annual cruise programme is that it provides a reasonable balance, a middle course, as it were, between the things that <u>must</u> be done practically and those that <u>ought</u> to be done scientifically. For example, by not requiring formal bids for cruises in Year 2 until April (late April/ early May if possible) of Year 1 it allows due note to be taken of the nature of the Spring plankton bloom - always a climactic period in non-tropical fisheries science - immediately prior to the proposed cruises. At the same time it gives just long enough for attending to such practicalities as working out financial forecasts and submitting estimates for the next financial year, making sure that the gear required for the first cruises of Year 2 is available, and staffing the eventual programme with scientists and crew. The need to deal with this latter aspect no later than, say, October-November of Year 1 may come as another surprise, but sea-going does involve significant breaks in both domestic and scientific work schedules that are best dealt with well before they happen. If nothing else the need for forward booking of summer vacations early in Year 2 produces considerable pressure from staff of all kinds to know what their sea-time commitment is likely to be as soon as possible.

Some fleet management teams are dealing with ships that are pooled not only between fishery institutes but also between, perhaps, different kinds of scientific institutes, university teams and military personnel. In such cases bids for cruises are often called for a clear 2 or 3 years before they actually take place. As far as the individual scientist is concerned -and particularly the fisheries biologist - such a system is to be avoided if at all possible. The built-in inflexibility of approach may be acceptable to, say, geophysists and hydrographers, i.e., chart-makers, but it severely penalizes a scientist trying to link his studies to the variability of biological phenomena.

When a vessel is wholly owned by an institute and it is the only one to be programmed there is the temptation for the director to act as fleet manager and simplify the whole process but, given its overall importance and the other calls on his time that normally occur, it seems more sensible for his deputy or another senior scientist to do the job and present him or her with alternative policies when problems arise. If nothing else there is more likelihood then that full consultations will take place with the scientists making the bids in regard to the ideal duration and the time of year when they need to be at sea. Once choices have been made by the director between competing bids then the Fleet Manager can go away and draft the first version of the programme.

Annex 2 may give the idea that this operation takes place in a vacuum, as it were, with no relationship to previous years. This is not so usually, and both the senior management team and the fleet manager should be careful that follow-ups of previous cruises do not automatically have priority over new ventures. In particular they must make sure a balance is struck in any year between monitoring-type cruises linked to statutory needs, e.g., groundfish surveys as background to TAC negotiations, and cruises stemming from flashes of insight that test hypotheses of one kind or another and in so doing advance marine science in a general sense.

3.4 The roles of the fleet manager and marine superintendent

More often than not first drafts of the next year's cruise programme will contain 80% or thereabouts of the final version so that it is essential that the marine superintendent should play a significant role in its compilation. In this way details of the ship's programme that relate to annual surveys required by the classification societies, etc. (Eddie, ibid.) and any proposed modifications can be built in with minimum fuss all-round. Dates that may be perfect for the marine superintendent may clash - if only slightly - with a need to be at sea sampling a particular plankton patch, for example, and such situations are best resolved by discussions between the fleet manager - who knows of the scientific nuances - and the MS who knows what must be done if the ship is to be kept up to scratch for the whole of its life. He can also temper any excessive zeal on the part of the fleet manager to shorten periods in port unrealistically or to have too many sailings on days that, for one reason or another, are socially less acceptable than others. In short close liaison between the fleet manager and the marine superintendent over the first draft of an annual cruise programme can turn a possibly prolonged exercise into a short burst of activity that then develops its own momentum and becomes little more than fine-tuning.

The need for such fine-tuning will arise because, almost certainly, once the first draft goes back to the scientists they will see that some need or other has not quite been met or that some opportunity for extra sampling is available that they had not appreciated before. Indeed if actual gaps in the programme appear new possibilities for cruises may occur to them and fresh bids make their appearance. Such developments call merely for a further draft or two though each of these should be checked with the research teams to make sure that any changes proposed have not upset their initial conception of what the programme will be. Consultations of this kind are necessarily more prolonged than might be expected if only because the people needed to clear a draft are often only rarely available together but they are well worth carrying out. Generally some eight weeks after a first draft has appeared a final version will be ready for staffing.

3.5 The detailed staffing of cruises

The fleet manager should not be involved with the details of staffing each cruise if only because, by his very position, he may be somewhat removed from the actual research projects. His role now is to see that SICs of cruises are nominated, together with their supporting teams, by the research groups themselves. Where vacancies occur he can simply set a deadline for the staffing to be completed that includes a week or so for tidying up loose-ends and then see that the proposed complete programme is presented to senior management for final approval before it is circulated to parties inside and outside the organization. (Ideally senior management should have at least seen all earlier drafts "for information" so that they are kept aware of the state of play at all times.)

3.6 The distribution of the annual programme

The number of outside people and institutions who need to have a copy of the cruise programme of an FRV is considerable. Obviously it is a help to local harbour-masters to know the broad pattern of ship movements to be expected and to have the information to hand but in recent years the foreign affairs department of central governments, search and rescue centres, and the compilers of national research vessel programmes that will eventually become part of international inventories, have also been added to the accepted circulation list. Other national laboratories will be interested, too, and there may well be regional arrangements for the formal exchange of programmes between institutes from different countries. Many of these exchanges may be purely formal, but on occasion there is mutual advantage in knowing that work is to be done by someone else at a particular time and in a particular area.

From time to time slight changes of the dates or staffing of cruises will be forced by circumstances. There is no need to circulate these widely - such notes often cause more confusion than is necessary. The minimum need is that the fleet manager and MS should be told as soon as possible of any change of SIC, and the SIC's themselves given as much notice as possible of enforced changes of sailing and docking days. Staff changes can be left in the hands of the SIC.

4. CARRYING OUT THE ANNUAL CRUISE PROGRAMME

4.1 Planning the individual cruises in general terms

Once the annual cruise programme has been issued responsibility for seeing that it is carried out efficiently lies with the FMT and the nominated SIC's of each cruise. As has been suggested earlier (section 3.3) the latter will generally be personally involved with their cruises either directly, e.g., the SIC's research project is actually being carried out, or the SIC reports to the scientist who has suggested the project in the first place. Consequently much of the pressure to get things done for the cruise reaches the FMT from the scientist-in-charge. The best way to make sure that nothing is left to chance is for the fleet manager to call a pre-cruise briefing about 7-10 days before the ship returns to port from its previous cruise, which should be attended by the SIC, or his deputy on the cruise if he is not available, the marine superintendent and whoever is responsible for making sure that the more usual items of scientific gear are provided for the cruise. This latter role will be filled in different ways from institute to institute to match local circumstances. Certainly once two or more FRVs have to be serviced, there will be many items in common that need to be supplied or replenished routinely (e.g., glassware, logbooks, pencils, tools, etc.) as well as the need to make sure cables for particular jobs are in place or the appropriate samplers have been supplied, etc., when there may well be conflicting demands from SICs. Such matters really lie outside the experience of a marine superintendent and his master fisherman helper (Eddie, ibid.)

and are best handled by the addition to the FMT of a fleet support team (FST) as proposed in section 3.1. In some cases, of course, circumstances will dictate that the role is merged with that of the ship's husband, though anything but the most basic FRV will call for this additional supporting service.

(i) The role of the Fleet Support Team (see also Fig. 1)

The scientific staff on a particular cruise may be at sea only once or twice a year and the lessons learnt from one cruise about the need for this or that piece of gear to be on board may be forgotten between cruises. The first priority of the FST is to make sure that scientifically an FRV is as well prepared as is possible cruise after cruise. Ideally the leader of this team - if more than one person can be provided - will be an experienced sea-going scientist-cum-fisherman-cum-engineer in his own right who will be supported by experts in the fields of, for example, electronics and fishing gear. Local factors will, of course, decide the composition of skills in the FST belonging to one institute. The important thing to realise is that the very fact that an FRV exists produces the need for it to be serviced properly between cruises, and on the scientific side this should not be left solely in the hands of the scientists who are to use it frequently.

Given that preparations for a cruise involving modern technology of various kinds have to begin well before the cruise starts, one way of linking the fleet support team and any cruise is for the fleet manager to ask the SIC to send in a formal list of his requirements to the FST some 4-8 weeks before his sailing date. In this way the head of FST may find himself - if there are two or more vessels to be serviced, for instance - with an almost continuous stream of work that has to be done to very specific and unchangeable deadlines. One of his great assets, therefore, must be the ability to juggle with competing claims for the work of his staff and see that, while each cruise is properly prepared for, the one next in line is not being unduly neglected in consequence. All his efforts will appear to peak when the ship sails with the SIC satisfied that his gear is in place and, as far as he can tell, in good order but, in fact, a more important practical milestone for him and the rest of the FMT is the pre-cruise briefing.

(ii) The pre-cruise briefing

The aim of this meeting is to bring order out of the potential chaos of a ship coming in for a few days between cruises with, on the one hand, its officers and crew wanting to make the most of their time ashore and, on the other, a new team of scientists, as well as the FMT being intent on getting it to sea again from the moment it docks. It enables the fleet manager, marine superintendent, head of FST and the SIC to systematically check what loose-ends have still to be tied up (see Annex 2 - possible agenda for the meeting). In particular the SIC can assure himself that the list of requests to the FST has been properly processed at a time - about two weeks before the cruise begins - when there is still the possibility of putting right any misconceptions or interpretations of his needs.

(iii) The role of the Scientist-in-Charge with special reference to the Master of an FRV

It has been pointed out several times already that the SIC plays a pivotal role in the run-up to a cruise. Given that he is concerned with the work to be done in a very clear and direct way his motivation for the overall success of the venture will be a prime factor in seeing that the FMT - which looks after every cruise and therefore sees nothing special in any particular one - is doing its job properly. During the cruise his role as motivator of all that goes on continues, but it is greatly changed in character by the fact that he has to live and work with the captain or master of the FRV.

When at sea the complements of research vessels of all kinds are rather specialized communities comprising, as they do, the officers and crew who live on the ship most of the year and the scientists who, in many cases, come on board for relatively short periods of time and in effect take charge of the facilities. The officers and crew live and work, moreover, in a semi-military society which has strict rules and regulations that are both explicit and traditional: the scientists tend to be much more free-wheeling. Such a situation, when allied to the peculiar pressures of living cheek-by-jowl with other people from day-to-day in conditions that may be extremely uncomfortable for quite long periods of time, leads to confrontations of one kind or another at many different interfaces (Anon., 1975). The most important interface of all is that between the SIC and the captain or master.

Practically, and often legally, the SIC is the owner's representative on board the vessel and the captain is his agent. This situation calls for considerable understanding from the SIC insofar as in both years and experience he may be a novice in all things connected with the ship and its crew when compared with the captain. Ideally the SIC merely briefs the captain on his scientific aims in general before the cruise begins and then discusses with him daily the progress being made whilst the normal life of the ship goes on under the captain's regime. The SIC should never publicly countermand an order given by the captain or - if possible - allow a situation to develop in public where such a move might be thought necessary. He must make all possible attempts to see that likely areas of conflict are discussed in private and respect the captain's own legal position with respect to the ship and its crew throughout the cruise. He should also make it clear to his staff that whilst on board they are, in effect, privileged guests of the captain and crew. Consequently the scientists should respect the ship's conventions providing they are so arranged that the needs of the scientific programme of work are paramount at all times except when the safety of the ship is in doubt.

The SIC's role is, at times, a very difficult one for a scientist to play. The captain has the enormous advantages of long sea-going experience, familiarity with the ship and the charisma of being a captain, but he also has to have faced the fact that he is employed to provide the SIC with the full range of the ship's facilities virtually on demand. Most of the time therefore the SIC-captain relationship is one of mutual interdependence but almost certainly, on at least one occasion in his sea-going career, an SIC will find that he has to impose his will on a captain for one reason or another. This is tacitly recognized by research vessel captains en masse but never really accepted. Fortunately such times are few and far between and various formal "ground rules" that slip imperceptibly into the traditions of the relationship, enable some of them to be side-stepped anyway. One such rule on the vessels belonging to the Fisheries Laboratory at Lowestoft is that, while the captain decides when the weather is too bad to work, the SIC decides when the scientific programme can be closed down and the ship can steam for home. In practice, of course, not only can the Lowestoft captains find innumerable housekeeping reasons for the ship to be in for a particular time but also the chief engineers can find extra knots in the engine that did not exist before.

4.2 The responsibilities of the SIC with reference to a particular cruise

In this section the duties of the SIC are set out in quasi-note form and chronological sequence. Versions suited to particular institutes could be produced by adopting the general schema and making such detailed changes as are relevant and then making sure all SICs have a copy for reference. Certain points, e.g., the detailed arrangements for obtaining permission to work in foreign waters, are specific to the conditions at the Fisheries Laboratory at Lowestoft, but will appear in one form or another in any institute.

The SIC of a cruise is the officer designated as such in the research vessel programme, irrespective of rank. The SIC's responsibilities are defined below for the various phases of a cruise.

(1) Before the cruise

(a) Up to 7 months before

Complete form for permission to work in any way inside the EEZ of another country or to call at a port in the USSR, Norway, France, Spain, Portugal and the Republic of Ireland. The actual period required for the submission of these forms to each country with a North Atlantic coastline is given in Annex 3.

Make sure a typed version of the form for each country likely to be concerned is sent to the foreign office via the fleet manager and chase up progress at monthly intervals. Any problems or lack of progress should be brought to the attention of the SIC's line manager.

(b) <u>8 weeks before the cruise</u>

Send a gear requirements list to the head of FST. All gear needs should be listed. Progress on all fronts should be monitored at about fortnightly intervals.

Obtain a copy of the current diving regulations if divers are to be used and see that its provisions are carried out during the run-up to the cruise.

Submit a case to the director for hospitality to guests when the ship is to visit a foreign port if a reception of some kind is planned.

Clear with the administrative section:

- the conditions, under which guests from other institutions and/or countries who will be members of the scientific staff during the cruise are being carried;
- any procedures required via the current Immigration Act relating to scientists being carried.

(c) <u>4 weeks before the cruise</u>

Order vehicle/crane facilities after discussion with the marine superintendent.

Draw up a cruise programme in the format of Annex 5, send it in draft to the director to be initialled and then send 4 copies to the Fleet Manager who will have arranged a pre-cruise briefing for about this time. This version of the programme can be in longhand, but preferably will be typed. Normally full circulation should follow the pre-cruise briefing. The SIC is responsible for checking the master text before multiple copies are produced.

Check whether the cruise will take the ship into a firing practice and exercise area i.e. coastal military firing ranges. If it is likely that one or other of these areas will be visited the Range Authorities should be informed by letter.

N.B. Cruise documents will be handed over at the pre-cruise briefing.
(Comprise: Defects list, data archive sheet, consumable stores sheet and project-allotment form)

(d) <u>2 weeks before the cruise - the pre-cruise briefing</u>

Issue Bond forms and make sure completed forms are returned well before the visit to the ship takes place.

Inform administration of the shift rota to be worked if this is appropriate.

Attend the pre-cruise briefing or send 2 i/c of the cruise.

(e) <u>Meeting the ship from her previous cruise</u>

The SIC must arrange to meet the ship when it docks and formally take her over from the previous SIC. This "take-over" should entail checks that:

- the keys to all drawers, cupboards and doors are on the SIC's keyboard;
- drawer and cupboard contents and all books in the scientific library are accounted for;
- the research winches and echosounders, computer and other items of fixed shipboard scientific hardware are in good order;

- all the laboratories are clean.

It should also involve acceptance and discussion of the defects and stores requirements lists.

Given that the master and ship's officers are usually busy with Customs and shore-engineers at this time, the SIC should - at the very least - leave with the master:

(a) his cruise programme, completed Bond forms and

(b) a note giving more details of:

- possible ports of call
- coastal military exercise ranges that may be encountered
- any foreign scientists to be carried
- the general preparations that should be made to the fishing deck and/or other working areas for the cruise
- the possible need for staff to join or leave the vessel by tug or pilot boat at some point in the cruise.

If it is at all practicable to do so the SIC should discuss these documents with the master. If this is quite impossible the SIC should check with him by telephone within 36 hours that there are no ambiguities or difficulties from the SHIP's side.

(f) Between cruises

The SIC is responsible for checking that all the gear requested is delivered to the ship and is set up properly by FST and that the ship's systems that will be used appear to be in good order. This should include the winches and any specialized laboratory facilities. It may involve the SIC's presence on the ship for several days before the sailing date. At the very least, both FST and the ship's master should be told how the gear should be stowed.

The SIC should make sure his staff know the sailing time and that they should report on board at least one hour beforehand or as requested by the master.

(2) During the cruise

(a) Carrying out the observational programme

Great care should be taken with the preparations for the first station: things tend to go wrong then just because routines of working have to be re-established. If trawls, plankton samplers, CTD's and current meters i.e. the more costly items of equipment, are to be deployed the SIC should ensure, in particular, that it does not take place as darkness approaches if at all possible.

During the cruise the programme should be modified freely to suit conditions, taking the best possible advantage of weather and of unexpected observations. The SIC should discuss the work plan with the master at least once a day and let him know what is required of the ship's officers and crew in all departments - bridge, deck, engine room and catering. Complaints regarding the vessel, her crew, messing, etc., should be taken up with the master as they occur and only raised later at the Laboratory if not satisfactorily resolved on board. (The master should be warned that this is to happen, of course.)

The decision to abandon work because of weather or of the needs of the ship should be reached by consultation between the SIC and the master, but the last word lies with the master.

The decision to end the voyage is for consultation between the SIC and the master but the last word lies with the SIC unless the safety of the ship is at risk.

The SIC should remind his staff that they are in all ways subject to seafaring discipline and customs. In particular they should not go ashore or on the bridge without the master's permission.

The master has been instructed to send a daily signal to the laboratory giving details of the ship's position and the work in progress. This signal can be used by the SIC for passing information also. In fact all substantial losses of equipment should be reported in this way initially.

During the cruise research equipment and/or ship's installations may be damaged. If immediate repairs are felt to be necessary the marine superintendent should be informed as soon as possible. In any case a written estimate of the cost of the repair should be obtained before any work is put in hand by a contractor.

(b) Documentation on a day-to-day basis

The SIC's logbook, the station sheets and the deck log must be kept up-to-date as the cruise proceeds. The first is the responsibility of the SIC, the last two of the master. These documents provide a history of the cruise and are to be filled in properly and in full. In particular the staff list, gear index, station positions and the list of documents containing data collected during the cruise must be entered in the spaces provided in the SIC's logbook, and this book is to be used to provide a comprehensive record of the scientific tasks undertaken during the cruise and their chronology.

In some cases staff may wish to use notebooks and special sheets for recording particular data that will not go easily into the SIC's logbook. When this is done a note to that effect must be entered in it but on no account is any piece of information called for by the logbook to be omitted from it on the grounds that it is already written elsewhere.

Details of films, magnetic tapes, discs and punched paper tapes containing data collected during the cruises are to be entered in the SIC's logbook.

All times entered in the SIC's logbooks, the station sheets and the deck log must be Greenwich Mean Time. This also applies to oceanographic logbooks, plankton logbooks, fish measurement logbooks and the cruise report.

The SIC should see that a record of the actual hours worked by each member of the scientific staff is kept. He must ensure that he does not give blanket approval for allowances when scientists are not actually working. The SIC must aim to keep all seagoing allowances as low as is possible consistent with the efficient conduct of the research programme.

(c) The safety of all personnel

In general

The master is ultimately responsible for the safety of the ship's company and the SIC must collaborate with him in ensuring the safety of people operating winches and working around them. The SIC is responsible for seeing that work carried out in the ship's laboratories complies, as far as is practicable, with standards of safety adopted in laboratories on land, e.g., hazardous wastes must not be poured down sinks.

All stations are to be supervised by scientists with previous sea-going experience. The scientist in charge of a station should try to avoid being occupied when gear is being worked or fish is being handled on deck. He should keep himself free to prevent any mishandling, to consider improvements and to consult with the ship's officers. He should take steps to see that his staff consult with the ship's officers when necessary and that they do not work in dangerous positions in relation to winches, stern ramps, ship's sides, etc. When stations are being worked at night at least two members of the scientific staff must be on duty at all times.

The SIC should ensure that all his staff are conversant with the contents of the department of trade's booklets "fishermen and safety" and "personal survival at sea", copies of which have been placed in each scientific cabin.

(d) Safety: diving operations

Diving operations are to be carried out under the terms of the "health and safety at work" regulations. The responsibility for seeing that this occurs rests with the diving supervisor nominated for each cruise on which diving takes place. The SIC and master share a watching-brief during diving operations to consult with the diving supervisor about any matter which may affect the safety of those diving before, during and after the diving operations take place.

(e) Safety: winch-working

It is the responsibility of the scientist-in-charge in collaboration with the master to decide how research winches are to be worked. No matter whether crew or scientific staff are chosen to drive them it is the responsibility of the master and the SIC to see that they are properly trained. There is no obligation on any member of the scientific staff to drive research winches. The scientist-in-charge is responsible for the well-being of the scientific equipment on the end of the wire, the wire itself, meter wheels, etc. and the research winch. He should see that all the research winches on board are regularly maintained during his cruise whether or not he makes use of each and every one of them.

(f) General housekeeping matters

Photographs of cruise activities

Photographs of equipment, specimens, etc., required for official use should normally be taken with departmentally-owned cameras. In cases where an officer has to use his own camera for the purpose of taking official photographs the laboratory will supply him with film or reimburse him after the cruise.

The scientist-in-charge should not allow staff to take a photograph of official equipment, specimens, etc. for their own use without their first obtaining his permission. He should remind them that his permission will have to be obtained if they eventually wish to publish photographs taken during the cruise. This will include clarifying the copyright position in each case.

(g) Visits to Inspectorate staff during port calls

When a research vessel calls at a port which is the base of a member or members of the fisheries inspectorate the SIC should either call on him or make arrangements for him to visit the ship if the timing of the port call makes this practicable.

(h) Laboratory conditions

During the course of the cruise the ship's laboratories should be kept in good order by the scientific staff. In particular, wet laboratories should not be allowed to become dirty or smelly.

(i) Sickness

In the case of severe sickness or injury scientific staff, like the other members of the ship's company, may be put ashore at the most convenient port at which suitable medical attention is available. Their return to their home station will be the responsibility of the laboratory.

(j) Ending the cruise

As the cruise draws towards its close the SIC, in consultation with the master, should decide the most appropriate docking time and give the laboratory at least 48 hours notice of it. Monday arrivals must be notified on the preceding Thursday at the latest. Requests for lorries and/or cranes to meet the ship should be made at the same time.

(3) Steaming home and the immediate post-cruise period

(a) Condition of Laboratories and Scientific Gear

Maintenance of the shipboard laboratories and equipment is the responsibility of the scientific staff on each cruise. The SIC should ensure that either on the run home or once in port his staff:

- Thoroughly clean all the laboratories and leave them with the floors scrubbed and the benches polished. Refrigerators should be emptied.

- Check the contents of the tool kit noting discrepancies on the defects list. As the tools are checked they should be cleaned and greased and the box locked up on completion.

- Check against the list kept on board the contents of the drawers in the laboratories. Again, discrepancies should be noted and the items put into order. These drawers should be locked once the check has been made.

- Check the contents of the scientific library and lock it up.

- Dismantle and pack away any formalin dispensers.

The SIC should collect all the keys and leave them in his cabin for his successor. He should make sure also that the file of cruise reports in his cabin is complete. If it is not all discrepancies should be noted on his defects list.

(b) End-of-Cruise Documentation

(i) The following documents should be prepared during the run home or with 24 hours of docking:

- SIC's logbook

- Oceanographic logbook, with positions and thermometer numbers entered (if used)

- Plankton logbook (if used)

- Fish measurement logbooks (if used)

- Station and deck log sheets

- Cruise report. The format to be used is given in Annex 6. The draft should be seen and initialled by the master and the fishing skipper if there is one. It can be supplemented by the station and track charts drawn using the blank outlines found in the SIC's cabin.

- Data archive sheet.

(ii) Cruise reports. As soon as possible after the cruise the draft cruise report should be sent to the director via the SIC's head of section. Once it has been initialled and typed the SIC is reponsible for checking the typescript before multiple copies are distributed. All logbooks and station sheets are to be passed to the fleet manager at the debriefing meeting (see "debriefing" below).

(iii) Scientific stores and defects list. A carbon-copy of this list should be left with the master. The entries should be discussed with him so that any ambiguities can be cleared up. The top copy must be passed to the head of FST within 24 hours of the ship docking.

(iv) Deck and accommodation defects. These should be discussed with the master when found since many can be attended to at sea. Outstanding items should be listed at the end of the cruise and the list, once agreed with the master, passed on to the marine superintendent via a file.

(v) Gear and equipment losses. When gear and equipment is lost or badly damaged authority to write it off has to be requested from headquarters. The SIC's cruise report should, of course, mention such items and the circumstances in the context of the cruise, but it may be felt necessary to provide more details in a separate note so as not to unbalance the report. This should be written as soon as possible after the loss or damage has occurred and should take in the accounts and opinions of other members of the ship's company if appropriate. This note will form the basis of the write-off procedure.

(c) Clearing the Ship

The SIC is responsible for seeing that:

- Bond and cash advance accounts are paid before his staff leave the ship.
- Personal belongings and sea-kit are cleared from the cabins except when a scientist is making two trips in succession and the chief steward has approved exemption from this rule. In such a case the items are left at the owner's risk: the Laboratory accepts no responsibility for their safety.
- The despatch of samples, specimens and surplus chemicals (including formalin) to the laboratory is done properly.
- The ship is cleared of all the gear he has used on his cruise unless he has been told by FST that it should stay on board.

(d) The distribution of fish caught during the cruise

The catch of fish of a research vessel is the property of the laboratory. A member of staff may land a "fry", i.e., the amount of fish a person can carry easily. It is hoped that commonsense will prevail if/when this definition is challenged as to the actual amount of fish referred to.

(e) Debriefing (see also 5.2)

A debriefing meeting will be held by the director shortly after the cruise has ended. It will be attended by the fleet manager, the marine superintendent and others from the institute as felt to be required, as well as the SIC. All logbooks and station sheets associated with the cruise will be handed over to the fleet manager at this time and he will be responsible for their registration. The meeting will be concerned not only with what happened during the cruise but also with the plan for working-up the data and its archiving and with plans for similar cruises in the future if they are thought to be needed.

4.3 Data archival

Once the FRV has docked and been unloaded the SIC and his team will - generally - want to think of anything else but the ship and the results of the cruise for at least a few days. They will also find, too, more often than not, that jobs have piled up from other parts of their workload so that the cruise rapidly loses the rather special, central, place in their thinking that it had only a short while before. The idea of the formal debriefing session is that, as far as the institute as a whole is concerned, the SIC will be forced to attend to various loose ends. One of the most important of these in the long-term is the archival of cruise data.

The data collected by research vessels - the sizes of fish caught in a particular haul, for example, or the direction of the water current at a particular depth and a particular time - cost a great deal in purely accounting terms. Scientists can only expect their paymasters to continue to supply the funds to collect this information if, after it is amassed, it is looked after properly. Good archiving also has its own reward. Much extremely useful data can, and have been, extracted from the files of earlier research cruises, and used to answer questions over and above the original purpose for which they were gathered because the information has been adequately archived.

For the most part cruise data archival consisted, until only 4 or 5 years ago, solely of registering centrally the various logbooks that had been completed during a cruise and keeping track of who borrowed them from time to time. Access to the logbooks or the cruise reports would provide anyone with a means of finding out where and when just what data had been taken and he could go to the relevant specialist area - the plankton group or the physical oceanographers - if he wanted to see the current state of the working-up of the data or be directed to the completed data set itself which would be set out in tables or maps or both. As the data sets built up from the early years of the century individual laboratories begin to issue data reports yearly or by cruise as discrete publications, but the labour and time involved in producing them was always immense. With the explosion of marine studies in the period 1960-70 and the arrival of new techniques which gave so much more data (e.g., not 20 temperature points in a 1000 metre deep station from water bottles but 25 measurements per second as a CTD probe descends at 40 metres per minute) these manual techniques - even when aided by the first computers - were always several years behind schedule.

With the arrival of much more flexible computing power both on land and at sea, and with the evolution of database techniques in the last four years in particular, there is a good chance that institutes will be able to archive their cruise data at least as efficiently as was done in the 1930s - when there was so much less to look after anyway - and also retrieve it virtually in real time which is a new dimension. The main reason for the improved prospects is the widespread availability of on-line data recording to microcomputers or a centralized system or a mixture of both. As the ship steams along its position can be recorded automatically - with manual checks possible at various times - and data can flow to the data centre from, in theory, anywhere in the ship and be logged against time and place.

Similarly CTD station data or the results of a trawl haul can be logged within a short while of a ship moving on to the next station. Hence for an FRV with computing power of some kind available the chances are that the observations made during a cruise can be logged whilst at sea and the tapes or discs simply fed to the land-based computers once the cruise is over. In short, logbooks have, in principle, been overtaken by computers as the ultimate means of cruise data logging and archival. For many institutes, of course, logbooks will remain in being for some time and this is the reason for the emphasis placed on them in section 4.2. Indeed the SIC's logbook should still be needed as an informal diary of what happened at each station of a cruise - and at any other time the SIC feels entries should be made - but it no longer needs to contain everything about the observations made when used on an FRV with data logging facilities.

Once "good" data has been put into an archive, it is important to all potential users that they know of its existence and can reach it easily. Some institutes have now gone back to the idea of issuing regular data sets, thanks to the ease with which standard outputs can be produced by computers. Indeed some Japanese institutes, for example, issue yearly details of water temperature, salinity and dissolved oxygen at 10 metre intervals for all stations that their vessels occupy. Others prefer to issue data inventories which list the stations occupied, what was done at each, and then give some idea - graphically or by statistic or both - of the character of the data. In this way, at least, people elsewhere can have some idea of whether they are interested in trying to get hold of the actual data itself.

Within an institute a computerized cruise inventory that can be "searched" to give, say, all cruises that trawled in a given area over a certain period of time would appear to be a useful modern version of the printed lists of cruises used by previous generations of workers. Such an inventory is relatively simple to set up and might even be produced on manually-searched cards if access to computers is restricted. The essentials of the system are that the SIC should complete for his cruise a data archive form which identifies ship, cruise, dates, area of work by latitude and longitude and common name, if any, and the number of stations at which various operations were performed, viz. 21 grab samples, 14 trawling stations and 7 water column casts. Even such a coarse scheme will enable anyone to locate fairly easily those cruises that are most likely to be of relevance to his immediate needs.

The director of an institute with an FRV in prospect may feel that data archival is the least of his worries. Given, though, the rate of data capture these days from instrumentation of all kinds, as well as the cost to his institute of each item of data held in a logbook on tape or on film, and its potential worth to him and his colleagues - and their successors - he would be wise not to brush it to one side for more than a day after the ship has sailed on its first cruise under his responsibility.

5. WAS THE EFFORT WORTHWHILE: ASSESSING THE VALUE OF AN FRV CRUISE?

It is very easy for people to look back on an FRV cruise - or a whole series of such cruises - and point out, with the benefit of hindsight, that very little of tangible worth appears to have been produced. In short the work has not been "cost-effective" according to one or other of the many possible definitions of this popular term. It is very easy also for participating scientists to view sea-time as an end in itself and to be perpetually planning, taking part in and recovering from research cruises. Clearly some kind of middle course has to be steered between cruises under the name of fishery research that are little more than surveillance exercises - and therefore rather easily and simplistically justified - and studied of marine esoterica of one kind or another undertaken for their own sake on a long-term basis.

Undoubtedly the charting of this middle course must fall to the director of an institute and his group leaders in the first place. Only the people in charge can be aware of the full range of financial and scientific pressures that are at work at a given moment and adjust the balance of the programme accordingly if adjustments are needed. For this reason above all the director must be kept aware of the detailed programming and operational problems of the ships being used and, if he does not have a fleet manager to handle the details, he most give time to them himself.

5.1 The Fleet Manager's point of view

If a fishery institute is to develop as a balanced entity, most annual sea-going programmes, whether the vessels are wholly owned, chartered or borrowed, should contain a mixture of both applied, in the narrowest sense, and pure science and be spread across the disciplines of physical, chemical and biological oceanography. Experience has shown time and again that there are tangible benefits to be gained from having scientists from several disciplines working together in the same building and at sea on different aspects of a common problem. Indeed people may well be attracted to an institute if they can see from its annual reports that sea-time is found for a wide range of disciplines and fisheries problems. Consequently one test that a fleet manager might well apply to his annual cruise programme with hindsight, is "Did I manage to produce a well balanced programme of work and not just fill up the time available by, in effect, handing over the vessel to the most vociferous Section?".

Another is to look at the extent to which cruises made separately by different groups of workers might, in fact, have been planned from the first as multi-disciplinary ventures. A sequences of such cruises stretching over several years may be found to be particularly useful where a laboratory is, perhaps, not only getting its programme started but also building up a background picture of a sea area in which it is to operate. In this case the FRV's steaming-time to and from the working area is at a minimum and some use can be found for almost all the period spent in the area of interest because once the trawl winch is finished with, for example, the ship can turn to moored station deployment or water column sampling. Some care must be taken by the SIC, of course, to make sure that he does not put too much continuous pressure on the captain and his crew as he asks for one type of gear and then another day after day.

5.2 Senior Management's viewpoint

Either the director or his deputy should chair the debriefing session for each SIC. The fleet manager - if there is one- and marine superintendent should also be present. On each occasion the session may begin with a short presentation by the SIC of what he did, why he did it and of the results obtained and this may lead to some discussions about the way the data will be processed and stored and the implications for future seatime. The second part of the meeting will tend to consist of apparently more mundane questions about the way the ship and the complement - both crew and scientists - functioned. The result of the session will be that the chairman should be able to build up a picture of both the value to the institute's programme of the observations made and also the efficiency of the entire operation from cruise planning through to docking and the "return to the laboratory" phase. The second half of the meeting is all that much more important, of course, if the aims of the cruise have not been met in large part. In these cases - a gear or instrument testing cruise with few results, for example, or a half-finished trawl survey or a fish behaviour cruise aimed at testing an hypothesis that never really got started and yielded no results either way - senior management should be asking such things as:

Was the cruise long enough? What was the weather pattern in detail? Did the ship function properly as a piece of machinery? Did the captain and SIC mis-judge a weather forecast and lose a day here, or a day there owing to an unnecessary steam for shelter or through spending too long at anchor? Was a mid-cruise break unduly prolonged? Were there ship-handling faults or winch failures or did the scientists arrive on board badly prepared? At times the debriefing session may appear to be no more than a ritual but as often as not some point will arise that the fleet manager needs to take note of and senior management need to be aware of.

5.3 The SIC's point of view

Earlier in this paper attention was drawn to the importance of the relationship that develops between the SIC and the captain of a research vessel during a cruise. The different standpoints adopted quite naturally by these two people are shown particularly clearly by their respective attitudes towards summing up the success or otherwise of a cruise. In large part both men are "managers" wanting much the same things - fair winds, calm seas, untroubled machinery and an efficient crew. Additionally though the SIC can get some sense of achievement from a cruise via the data he collects - or depression due to its lack - that the captain cannot really share with him. To the captain the cruise is just one of a long series: to the SIC it may be his only venture to sea that year and the corner-stone of two years further work on shore that leads to considerable kudos. Such differences of view will colour the separate reports of the two individuals concerned and it is as well for the fleet manager to appreciate this as he reads them. Sometimes, for example, an aspect of the behaviour of the scientists may loom large in the captain's report and not even be part of the SIC's memory of the cruise. At the pre-cruise briefing stress must be placed on the need for the SIC to talk over the cruise with the captain in general terms during the steam home so as to air, and if possible deal with completely, any such aspects of the cruise. At the very least an agreement to disagree should be made with the corollary that the SIC should raise this or that matter at the debriefing session.

Similarly significant differences in their appreciation of the value of a cruise may develop between the SIC and his line management. To the latter a particular cruise may be just part of the institute's overall programme, to the former it may be professional life or death. Ideally these differences will be ironed out on at least an annual basis by a "project review" or "formal report" where senior management and the project leaders can exchange views on the scientific strategy to be adopted over the next 12 months. Out of the cases presented and the consideration given to them a clear sea-going programme should emerge that can be justified to all and sundry. Once a cruise has taken place the onus falls on the project leader/SIC to use its results to justify the idea that further cruises are needed to add to his data set. Senior management should be very wary of either apparently open-ended sea-going programmes or bids for cruises based on previous cruises for which data has yet to be worked up.

5.4 The outside world

There are at least two ways in which the results of an FRV cruise can be assessed in a meaningful way by the world outside the institute. First and foremost, perhaps, to the rest of the scientific community is the eventual appearance of published papers dealing with the data that have been collected. Because the oceans remain relatively unknown quantities, observations made in one area and properly reported remain of considerable intrinsic importance in many other areas. They are of even greater value, of course, if they form part of a sequence of cruises that investigates in detail a particular aspect of marine science. Second, even when the results of a cruise may not be suitable for formal publication, they may, in fact, underpin the deliberations at international working group meetings called to discuss regional fisheries problems and also be of real interest to fishermen themselves. Fishery biologists, for example, will use groundfish survey reports as an alternative view on the state of a stock to that provided by commercial data - both will have their strengths and weaknesses (see section 2.2.2). Pollution scientists, on the other hand, will be able to demonstrate via the results of cruises the latest situation around a dumpsite or at the end of a pipeline. Work of this kind has always been of great importance in any fishery institute but, to some extent, has never been given the recognition it deserves. The director and his group leaders should make clear at fairly regular intervals that they do appreciate that much of the value of their working group discussions with colleagues from other institutes is derived, in large part, from the situation-reports they receive from such "routine" cruises.

Some degree of permanent recognition for the results of a cruise or a series of cruises - and incidentally wider dissemination of the results - is provided if the final scientific assessment is published "in house" in an institute report series. In this way the SIC and his team have a definite target to be achieved and the satisfaction of rounding-off a piece of work while other people, and most particularly fishermen and the fishing press, can use the material for their own purposes. The importance of regular reporting to the commercial and artisanal fishermen of the work being done by an institute cannot be stressed too much. It may require extra work at times on the part of the scientists which is not precisely called for in their job descriptions but such work, and the relationship that develops with it, will be to the overall benefit of the institute.

At some institutes an SIC is not allowed to go to sea again before the final draft of the scientific assessment of the results of his last cruise has been made and accepted in principle by his line managers. This does not mean necessarily that the material is ready for publication in a journal or technical report: the results of several cruises may have to be combined before a suitable text can be produced or the results may simply not be good enough or suited for publication for some other reason. Nor does it ensure, necessarily, that the material is put into some kind of order a relatively short time after the cruise has finished every time - the SIC may not want to go to sea again for another year! Hence like all such rules directors should consider its relevance to their own situation and derive the variant of it that suits them best.

Something does need to be done though to ensure that samples and records of all kinds from any cruise are not just left untouched. If nothing else one or other strange aspect of them that comes to light in an early post-cruise housekeeping exercise may be explained by, for example, an idiosyncracy in the way a station had to be worked. The scientific staff on the ship at the time will remember the occasion and an appropriate note can be made. Such a note will be of real worth to other workers who were not on board at the time. Indeed efficient housekeeping of this kind potentially allows the reassessment of the results of the cruise by anyone, anywhere - if the material gets into the international databanks - at any time in the future. Now that systematic fisheries science has existed for the better part of a century a feature of future work may well be papers that bring together data sets from different cruises and periods for one particular region or group of regions. A current example of the first of these possibilities is the reworking of temperature and salinity data taken in the Norwegian Sea in the 1950s now that a 30-year time series is becoming available for study (Dickson and Blindheim, ICES 84). In general as time goes by the numbers of papers and reports that use the data collected on any FRV's cruises will grow and the scientific community will become aware of the ship's existence and, hopefully, of its worth in their terms, while politicians and administrators for their part will gradually appreciate that much of the advice they are being given stems from actual observations at sea. In short the fact that the essential value of a fishery institute to society stems in large part from the range and quality of the observations it makes from its FRVs will be established once again.

5.5 Concluding remarks

Any country considering the construction of an oceanographic research vessel should assess carefully whether it really needs to build one or whether it can lease or borrow one instead. This is because of the continuous drain on funds and supporting manpower resources imposed by the existence of any vessel over 10 metres in length during its 20-25 year lifespan whether it is at sea or not.

If a country decides it does want to own its own vessel it should carefully consider the size and type required. It will probably find that about 80% of its possible needs would be met by a ship of about 25 metres in length and that to meet another 5-15% would require a larger ship, which will double the costs on a continuing basis over 20-25 years. It also needs to choose between an oceanographic research vessel *per se* and an FRV. Everything that can be done on the former can be carried out on the latter - given the use of portable laboratories - but the reverse is not true because of the need to carefully site and house trawl-winches and trawl-ways at the design stage. In effect therefore the oceanographic research vessel is a sub-species of the FRV and yet the costs of construction are very similar. An FRV therefore offers the better investment of funds.

Fishery research could not exist in a true sense without FRVs. Advances in remote sensing may prove to be an aid in FRV deployment but they will effect only marginal improvements in cost-effectiveness. For as long as there are fishery researchers there will be the need for cruise programmes that span the whole range of disciplines associated with their studies.

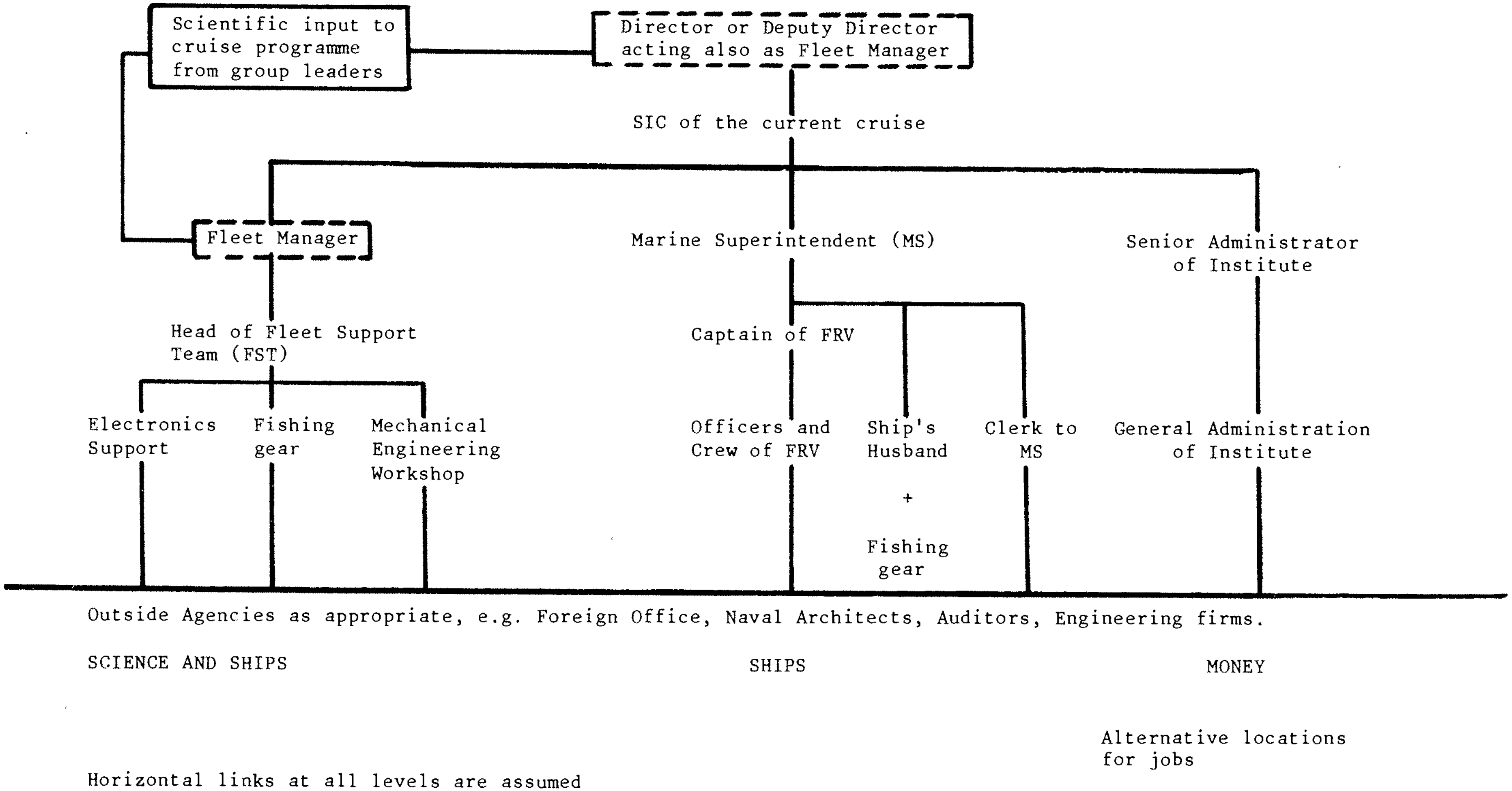
Because of the central place occupied by an FRV in an institute's scientific and financial programmes the director or a close associate on the scientific staff should be ultimately responsible for all aspects of the vessel. During a cruise this role is taken over on a day-to-day basis by the SIC, as far as the science is concerned, and by the master as far as the safety of the ship goes. To work properly it should be clearly understood that the SIC-captain relationship is another example of a "first among equals" situation with the SIC, the owner's representative, as the dominant partner.

The scientific programme of work on any cruise should be of a personal concern to the SIC in some very direct way. An SIC must clearly understand that a cruise does not finish when the ship is unloaded. The data collected must be processed, analysed, reported and archived before his responsibility for it ends. Two factors underpin this sequence: carefully thought out workplans and meticulous data recording during the cruise.

The semi-military rules and conventions needed to make ships work at all have to be respected by the scientific "visitors" on each cruise. Every cruise has its mixture of rewarding and disappointing experiences in all fields and the FRV crew-scientist relationship is no exception. Generally, however, the combination of hardships - including absence from home - endured together, calm seas and fair winds enjoyed together and a programme of work that could not be completed without the separate skills brought by both parties to the ship being merged, ensures that a very real "*esprit de corps*" develops that is not quite totally destroyed by the moment of docking.

FIGURE 1. An idealized fleet management team (FMT) for a fisheries research institute

NB. Local arrangements will decide: (a) if the fleet support team can be distinct from the ship's husband; (b) whether or not there will be a fleet manager who will double this work with either a research programme of his own or managing scientific support over the whole range required by the institute, e.g. information services, electronics and computing, or a mixture of both.



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ANNEX 1

Possible Format for Scientist-in-Charge's Logbook

(see below)

The right hand side Page(s) can be used on an ad hoc basis for

(a) general information on haul data

and (b) detailed fish sampling by species, length, sex, maturity, etc.

SHIP ....

CRUISE .... STATION ....

LOCALITY ....

Fish caught

Fish measured

Date

Depth (fms.)

Gear	Time (G.M.T.)		Depth (fms.)	Duration	

Benthos

Notes

Material Preserved

Hydrographic Observations made / not made

See Hyd. Log Book

ANNEX 2

A Fleet Manager's Calendar - In Theory

(Assumes a January-December Financial Year)

JANUARY (Year 1)

Project review assesses:

(a) Progress in Year 0
(b) Work in hand in Year 1
and (c) The programme for Year 2 on both land and sea in general terms.

(Fleet manager sits in on discussions where felt to be most appropriate or when specifically called in.)

FEBRUARY-MARCH

Management team agrees the principle features of programme for Year 2 - estimates drawn up with provisional sea-time by project included.

APRIL

Specific bids for Year 2 sea-time made - director decides priorities where clashes occur.

Final estimates for Year 2 submitted to HQ.

MAY

Draft cruise programme for Year 2 in circulation with request for nomination of SICs.

JUNE

(a) Agreed programme and SICs for Year 2 sent out with request for staffing with scientists by 1 October. (May be prolonged until July if several drafts needed).

(b) Some Year 2 foreign EEZ applications begin (6 month's notice).

(c) Capital purchases from Year 1 monies for ships finished apart from contingency funds.

JULY

Foreign EEZ applications (6 months).

AUGUST

Foreign EEZ applications (6 months).

SEPTEMBER

(a) Foreign EEZ application - 3 months and 6 month notices

(b) Reminder re - 1 October deadline sent to group leaders.

OCTOBER

(a) Foreign EEZ applications

(b) Full Year 2 programme circulated

NOVEMBER

(a) Foreign EEZ applications

(b) Year 2 cruise preparations begin in FST

(c) Project review documents being drafted within research groups - may need advice on sea-time in Year 3

DECEMBER

(a) Foreign EEZ applications

(b) Year 2 estimates approved

(c) Main capital purchases start

JANUARY

(a) Foreign EEZ applications

(b) Cruises begin

(c) Project review cycle begins again.

ANNEX 3

SIC's GUIDE TO THE LAW OF THE SEA

(As used by English Fishery research vessels)

1. Delimitation of EEZs

(i) EEZ stated to be 200 miles.

Norway, Portugal, France, Iceland and Spain.

(ii) No formal EEZ but a 200 mile "Fishery Zone" claimed:-

Denmark (Faroe and Greenland), F.R. Germany, Ireland, USSR, The Netherlands, USA, Canada, Belgium, Sweden.

If you plan to work within 200 miles of the coast of a country not in these lists please tell the fleet manager so that he can check if an application is needed.

2. Lead-in time for applications

In order to allow due processing of applications completed forms should leave the fleet manager for the foreign and commonwealth office (FCO) well before the particular cruise in question. In fact the minimum times are:

France)
Norway)
Republic of Ireland) 6.5 months; Portugal 3.5 months; All others 2.5 months
Soviet Union)
Spain)

3. Point to note about the form

(i) Entries to be typed.

(ii) Separate copies needed for each coastal state.

(iii) Part B - Question 3 - Purpose of research and general operational methods. A clear explanation of the proposed work in non-technical language together with a description of the equipment to be used will help to get your cruise cleared quickly and easily.

Question 4 - Chart showing stations, area of work, etc. Obligatory. To be as detailed as possible and to show nearest coasts, etc. so that maritime limits can be inserted if need be.

(iv) Coastal state pages: Answer "Yes" in col. 2 for water column and fishing activities. Answer "Yes" in col. 3 if the bottom is being dredged, cored, sampled or sounded apart from navigational echo-sounding.

(v) Inconsistencies, etc. in form-filling may creep in from time to time which hold up processing. Please therefore send your forms to the fleet manager for passing on to the FCO. He will be responsible for any mistakes that are made as far as we are concerned.

(vi) If the fleet manager is absent for more than one week files should be sent to the marine superintendent, drawing attention to the need for checking and transmission.

4. Replies from the FCO

(i) For fisheries research cruises outside a host country's territorial sea (i.e. a 3-mile wide strip around its coast), FCO merely notifies the other states of our intentions. There may not be any further letters or phone calls to look out for. No news is good news.

(ii) For cruises involving continental shelf work (i.e. a "Yes" in column 3) or fisheries research inside another country's territorial limits formal permission has to be requested and received before the work begins or the ship moves into the territorial sea in question. SIC's must make sure they have this permission and should chase the FCO through the fleet manager.

5. Submission of cruise reports to host country

Whenever clearance has been obtained for work to be done inside another country's EEZ a copy of the cruise report must be sent to the host country via our foreign office. SICs should send a copy of their report direct and let the fleet manager know that this has been done by a note. Routine delivery of reports as soon as possible after a cruise builds up good-will for future applications to work inside foreign EEZs.

6. Chartered vessels

As far as the FCO is concerned commercial vessels that are chartered become research vessels in legal parlance and need to be cleared for work in another country's EEZ just as a normal RV. Exploratory voyages are an exception to this rule.

ANNEX 3(a)

Current form to work in the UK's Exclusive Economic Zone (EEZ)

APPLICATION FOR A RESEARCH CRUISE WITHIN A COASTAL STATE'S FISHERY LIMITS

A. GENERAL

1. Name of research ship .... Cruise No................
2. Dates of cruise From .... To ....
3. Operating Authority ....
....
....
Telephone .... Telex ....
4. Owner (if different from para.3) ....
....
5. Particulars of ship Name ....
Nationality ....
Overall length (metres) ....
Maximum draught (metres) ....
Nett tonnage ....
Method of propulsion e.g. Steam Turbine/Diesel/Diesel Electric
Call sign ....
Registered port & number (if registered fishing vessel) ....
6. Crew Name of Master ....
Number of Crew ....
7. Scientific personnel Name and Address of Scientist-in-Charge ....
....
....
Tel/Telex No. ....
Number of Scientists ....
8. Geographical area in which ship will operate (with reference in latitude and longitude):

9. Brief description of purpose of cruise:

10. Dates and names of intended ports of call:

11. Any special requirements at ports of call:

B. DETAIL

1. Name of research ship .... Cruise No. ....

2. Dates of cruise From .... To ....

3. Purpose of research and general operational methods

4. Please attach chart showing, at the appropriate scale, the geographical area of the intended work, the areas to be fished, positions of intended stations, tracks of survey lines, positions of moored/seabed equipment etc.

5a. Types of samples required e.g. Geological/Water/Plankton/Fish. If fishing gear is to be used please indicate what fish stocks will be worked, the maximum quantity required of each species/stock and the quantity of fish to be retained on board.

5b. Methods by which samples will be obtained (e.g. dredging/coring/drilling/ fishing etc.)

6a. Details of moored equipment:

Dates: Laying	Recovery	Description	Latitude	Longitude

6b. Full description of ALL fishing gear to be used (e.g. bottom trawl, mesh size, attachments etc).

7. ANY HAZARDOUS MATERIALS (e.g. Chemicals, Explosives, Gases, Isotopes, etc)
(Use separate sheet if necessary)

(a) Type and trade name ....

(b) Chemical content (& formula) ....

(c) IMO IMDG code (Reference & UN No.) ....

(d) Quantity & method of stowage on board ....

(e) If explosives give date(s) of detonation ....

- Method of detonation ....
- Position of detonation ....
- Frequency of detonation ....
- Depth of detonation ....
- Size of detonation planned ....

8. Please set out details of:

(a) Any relevant previous/future cruises

(b) Any previously published research data relating to the proposed cruise.
(Attach separate sheet if necessary)

9. Names and addresses of scientists in coastal state with whom previous contact has been made.

10. State:

(a) Whether visits to the ship in port by coastal state scientists will be acceptable YES/NO

(b) Whether it will be acceptable to carry on board an observer for any part of the cruise YES/NO

[If 'YES' please indicate possible dates and ports of embarkation/disembarkation]

(c) When research data from the intended cruise is likely to be made available to the coastal state authorities and by what means.

If the report will not be available within 12 months of the cruise, please set out an explanation for the delay indicating when the report will be available.

C. SCIENTIFIC EQUIPMENT

Complete the following table - separate copy for each coastal state

Coastal State ....

Port call ....

Indicate "yes" or "no" other than for fishing gear when the total hours of fishing in each zone should be indicated

LIST OF SCIENTIFIC WORK BY FUNCTION e.g. Magnetometry Gravity Diving Seismics Bathymetry Seabed sampling Trawling Echo sounding Water sampling U/W TV Moored instruments Towed instruments	Water Column	Fisheries Research within Fishing Limits	Research concerning Continental Shelf out to Coastal State's margin	Distance from coast		
				Within 3 NM	Between 3-12 NM	Between 12 and 200 NM

.... Dated ....

(On behalf of the Principal Scientist)

N.B. IF ANY DETAILS ARE MATERIALLY CHANGED REGARDING DATES/AREA OF OPERATION AFTER THIS FORM HAS BEEN SUBMITTED THE COASTAL STATE AUTHORITIES MUST BE NOTIFIED IMMEDIATELY

ANNEX 4

POSSIBLE AGENDA FOR A PRE-CRUISE BRIEFING

1. Remind the SICs of need to meet the ship on docking and to formally take-over from the previous SIC, i.e. to accept he has left the ship in order. (Arrangements between SIC and MS to keep in touch about information on docking times and provisional sailing times, etc. can be made.)

2. Check position in regard to arrangements for work in foreign EEZs, carriage of visitors, overtime situation in relation to monies available, supply of safety gear as required by law.

3. Reminder to SICs of the need to warn their staffs to recognize ship's conventions when at sea and to inform the master of problems arising during the cruise in regard to the ship's arrangements that will be raised at the debriefing meeting.

4. Detailed discussion of provision of scientific facilities requested of FST. (Include computer-system and software availability, if appropriate.)

ANNEX 5

SPECIMEN PROGRAMME

MINISTRY OF AGRICULTURE, FISHERIES AND FOOD
FISHERIES LABORATORY, LOWESTOFT, SUFFOLK, ENGLAND

1980 RESEARCH VESSEL PROGRAMME

PROGRAMME: RV CIROLANA: CRUISE 1

STAFF

A N Other
....
....
....

DURATION

1-17 JANUARY

LOCALITY

North Sea

AIMS

1. To ....

2. To ....

PLAN (All times are Greenwich Mean Time)

....
(Scientist-in-Charge)

....
(Date)

INITIALLED: ......

DISTRIBUTION:

Basic List +

A N Other (i.e. scientists on the cruise)
....
....
....

ANNEX 6

SPECIMEN REPORT

MINISTRY OF AGRICULTURE, FISHERIES AND FOOD
FISHERIES LABORATORY, LOWESTOFT, SUFFOLK, ENGLAND

1980 RESEARCH VESSEL PROGRAMME

REPORT: RV CIROLANA: CRUISE 1

(PROVISIONAL: Not to be quoted without prior reference to the author)

STAFF

A N Other
....
....
....

DURATION

Left Grimsby .... h 1 January
Arrived Grimsby .... h 17 January
All times are Greenwich Mean Time

LOCALITY

North Sea

AIMS

1. To ....

2. To ....

NARRATIVE

RESULTS

1. ....

2. ....

....
(Scientist-in-Charge)

....
(Date)

SEEN IN DRAFT: .... (Master)
.... (Fishing Skipper)

INITIALLED: .....

DISTRIBUTION:

Basic List +

A N Other (i.e. scientists on the cruise)
....
....
....