UK Marine Research Vessels
An assessment and proposals for improved co-ordination

Executive Summary

In 2011, the Marine Science Coordination Committee (MSCC) formed a group to develop and assess a range of practical and innovative proposals for managing and operating research vessels across the UK more effectively and efficiently. Membership of the group included policy and science delivery partners from Departments and Administrations that commission or operate work on large marine research vessels. The UK currently has 7 large-scale ocean and global class marine research vessels of greater than 50m length.

Other relevant reviews were considered, and current requirements for and usage of vessels were analysed. There are clear differences in terms of the type of work, locations, operations and functions of the different vessels. The group considered a variety of scenarios for ownership and management arrangements and collaboration between MSCC members. The quality and relative financial savings of each scenario were scored. The optimum arrangement at present is one of "Integrated Operations", with better integration of vessel programming. A Working Group is recommended, to maximise collaborative working, including consideration of options for the future size of the fleet, and the use of new technologies as an alternative to ships for some functions. In addition, a Liaison Group that includes members from public sector vessel operators and industry is recommended to carry out more in-depth appraisal of the extent to which charter vessels could be utilised in delivery of UK marine science. The findings of the group are summarized below:

ToR 1. To assess the UK requirements for large-scale research vessels for the next 5 years

Although requirements will fluctuate, there is predicted to be demand, in terms of potential science projects that could utilise ship time, for the same number of vessels for the next 5 years and up to 2023, although affordability will become an increasing issue. Reducing the number of ships is the only way to achieve significant savings, which would be several £millions p.a., but for at least the short term, this would result in a significant reduction in the marine science conducted by the UK. Work on planned replacement of vessels should begin in 2013 and it is proposed that the Working Group include this topic in early work..

ToR 2. To propose cost effective options for the joint ownership and/or joint procurement of new vessels

There is no advantage in altering existing ownership arrangements but there is considerable merit in the Working Group developing recommendations on the type of vessel required and exploring mechanisms for joint procurement and/or ownership of new vessels in detail. These should aim to achieve agreement in 2013 on the mechanisms to be employed for procurement of new ships so that design and

procurement can commence thereafter. Joint ownership or procurement is unlikely to lead to any significant operating savings, but spreading costs across organisations may have advantages in terms of optimal programming for cost effectiveness.

ToR 3. To propose efficient arrangements for the management and/or maintenance of the fleet

Achieving the greatest possible number of days on active scientific activity at sea is the most cost effective manner to operate these ships. However, budgetary constraints and escalating operating costs may restrict the number of projects that individual organisations can afford to fund, and hence reduce their ability to operate these ships at greatest efficiency.

There are financial penalties to altering arrangements before break points in contracts but opportunities for integrating fleet management should be reviewed as these milestones approach. In the short term, the scenario of Status Quo+ should form the focus of any immediate collaborative working and the Working Group should (a) Develop Framework Agreements to enable asset bartering or sharing across organisations, (b) Share knowledge and information regarding vessel operations, (c) Foster cross-organisational communications, understanding and collaboration, with a view to maximising efficiency.

The science delivery under this scenario would remain the responsibility of each individual organisation and in parallel with improved joint operational arrangements for scheduling and planning, there is an opportunity to join forces for the procurement of vessel management/maintenance services subject to existing contractual commitments and Departmental constraints.

ToR 4. To identify costed options for strengthened co-ordination of Government vessel operation

Significant savings, of the order of £millions, are only possible if the number of ships is reduced, and in the short term this would seriously reduce the programme of marine science that could be delivered. In the medium term and beyond, 5-7 years+, the advent of new technologies and automated systems may reduce the need for extremely specialised ships for some functions.

Our initial proposals for strengthened collaboration are estimated to yield immediate efficiencies amounting to something of the order of £50-100K p.a. As framework agreements are implemented, management arrangements reviewed and new technologies become more readily available, savings are likely to increase to several hundred thousands p.a.

This report reflects feedback from MSCC and recommends that continued oversight of these research vessels is enabled via a Working Group to promote collaborative working and a Liaison Group to facilitate industry liaison on provision and operation of research vessels.

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1. Introduction

1.1 Purpose of Report

The House of Commons Select Committee, in their 2007 report, '*Investigating the Oceans'*, recommended increased co-ordination of UK research vessels. The Governments' response to that report noted that this aspect of co-ordination might need to be addressed by the MSCC at some stage. That stage has now been reached. Vessels and their operation form a significant proportion of the marine science budget, with running costs of the order of £25-30M p.a. and capital replacement value approaching £700M. Reductions in funding and cost increases for running research vessels in excess of general inflation are major drivers for greater efficiency in vessel operations.

There is a need to assess whether strengthened co-ordination to manage and use large-scale Government-funded marine research vessels more effectively could yield significant savings. This assessment should include identification of a range of options for strengthening co-ordination of Government vessel operation, including reducing the need to charter vessels, releasing time for wider-markets work or in the longer-term potentially reducing the size of the UK fleet. A practical and economic assessment of the potential options should be carried out, with recommendations of a course of action for Ministers/funding bodies.

Any assessment of UK requirements must take account of and meet the needs of the devolved administrations within the UK, recognising that the financial and operational responsibilities are managed separately. Therefore identifying mechanisms which facilitate mutual financial benefits accruing through closer cooperation is a key requirement. It was therefore proposed that officials from Departments and Administrations, through the MSCC, jointly develop and assess a range of practical and innovative proposals for managing and operating research vessels across the UK more effectively and efficiently. While the initial focus of this work would be on the large research vessels (greater than 50m length), the outcomes should also be of relevance to the co-ordination of smaller vessels.

1.2 Contributors

Staff from public bodies that operate large research vessels worked with officials from Departments and Administrations that use these assets in a MSCC working group. The group included participants from the Northern Ireland Department of Agriculture and Rural Development (DARD), Agri-Food and Biosciences Institute (NI) (AFBI), NERC through the National Oceanography Centre (NOC) and the British Antarctic Survey (BAS), the Centre for Environment, Fisheries and Aquaculture Science (Cefas), Marine Scotland and the Welsh Assembly Government, with input from MSCC, economists and practitioners.

1.3 Terms of Reference

The proposals received from the MSCC were reviewed by the group at their first meeting and the following Terms of Reference were agreed:

ToR 1. To assess the UK requirements for large-scale research vessels for the next 5 years

ToR 2. To propose cost effective options for the joint ownership and/or joint procurement of new vessels

ToR 3. To propose efficient arrangements for the management and/or maintenance of the fleet

ToR 4. To identify costed options for strengthened co-ordination of Government vessel operation, including consideration of:

a. The co-ordination across the UK of large-scale research vessels, their voyages and available time;

b. Combining programmes where logistics allow co-working (for example, adding additional research targets to statutory monitoring programmes);

c. Migrating work on chartered vessels to the Government fleet (including vessels operated by NERC and academic institutions) and *vice versa* where competitive costing allows;

d. The ongoing and enhanced co-ordination and bartering activities with other Member States and internationally, where they make good sense; and

e. Combining work on vessels chartered from various Departments and Agencies to optimise efficiency.

The UK currently has 7 large ocean and global class marine research vessels of greater than 50m length operated by Government Departments, Devolved Administrations, the Natural Environment Research Council (NERC), and research institutions. A number of other smaller vessels, including survey and logistics ships, are operated by Government, the Devolved Administrations, NERC, research institutions, universities and private organisations for smaller-scale coastal activities. While increased co-ordination of these vessels will be sought, it is not the primary focus of this report, which examines the improved co-ordination of the higher cost ocean and global class vessels.

The vessels included in this report are listed below:

Vessel	Ownership
Ernest Shackleton	NERC (British Antarctic Survey) - Leased
James Clark Ross	NERC (British Antarctic Survey)
Discovery	NERC (National Oceanography Centre)
James Cook	NERC (National Oceanography Centre)
Scotia	Marine Scotland
Corystes	Agri-Food and Biosciences Institute
Endeavour	Cefas

Details of the vessels are given in Annex 1.

These ships are high cost research platforms which are essential for delivering marine science. While increasing numbers of measurements can now be taken remotely using satellites, and there is increasing potential for autonomous vehicles, such as ocean gliders, to undertake some types of measurement, it is clear that we will continue to need vessels for a diverse range of marine science, from statutory long-term monitoring and survey (including fish stock status) to cutting edge investigative research, with work ranging from the UK coast across the global oceans.

2. Background

Co-ordination of research vessel activity already takes place on a number of fronts, within individual Administrations and between government departments in the UK. Internationally, fish stock surveys in Europe are coordinated in a system overseen by the International Council for the Exploitation of the Sea (ICES), and there are international ship barter arrangements for NERC vessels. The following sections provide a brief overview of these arrangements.

It is important to retain an overview of other relevant work and initiatives. The optimum arrangement for ownership or management of a vessel fleet is very sensitive to the composition and requirements of that fleet. The ideal solution for a small fleet, perhaps 4 vessels ranging from 12 to 50m based and operating in a restricted geographical area, will be very different to the preferred option for a fleet of seven 50+m vessels operating worldwide.

2.1 UK Developments

2.1.1 Management Group of Directors Review

The Comprehensive Spending Review resulted in forecast reductions in marine science budgets. The Management Group of Directors of Cefas, Marine Scotland Science and Agri-Food and Biosciences Institute (AFBI) commissioned a Review to Identify Efficiency Gains in the Operation of Government Marine Science Research Vessels to provide options for living within reduced budgets.

This review, which reported in 2012, considered the 4 vessels over 27m operated by the UK administrations. The following conclusions were reached and the MSCC working group took these into account:

> ***Maximising the operational "days at sea"*** is considered the best way of optimising value for the taxpayer as the fixed costs of owning and operating these vessels is relatively high compared to the variable costs in use.
>
> ***Strengthening cooperation and capability sharing*** should be encouraged and supported as far as feasible. The scope for savings is modest (equates to tens of thousands per annum) since considerable partnership working already exists.
>
> ***Management integration*** could provide options to deliver greater savings, but not likely to be millions of pounds. The earliest opportunity for integration is 2015, and professional studies to examine the operational models should be initiated 2 years before contract break points.
>
> ***Fleet Rationalisation*** is the only option with potential for big savings (millions) if the fleet is reduced by one, but this would currently result in non-delivery of the existing programme, in an environment of increasing Government demands and so is not thought to be practical or desirable.
>
> ***Income Generation*** through market charter has limited scope for increasing income generation due the lack of spare capacity across the fleet.

2.1.2 Scottish Survey Vessel Operators Group

The operators of publicly-funded research vessels in Scotland have conducted a review of demand and availability of ships. These vessels were around 20m length and predominantly operate inshore and on a day boat basis, returning to port each night. Analysis of the current and predicted demand for ship time in Scotland identified potential to make savings if the fleet was restructured and reduced in size and operational days at sea were maximized as far as possible. Realisation of savings may depend to a large extent on whether suitable governance and management arrangements can be put in place.

2.1.3 England and Wales

Organisations in England and Wales that require research vessels are collaborating to co-ordinate vessel programmes. This initiative has included Cefas, Environment Agency, English Heritage, JNCC, Natural England and the Countryside Council for Wales. The optimum arrangements have been made on a geographical basis, considering all activities planned for each area.

2.1.4 Northern Ireland

Coordination of the AFBI vessel programme is carried out annually, following bilateral work programme meetings with the main Devolved Administration customers in fisheries and environmental areas (i.e. Department of Agriculture and Rural Development and the Northern Ireland Environment Agency). Additionally, coordination takes place with the Marine Institute, Republic of Ireland, as the key annual survey of *Nephrops* stock status in the Irish Sea is carried out jointly by the two institutes. The major requirement for vessel time is to carry out fish stock assessment work in support of the EU Data Collection Framework, however vessel demand is increasing for ecosystem health monitoring and research, as well as marine resource assessment in coastal waters including high resolution seabed mapping. A recent internal review of vessel use conducted by AFBI examined efficiency and cost effectiveness of vessel operations and concluded that the vessel type and size in use was suited to the programme required by customers.

2.1.5 NERC

NERC has twice reviewed management arrangements for its fleet in recent years (2009 and 2011). The first of these reviews resulted in a move to integrated scheduling of its polar and blue water vessels, while both NOC and BAS are now developing scalability options, including supplementing overstretched budgets with increased charter income.

NERC is concerned that the effective real terms protection of its large research infrastructure costs base (including ships) against a background of an overall real-terms decline in its programme, places the science programme budget under a double squeeze. The situation is exacerbated by the fact that marine fuel oil costs have risen well above inflation and are highly volatile. Projections to 2018/19 of current trends imply what is likely to be an unacceptable squeeze on NERC science programme budgets without remedial action. Part of the problem arises because ship costs are hard to scale (unlike other areas of spend) in that there is generally a commitment to integer numbers of ships. NERC has some experience with scaling research infrastructure costs (e.g. through sharing with other users and commercial ship charter).

NERC's polar ships, operated by BAS, contribute not only to delivery of NERC science, but also to supporting the UK participation in the Antarctic Treaty System and to maintaining the UK strategic presence in Antarctica and the South Atlantic. The Minister for Science and Universities David Willetts MP stated in November 2012, "without pre-empting the timing and size of the next spending review settlement, - I consider that NERC should have a discrete funding line for Antarctic infrastructure and logistics from within the ring-fenced science budget to ensure a visible UK commitment to maintaining Antarctic science and presence."

2.2 European and Global Developments (ToR 4d)

Many of the scientific challenges being addressed by UK marine science are global in nature and so require international solutions, such as the bartering (exchange) of ships and equipment. NERC vessels operate across the globe and by bartering research vessel time within bilateral and multilateral agreements, NERC can take advantage of the geographical location of ships operated by its partners, and avoid relocating its own ships for remote and/or one-off projects. Overall this results in reduced passage times and associated costs. Bartering arrangements provide scientists with access to more diverse geographical areas for more of the year and much wider access to specialised facilities and equipment than would otherwise be possible.

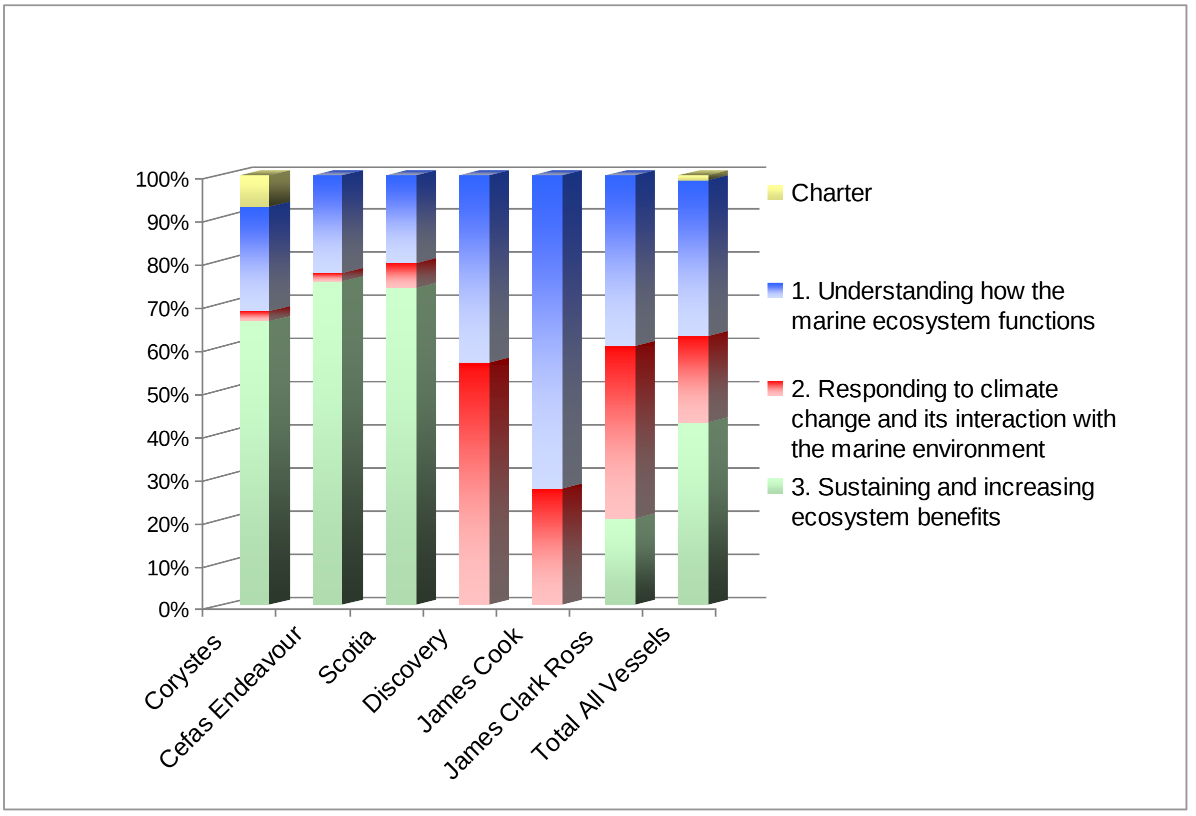
Since 1994, NERC has exchanged approximately 3.5 years of ship time, and in one year alone (financial year 2008-09), benefited from saved passages (transits) equivalent to over £1 million in fuel costs. Further information on these frameworks is given in Annex 2. These arrangements should continue where they result in economic and/or scientific benefits.

3. Vessel requirements (ToR 1)

The terms of reference for this review included an assessment of the UK requirements for large research vessels for the next 5 years. A number of factors indicated to the group that short (3-5 year) and medium-long (6-10 year) term horizons are relevant to this assessment. Firm contractual commitments exist for both vessel management and vessel activity over the short term. These include international commitments to environmental and fish stock monitoring which receive considerable financial support, such as that for fish stock monitoring through the European Data Collection Framework. In the longer term, greater scope exists for renegotiation and significant change in vessel activity if that is necessary. However, there is much less certainty around vessel requirements in the longer term.

The usage of vessels was collated for the current year where possible, or a typical recent year if the current year was particularly unusual, e.g. with long periods in port for repairs. The purpose of each cruise was brigaded under categories to correspond with the priorities of the UK Marine Science Strategy. In many cases, cruises are multifunctional, serving multiple areas of science by collecting samples that may be used for many purposes, or collecting samples and data required for different purposes from the same geographical location. This was recognised in the analysis of time allocated to each science area.

The vessel time allotted to each purpose in the current year and maps indicating the areas each vessel operates in are shown below.



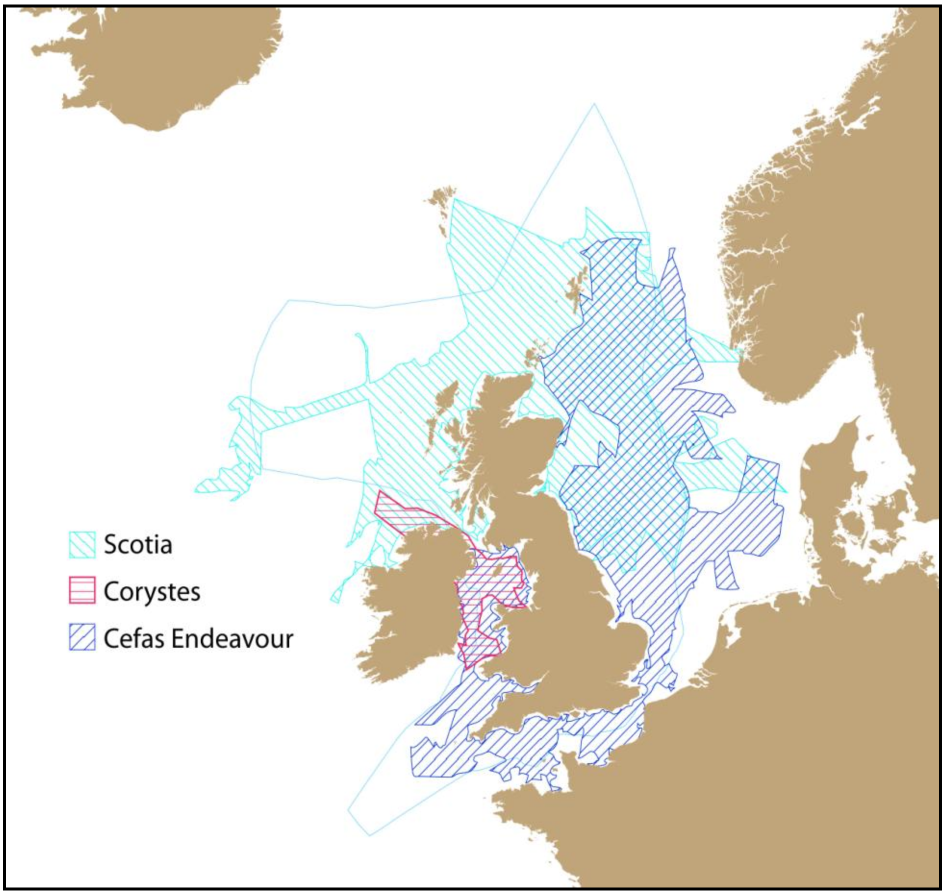
The proportion of research ship time each vessel spent at sea, arranged by activities contributing to each of the UK Marine Science Strategy (UKMSS) priorities.

Note *Ernest Shackleton* is a logistics resupply vessel and does not usually undertake research.

While the vessels can be grouped by activity, with some carrying out monitoring, survey and applied research work directly for government, others are more closely connected to supporting basic science supported by NERC and other science funders which is undertaken in Universities and Research Institutes. Some of the functions also show differences, with the government vessels more suited for trawling, and the polar vessels obviously equipped to operate in ice and cold climates. The locations that the ships operate in clearly group into UK, worldwide, and the polar regions.

UK - Cefas Endeavour, Corystes and Scotia

These vessels operate largely in UK waters and carry out work directly funded by UK government or EU. Over 70% of cruises are directed towards supporting the UK Marine Science Strategy priority "Sustaining and increasing ecosystem benefits". Such work frequently fulfils statutory or legislative requirements, generally under EU or other international regulation. These activities include fish stock assessment and monitoring levels of contaminants in the marine environment. Approximately 20% of cruises are directed towards "Understanding how the marine ecosystem functions" with a small proportion of time (7%) spent on work "Responding to climate change and its interaction with the marine environment".



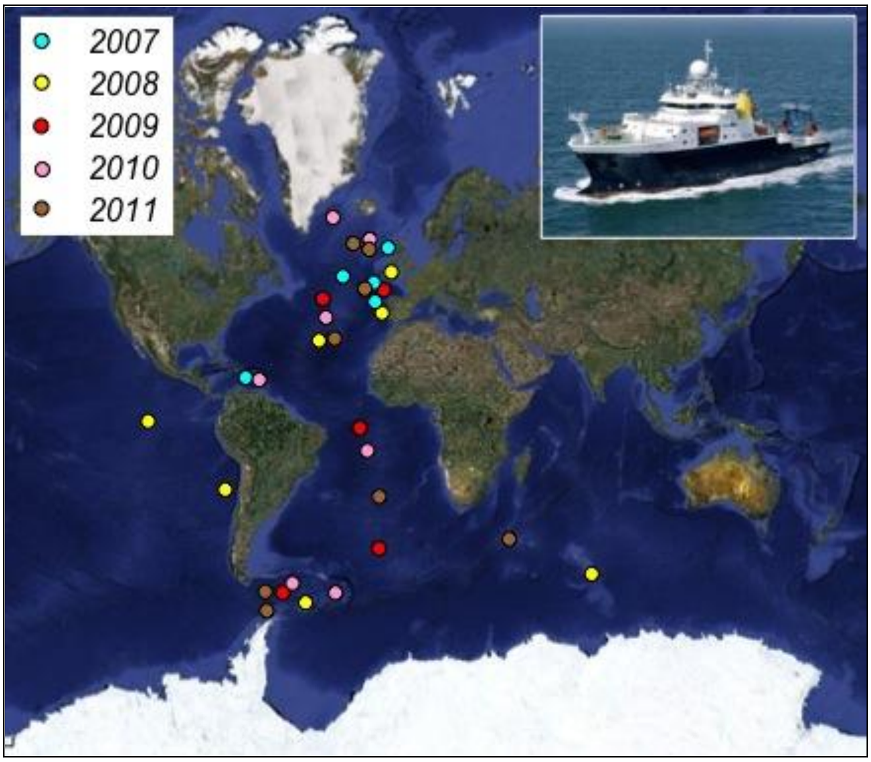
UK vessel operations in a typical year

Bluewater - Discovery and James Cook

These vessels operate around the globe and mainly off the continental shelf, conducting research in depths of several kilometres. The majority of their activity is directly related to "Understanding how the marine ecosystem functions" with slightly less spent working on "Responding to climate change and its interaction with the marine environment". These activities are managed and generally funded through the Natural Environment Research Council (NERC).

Over the past few years, the *RRS Discovery* has worked predominantly in the North Atlantic, and has been the workhorse for supporting many of NERC's sustained observing programmes, including the Atlantic Meridional Transect cruise series. The latter has regularly taken the ship as far afield as Punta Arenas at the southern tip of Chile. Nevertheless, the ship's more limited capabilities; particularly lack of multibeam echosounder and dynamic positioning (DP) has progressively restricted its utility over recent years.

In contrast the *RRS James Cook* has worked in more diverse and remote areas, generally reflecting cruises that require use of the ship's dynamic positioning capability (required for ROV operations) and/or its greater scientific capabilities as well as berths.



RRS James Cook work locations 2007-2011

Polar - James Clark Ross and Ernest Shackleton

NERC operates two polar vessels – the *RRS James Clark Ross* and the *RRS Ernest Shackleton*. The *James Clark Ross* is the UK's only ice-strengthened polar research vessel, and operates in both the Antarctic and the Arctic. She is recognised as an excellent scientific platform and supports a wide breadth of oceanographic, marine ecosystem and marine geosciences research. She can also undertake logistics support. The *Ernest Shackleton* is a polar logistics vessel and is used to resupply the UK research stations in Antarctica and on South Georgia by transporting cargo, fuel and people. She can also undertake limited oceanographic research work. When the vessel is not undertaking logistics work for BAS, she is used on a commercial basis in the North Sea in an oilfield and pipeline survey role.

The scientific activities of the *James Clark Ross* contribute principally to the UK Marine Science Strategy priorities of "Understanding how the marine ecosystem functions" and "Responding to climate change and its interaction with the marine environment". The

James Clark Ross also undertakes research in the Southern Ocean, especially around South Georgia, that supports the UK's participation in the Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR) (the Southern Ocean fisheries management organisation), which is closely aligned to the strategy priority of "Sustaining and Increasing Ecosystem Benefits."

As maximizing the operational days at sea is the most cost effective way to run ships, arrangements that avoid long sea passages without scientific work should be avoided. Considering these vessels in terms of geographical location, i.e. UK, bluewater and polar, is the evidently first concern in maximizing efficiency. However, as we are dealing with only a few ships in each location, there cannot always be a strict division into 3 separate geographical groups, particularly if the total number of ships were to decrease in future. The group maintained a flexible approach, looking at all feasible options to increase efficiency.

The review group considered likely future requirements for vessel time as detailed in the sections below. Considerable uncertainty exists over the future requirements for vessel time. In part this is due to novel and as yet incompletely defined demand for work in support of new developments such as marine renewable energy and marine planning, and also the rapid developments in new and automated technologies. The full implications of budgetary restrictions are also still unclear. Nevertheless, some predictions are required to assist development of options for the optimum future size and management of the fleet.

3.1 Short Term: 2015-2017

In the immediate future, i.e. 2013-14, vessel use is largely already committed or determined by the requirements of UK Government, international obligations, contracts or approved research grants. This work includes long term climate and environmental monitoring, sampling and monitoring under the EU Data Collection Framework (DCF) for fish stock assessment and the European Marine Strategy Framework Directive (MSFD), and European or global research contracts that are already in place. The UK Government is also committed to maintaining present levels of activity in Antarctica and South Georgia.

Alongside these commitments there is likely to be a continued growth in demand for work in UK waters in support of marine renewable energy and marine planning at local, national and international levels. There has been a rapid increase in demand for habitat mapping services in relation to designation of Marine Conservation Zones (MCZs) which has required any spare capacity from several organizations, plus substantial service delivery via the commercial sector. These demands are arriving at a time when budgets are likely to be increasingly challenging, compounded by fuel costs rising faster than most price indices.

To support requirements of marine planning it is envisaged that there may be a small increase in demand for seabed, hydrographic, habitat and biota sampling. This type of work is likely to be the main function of any charter work by the UK based research vessels for private sector customers. Some organisations find chartering their vessel is desirable to supplement income, although it can be difficult to forecast this demand and financial pressures, including competition regulation, may limit this market. As this is not the core business for our organisations and is not a reliable source of funding, it is not appropriate to propose a business model contingent on this income for most of the ships considered here. Nevertheless this is an important option that should be retained in any future management regime so that the ships can be operated for as many days as possible to offset overhead costs.

The increased cost of running vessels could result in reduced capacity to supply research ship time (even though demand may remain high). This is an issue that is of increasing concern to NERC.

Discussions on European requirements that will affect vessel requirements in the UK are now beginning or ramping up. These include revision of the DCF and establishment of monitoring programmes aligned to MSFD to measure progress towards Good Environmental Status. Assuming that budget restrictions will continue for the next 3-4 years, it is predicted that the traditional fishery-related work may decrease by approximately 10%. However, it must be noted that the data and samples collected on these cruises also support work on biodiversity, environmental status and climate change. Financial considerations could potentially also lead to a small decrease in long term monitoring activities carried out by UK vessels. The demand for time series data on decadal scales will increase as we develop our understanding of climate change and adaptation. Publicly funded monitoring is the most important source of these data and in the marine environment; the vessels considered in this review are by far the most important platforms for this science. Thus any reduction in long term monitoring must only be undertaken with full understanding of the implications of reducing the frequency of, or distance between, sampling. Remote sensing and autonomous monitoring systems have the potential to reduce the requirement for scientific vessel time, although less specialised ships will still be required to deploy and service the equipment. Experience shows that any time released in this fashion can be taken up by testing the next generation of equipment or methods, providing funding allows.

Overall, it is expected that, although the type or purpose of work conducted by these ships may fluctuate in the period to 2017, there is unlikely to be any significant decrease in total demand for ship time in this short term. Indeed, vessel time is consistently over-subscribed and likely to remain so. However, the affordability of these vessels will become increasingly difficult. Running costs, particularly fuel, are rising at a time when budgets are decreasing. Thus ship costs comprise an increasing proportion of project and organisational budgets. Some organisations have already taken measures to reduce the scale of ship operations, e.g. by cutting the number of additional vessel days chartered in. Where no vessels are chartered in, reducing the number of active scientific days at sea yields minimal savings due to the high fixed costs of owning these ships.

3.2 Medium-Long Term: 2018-2023

It becomes even more difficult to predict demand for vessel time in the medium to long term. However, costs are likely to continue to rise and thus ship-based projects will become even more expensive and affordability will remain the key issue for marine science activity. Maximising operational days at sea through better collaboration, backed by framework agreements, should ensure best value for investment in these UK research vessels.

Optimistic forecasts of a small increase in government vessel usage are only of the order of 5-8% more days at sea each year towards the end of this period. This is not a level that would warrant any increase in the number of vessels operated by these organisations, but could most likely be accommodated by the current fleet size supplemented by ad hoc charter of other ships. Sustained demand for marine research and monitoring, coupled with continuing increases in ship operating costs, and fuel in particular, will continue to put pressure on the ability of departments to operate these vessels at full capacity. New investment in automated systems and technologies has the potential to reduce the need for specialised ships towards the end of this period and hence collaboration on planned replacement should occur to maximise the utility of these vessels across MSCC members where feasible.

Notwithstanding this, any decision to reduce the number of vessels without greater certainty of future conditions would be impossible to reverse quickly given the large capital costs and long project times for new builds. As such, a premature decision to decommission or sell ships in the short term could have a serious adverse impact on the ability to fulfil the UK marine science programme, UK Government and international obligations. All organisations involved in this review appreciate the need to cooperate to make best use of the large research vessels and already undertake largely informal collaboration to do this. In the event that the total number of ships was reduced, increased cooperation, with a more formal open and transparent programming arrangement, would help to reduce the adverse impact on any single organisation.

Replacement of some of the vessels will need to be considered over the medium to long term timescale, so the overall fleet size and potential for joint ownership or management needs to be reassessed at these milestones, starting in 2013.

4. Charters

Commercial ships are currently chartered by MSCC organisations to participate in or augment vessel activities. The current and potential future use of charters was discussed by the group and key points are summarised below. Careful consideration of several factors is required to carry out suitable options appraisal when examining the extent to which commercial vessels could participate in the MSCC science programme. These factors include; organisational business models; pressures on capital and running cost budgets; detailed knowledge of the type, quantity and quality of work required under the marine science programme; and objective information on commercial ship availability and capability. Discussion at MSCC has provided an avenue for further exploration of this topic and a Research Vessel Liaison Group is proposed, involving MSCC organisations and the Marine Industries Liaison Group representative.

4.1 Requirements – current and predicted

Additional vessels are occasionally used by the MSCC organisations. Typically, a range of vessels are each chartered for a single cruise. These vessels may be chartered when several vessels are required to operate simultaneously, such as the anglerfish surveys off the West of Scotland, where 3 vessels fish different areas concurrently. Commercial fishing vessels have been chartered to participate in these studies. Other charters generate efficiencies, such as a few days where a small commercial platform is chartered to service an instrumented mooring instead of incurring greater costs to sail a larger vessel for long periods to carry out work that does not require such a specialized ship.

Commercial fishing vessels are also used in Industry-Science partnership projects. This work often engages fishermen to carry out work to investigate topics proposed by the industry.

4.2 Extent to which charter market currently meets requirements (ToR 4c & 4e)

As discussed above, work is currently migrated on chartered vessels to the vessels involved in this review, or vice versa, where it is cost effective and competitive to do so. Current communications between ship operations managers in each organisation already allows any charter work to be combined if possible.

Although charters play an important role in the marine operations of MSCC organisations, they have not been used to the extent that they could replace one or more of the vessels considered here. Scientific vessels are highly specialized and each is unique, with customized structure and equipment. No single charter vessel will have all the equipment to be able to carry out all the work of these vessels, which ranges from fishing to precise positioning for sampling, and including laboratory facilities. Different vessels are chartered for the various functions, and it is not simply a case of long-term chartering of one ship to replace a research vessel.

Public funding and procurement has also presented difficulties when it is necessary to have a single vessel to carry out work for the same period in several successive years, or to ensure the same ships and equipment are used year on year for an extended period.

Nevertheless, on paper, increased use of charters could enable savings to be made in terms of reducing the capital investment required to maintain and replace vessels. Risks of operating vessels would also largely be transferred to the operators. However, running costs could be increased in hiring commercial ships, and there are significant risks to the scientific programme in terms of ensuring continuity of long term data series and quality.

4.3 Future options

As mentioned above, discussion at MSCC opened up the possibility of further work with industry to examine the short, medium and long term options for migrating work between public sector and charter vessels. A Liaison Group is proposed to consider future options. The group should include consideration of vessel availability, capability and flexibility of time and location, together with quality assurance requirements, relative costs and funding models. The Group may have expertise related to other areas of Research Vessel management and operation which will be explored when the Group meet.

5. Options for joint procurement of new vessels (ToR 2)

In the medium-long term, several of the vessels within this review will reach or approach the end of their practical working life as research ships. Vessel replacement decisions must be taken several years in advance of the time when the ship is required, in order to design and build a vessel. Severe capital restrictions could result in an organisation deciding not to replace a vessel and to reduce its fleet once an older vessel reaches the end of its service. These vessels provide services that support the UK and international marine science programmes. Any decision to not replace a vessel, and thereby to reduce the scientific services available, will have wider implications. The reduction in capacity would then mean that either the science programme must be reduced or alternative ships must be chartered. As noted above, research vessels are very specialised, so it is unlikely that charter could provide all the services required, and use of charter vessels would increase running costs for the programme considerably.

As it is predicted there will still be sufficient demand to require the same degree of marine science in the long term, an avenue for oversight of the whole fleet being considered here, which is in effect a UK public sector operated fleet, could be a considerable advantage. Prompt and timely decisions on investment in replacement vessels could then be taken with a broad perspective across UK marine science, ensuring fit for purpose ships could be built in the most cost effective fashion, and potentially reducing the risk to individual organizations. Joint procurement can be a particularly attractive option at a time of budget constraint as it enables cost and risk reduction for individual organisations. This approach would require very early agreement between organisations in order to ensure replacement vessel(s) were ready when required and to coordinate replacement of ships with end of service dates that vary by 5 years or more. Maintenance of a group with oversight of the ships operating around the UK is recommended. This group should make broad recommendations on the type of vessel required and explore mechanisms for joint procurement in detail. Consideration should be given to all available procurement routes and the possibility of life-extension programmes.

6. Coordination of vessel programmes (ToR 4a)

Informally, vessel operations managers from each of the MSCC organisations already work together to achieve savings through better coordination of vessel activities. For example, AFBI carry out sampling in the Irish Sea on behalf of Cefas as this is more cost effective than sailing the *Cefas Endeavour* long distances to and from sites that are closer to the normal operating area of the *Corystes*.

This coordination achieves savings by reducing the distances that vessels have to travel, thereby reducing fuel costs and staff time spent on vessels in transit. This mode of operation, operating individual vessels in restricted geographical areas, is being applied to smaller Environment Agency ships and is the most effective operation of a fleet of smaller vessels of less than 20m. For the larger vessels being considered here, the range of operation spans the globe and NERC now coordinates schedules for its ‘global’ vessels through a single integrated mechanism, as well as meeting formally every 6 months to coordinate schedules with its European barter partners. Due to the different areas of operation, there is less opportunity to coordinate the work of the ‘global’ research vessels *Discovery*, *James Cook* and *James Clark Ross* with the ‘UK’ vessels

Corystes, *Cefas Endeavour* and *Scotia*. Nevertheless, improved coordination and sharing vessel programmes provides the best opportunity to maximise the active days at sea for each ship.

Although coordination of the 'UK' vessels is already occurring, minor modifications to increase the formality of these arrangements would provide greater reassurance that they will be maintained, for instance if any of the personnel change. Formal arrangements would also ensure that the work of vessel managers to achieve best value would be more readily recognised and reported. Probably the most significant measure that could be taken would be a more proactive sharing of ship schedules at the early planning stage, potentially with a view to moving to greater joint programming of the fleet as already happens in the context of international ship barter. Vessel managers should be tasked with preparing terms of reference and processes to formalize these arrangements. In the event that any of the vessels reviewed here is not fully utilised, the ability of MSCC members to use ships from other MSCC members in preference to chartering in commercial vessels should optimise the ability to maximise the active days at sea for each ship and may reduce expenditure on charters.

7. Combining vessel programmes (ToR 4b)

Combining vessel programmes would be a step change in operation of the UK research fleet. This option entails considering vessel requirements and vessel provision as a whole, rather than individual requirements and vessel time managed largely independently by each MSCC organisation. Although overall vessel time would not increase, expectations of marine research that could be carried out might rise disproportionately.

Currently, individual organisations run processes to plan vessel programmes that satisfy as many of the requirements of their customers and scientists as possible. This inevitably involves prioritisation of work as there are invariably more requests for ship time than can be accommodated. Under a scenario of combined programming, prioritisation would be required across the board, considering requests for vessel time from government and academia as a whole. These decisions would be extremely difficult and mechanisms for these assessments would need to be devised carefully.

Considering the current vessel programmes, there do not appear to be any further opportunities for savings through combined programming other than those that are already being achieved through coordination by vessel managers. This is largely due to the operation of each vessel in geographical locations that do not generally overlap. Therefore, at present there does not seem to be any advantage in creating systems to prioritise work across all MSCC organisations. Nevertheless, if some ships were not fully utilised and were available to the MSCC members through framework agreements, more integrated programming might enable savings through reduction in the number of commercial vessels chartered in.

8. Ownership and Management Arrangements (ToR 2 & 3)

The current ownership and management arrangements of UK marine vessels were collated and confirmed at a meeting of the group in September 2011. A workshop held at that meeting was used to explore and analyse various options for future ownership and management of these vessels.

8.1 Current Ownership and Management Arrangements

Current ownership and management arrangements for the UK scientific research vessel fleet are summarised in the table below:

Vessel	Ownership	Management
Ernest Shackleton	Leased by NERC (BAS) from GC Rieber	In house
James Clark Ross	NERC (British Antarctic Survey)	In house
Discovery	NERC (National Oceanography Centre)	In house
James Cook	NERC (National Oceanography Centre)	In house
Scotia	Marine Scotland Science	In house (with 3 Compliance vessels)
Corystes	Agri-Food and Biosciences Institute	Outsourced (SERCO 2-4 yrs remaining)
Cefas Endeavour	Centre for Environment, Fisheries & Aquaculture Science	Outsourced (POMS 2-6 yrs remaining)

The majority of vessels are managed in-house. In general, where more than one large vessel is operated, it can be more cost-effective to manage these in-house. Where management has been outsourced, contracts are in place for periods of up to 6 years. Management companies may have greater experience of vessel management and maintenance and will assume some of the risks. The degree of risk transferred from the owner to the management company will inevitably be reflected in the contract pricing. This may include liability for some elements of the vessels such as the engines, and crewing arrangements. Outsourcing relieves the scientific organisation of these demands, allowing them to focus on core scientific work.

The decisions to manage vessels in-house or via another company have largely been taken by each organisation independently and considering only the vessels owned by those individual organisations. Consideration of all UK marine research vessels as a whole may provide new and alternative options for ownership of new ships and management. The total of 7 vessels is a significant fleet that may offer opportunities for economies of scale.

8.2 Options for Future Ownership and Management Arrangements

There is something of a continuum of ownership and management arrangements available for the UK research vessel fleet. These range from each organisation managing and operating its vessel(s) in-house, to a fully integrated fleet that is owned and managed as a whole, potentially widening to the European level.

In order to enable comparison of different options, a number of scenarios were agreed that illustrated varying levels of collaboration between MSCC members. These scenarios were:

1a. Status quo (no change)
Under this option the ownership and management arrangements would be maintained as in the table above.

1b. Status quo with increased collaboration (Status quo +)
Ownership and management arrangements maintained as in the table above but with increased collaboration pursued through better communication and cooperation between vessel operations managers. This would specifically involve better advanced planning and coordination of ship schedules to achieve efficiencies through bartering, as well as vessel and equipment sharing wherever possible.

2a. Integrated fleet management, maintenance and vessel operations – common in-house (Joint Venture)
Management of the vessels to be done by a joint venture (JV) between all MSCC organisations, forming a single entity, preferably independent of the MSCC organisations, to manage the entire fleet.

2b. Integrated fleet management, maintenance and vessel operations – outsourced provider
Management of the vessels by a single outsourced provider.

3a. Integrated science programme with shared assets (Joint Venture)
In addition to management of vessels as a single fleet, the science programme of all vessels to be considered as a whole.

3b. Integrated science programme with shared assets (hosted) and outsourced provider
As 3a but assets managed by an outsourced provider.

4. As 2 & 3 with asset sale and lease back
Sale of vessels with lease back is an alternative to MSCC organisations owning their own ships.

5. Wider European initiative (integrate fleet management, maintenance and operations)
The potential exists to collaborate at the European level to own, manage and operate vessels. The Eurofleets initiative is one example, but other arrangements for collaboration to a greater or lesser degree are possible.

Each scenario was discussed and scored using a basic low/medium/high rating. The workshop noted that the intention was not to undertake a highly detailed analysis, rather a qualitative assessment which might be useful in narrowing down areas for more detailed consideration and comparative costing. Estimated savings were discussed but detailed analysis is very resource intensive and has not been undertaken. The agreed scoring can be seen in the table below.

Scenario	**Achieves MSCC Aims**	**Feasibility**	**Maintains Science Programme Control**	**Overall Qualitative Score**
1a. Status Quo	0	3	3	**6**
1b. Status Quo +	1	3	3	**7**
2a. Integrate operations (JV)	2	3	3	**8**
2b. Integrate operations (outsourced)	2	2	2	**6**
3a. Integrate science & ops (JV)	3	2	1	**6**
3b. Integrate science & ops (outsourced)	2	2	1	**5**
4. As 2 & 3 with sale and lease back	2	0	1	**3**
5. Integrate (EU)	2	1	1	**4**

Some options have very low feasibility. These include the sale and lease back of vessels, which could generate significant income in the short term but is likely to be politically unpalatable and could carry high running costs in the medium to long term. European integration was also considered problematic due to long timescales required to agree arrangements and the risk of reducing the ability to fulfil the current scientific programme.

There is a trade-off between savings and operational delivery. There is a balance between integrating the operation of vessels and sustaining the ability to plan and execute a vessel programme that fulfils the objectives of individual MSCC members as far as possible. A fully integrated arrangement that considered the science programme as a whole, as well as integrating the management of vessels, would demonstrate increased cooperation and potentially greater savings. However, this arrangement is very likely to result in a vessel programme that cannot completely satisfy the needs of all the MSCC members and thus yields lower value for money overall.

The optimum outcome is that of “Integrated Operations (JV)” in a structure hosted by the MSCC organisations. The science delivery and asset ownership under this scenario would remain the responsibility of each individual organisation. The creation of a single vessel operations office in one of the organisations, containing staff representing each of the member organisations was discussed. Although this would maximise communication across the organisations, there would be significant drawbacks in terms of the need for liaison staff to be located close to where the vessel operates for maximum efficiency. Therefore the optimum arrangement is likely to comprise a set of formalised agreements and mechanisms for joint working, such as shared sight of ship schedules

It was however noted that existing contractual arrangements prevent such integration until 2015 at the earliest, but that planning to progress any form of integration would take time and that progress should be under development from 2013 at the latest if such an opportunity was to succeed.

In the meantime it was felt that the next highest scenario (Status Quo +) should form the focus of any immediate collaborative working. Such collaboration could take the form of progressing some of or all of the following:

- Developing Framework Agreements to enable asset bartering or sharing (i.e. use of vessels or scientific equipment) across organisations without time consuming or costly procurement processes
- Sharing of knowledge and information regarding vessel operations (e.g. ship schedules, service specifications, details of key performance indicators etc.)
- Regular cross-organisational communications to develop understanding of common issues and also to identify collaboration opportunities

These measures are estimated to yield savings initially of the order of several tens of thousand, but potentially rising to £00sK if the requirement to charter in was reduced through use of other MSCC ships as available.

9. Economic analysis

As noted in the Management Group of Directors (MGD) Review of Government Marine Science vessels, the fixed costs of owning and operating these vessels are extremely high relative to the variable costs of daily use of the ship. Capital costs of large research vessels are significant (in the range of £50-200M, depending upon size and specification). This cost is a significant factor in the future shape of the fleet. Decisions to replace these large assets need to be taken years in advance of the actual date they are brought into service, to allow time for specification, design, procurement and build. If capital is constrained at this point, replacement can be placed at risk. Therefore, as recommended above, collaboration in considering future demand and supply of science vessels, such as a working group, and with the ability to make recommendations on need for replacement ships and potentially able to contribute to any case for joint procurement, will be a distinct advantage in the future.

There are significant fixed costs involved in owning a ship. These are dominated by maintenance and crew costs, which amount to over £5M p.a. for a large ship. This, added to the annual depreciation charges will typically account for more than two thirds of the annual vessel operating costs with the balance being scientific staff costs, operational fuel, travel and subsistence and any equipment hire/purchase. This situation is compounded by rising and volatile marine fuel costs.

As already noted by the MGD, full utilisation with maximum operational days at sea is the most cost effective manner in which to operate these vessels. The additional costs of active operations have been outweighed over recent years by the gains in terms of scientific operations and data acquired, however this argument has become more fragile as budgets have come under pressure; the consequence of which is that some ship operations are now approaching affordability thresholds. Within the daily operational costs, there may be minor savings such as altering course or speed to balance fuel requirements with time spent at sea. This type of decision is taken daily by vessel liaison staff in conjunction with officers and managers of the ships.

Due to the high fixed costs, the number of vessels in the fleet is the single largest determinant of costs. The greatest savings (£millions p.a.) can only be achieved by reducing the number of ships operated. However, as discussed above, this would have significant impact on delivery of current UK and international science programmes.

The relative annual costs of each of the scenarios in section 8.2 were estimated. The Status Quo+ and integrated in-house operations options are estimated to immediately save a few days, resulting in a marginal annual saving of the order of £50k p.a.. The integration of operations and science options (2b, 3a and 3b) would also generate this order of saving but are all estimated to result in an increased requirement for travel from base to the nearest port where each vessel is operating, probably requiring an additional member of staff overall, at an overall small increase in cost. The sale and lease back option would generate a large payment up front but then higher annual payments that would most likely cancelled out this income before the end of the useful life of the vessel. There is also an increased risk of not being able to fulfil all scientific requirements. Costs under a scenario of integration at the European level are difficult to gauge but are likely to be in excess of the integrated options by a considerable margin, along with reduced likelihood of having unrestricted use of the vessel.

From this brief review of likely relative costs, Status Quo+ and Integrated In-house Operations options appear to offer best value for money, which supports the qualitative assessment of these options. As integration develops, the potential to maximise savings increases, particularly if arrangements are put in place that maximise active days at sea for the ships reviewed here and this reduces the requirement to charter in commercial ships.

10. Ownership and management options and recommendations (ToR 2&3)

Taking the assessments carried out under this review as a whole, the following recommendations can be made;

10.1 There appears to be no immediate cost or operational advantage to altering the current ownership, management and maintenance arrangements for UK marine research vessels. Nevertheless, MSCC recommends that an overview of the UK science fleet and requirements is maintained. It is proposed that a Working Group continues to facilitate collaborative working and a Liaison Group carries out more detailed investigation of the extent to which industry should be involved in UK marine research vessel provision and operation.

10.2 As breakpoints in management contracts etc. approach, this should be reviewed and alternative options considered by the Working Group. The first contract breakpoint is in 2015 and it is recommended that work begins early in 2013 to assess options and make recommendations for the future. This work should also take account of options for vessel replacement.

10.3 The Working Group should consider options and implications for the future size and configuration of the UK marine research fleet, particularly options for planned replacement of vessels as they near the end of their useful life. This work should take options for fleet management into account and include consideration of the work and findings of the Liaison Group on charter provision.

10.4 The potential for new technologies to reduce the requirement for specialist ship time should be kept under review, with the Working Group considering options for the medium-long term.

10.5 Vessel operations managers already achieve significant efficiencies through relatively informal cooperation. This should be strengthened through instigation of the Working Group to enable exchange of ship programme information and work to achieve maximum efficiency in ship use. Furthermore, the Working Group should aim to develop appropriate agreements to facilitate sharing or bartering between the organisations involved without the need for lengthy individual procurement processes. Existing barter and sharing agreements should be retained. This work may include equipment and expertise as necessary.

10.6 The Liaison Group and Working Group should report back to MSCC.

11. Draft Items for Working Group and Liaison Group

	2013				2014				2015			
Working Group												
Terms of Reference			*									
Exchange of Programme Information and optimising days at sea												
Development of Arrangements to promote maximum efficiency												
Options for future fleet												
Management Contract Review												
Topics for Liaison Group consideration												
Report to MSCC			*			*	*		*		*	
Liaison Group												
Terms of Reference				*								
Charter requirements												
Other areas for joint consideration												
Report to MSCC			*			*	*		*		*	

Annex 1. Details of vessels included in this review

For details of polar vessels, see http://www.antarctica.ac.uk/living_and_working/research_ships/rrs_james_clark_ross/technical_data.php

Institute	**Marine Scotland**	**AFBI**	**Cefas**	**NERC**	**NERC**
Vessel name	**Scotia**	**Corystes**	**Endeavour**	**James Cook**	**Discovery**
Date commissioned	1998	1988	2003	2007	Scheduled for June 2013
Port of registry	Leith	Belfast	Lowestoft	Southampton	Southampton TBC
Length	68.6 m	52.5 t	73.916 m	89.5	99.7
Breadth	15 m	12.8 m	15.80 m	18.6	18.0
Deep draft	5.6 m	5 m	5.50m	5.5 to 5.7	6.5
Gross tonnage	2619 tonnes	1289 t	2983	5,368	5941
Builder	Ferguson	Ferguson Ailsa	Ferguson Shipbuilders	FlekkefjordSlipp and Maskinfabrikk, Norway	C.N.P. Freire, S.A., Vigo, Spain
Communications	Furuno Far 2835 S ARPA radar 2 Furuno FR 2110 6.5 X band radar Racal Marine Mk53 Decca receiver Raytheon Nav 398 Loran C receiver Sercel NR58 DGPS Sercel NR 230 DGPS 2 Microplot with ARCS charts	Furuno Universal AIS FA-100 Furuno AD Converter AD-100 Skanti MF/HF DSC radio telephone Sailor SP radio receiver 2 Sailor RT 4822 VHF-DSC SKYLLA-TG 24v30a GMDSS Thrane TT 3606E Mini M	In port BT Tel. Cellphone Voice/Fax/Data Radio TELEX Inmarsat C Fleet 77 (Inmarsat F) VSAT Satcom/ Internet system	256kbs VSat Inmarsat	256kbs VSat Inmarsat

Institute	**Marine Scotland**	**AFBI**	**Cefas**	**NERC**	**NERC**
Vessel name	**Scotia**	**Corystes**	**Endeavour**	**James Cook**	**Discovery**
	Furuno FE680 Robertson Autopilot RGC11 Gyro Furuno CI 35 speed log	Terminal In port cellphone Voice data fax Fleet 77			
Endurance	28 days	20 days	42 days	50 days	50 days
Complement	17 crew, 12 scientists	7 officers 9 crew 9 – 11 scientists	16 crew 19 scientists	9 officers 13 crew 32 scientists	9 officers 13 crew 28 scientists
Propulsion system	3 Wartsila type 9L20 DE marine diesel engines 1 Cummings harbour alternator 240 Kw, 1 Cummings emergency alternator 88 Kw	2 Allen S12	2230 Kw	Diesel electric: 4 x Wartsila 9L20 diesel generators ; 2 Teco Westinghouse DC (2500kW ea.)	Diesel electric: 4 x Wartsila 8L20 diesel generators ; 2 Wartsila DC (2200kW ea.)
Power generation	3 Ansaldo type GSCR630X8 and 230 volt eletrical supply via 2 Hitzinger generators	2000kW at 7500 rpm	3240Kw	7.080MW	5.760MW
Power propulsion	2 Ansaldo type DH900DC	3 m propeller 190 rpm	3 diesel electric AC generators 2 X tandem electric DC motors Single screw Emergency/harbour generator	2 x Wartsila/acbLIPs, 5-bladed, fixed pitch, 3.6m diameter	2 x Azimuth thrusters with 5-bladed FP propellers

Institute	Marine Scotland	AFBI	Cefas	NERC	NERC
Vessel name	**Scotia**	**Corystes**	**Endeavour**	**James Cook**	**Discovery**
Thrusters	Elliot White Gill bow thruster 720 Kw and Brunvoll electric tunnel stern thruster 380 Kw	White Gill 40VST azimuthing	Flush mounted azimuthing bow thruster and tunnel stern thrusters	Bow tunnel thruster 1200 Kw Retractable Azimuth thruster 1,350 Kw Stern tunnel thruster 800Kw Stern tunnel thruster 600Kw	Retractable Azimuth thruster 1,350kW Water-jet Bow Thruster 1,575 kW
Trial speed	13 knots	12 knots	14.4 knots	10.5kts cruising 14.5kts max	12kts max
A frames / Gantries	Aukra type KDE60 Aukra 5t hydrographic equipment Aukra 10 t hydraulic plankton Aukro 10t hydraulic Odim 6.5 t hydraulic gamma frame	12 t stern A frame 5 t starboard A frame 20 t stern crane 20 t midships crane3 X 1t 20 t fo'castle crane	25 t stern A frame, 7 t articulated side A frame, 3 X cranes 35tM, heave-compensated	Stern A frame 30T Stbdmidships gantry 30T CTD hydroboom 5T Main crane 250T.m 2 x 40T.m handling cranes aft	Stern A frame 20T Stbdmidships gantry 20T Bullhorn boom20T Main crane 250T.m 2 x 40T.m knuckle-boom cranes Heavy Lift Offshore Crane, 20T/17 m. 3 x Handling Cranes, aft and midship, SWL 2 T/14 m. Deck Handling/Provision Crane, fwd. SWL 2 t./12m.
Winches	2 Brattvaag D2M300, 1 Ulstein synchro 2020 auto trawl system, 2	FK Smith A/S TA 600C auto-trawl	2 X trawl winches, 2 X net drum winches, double barrel survey	CTD (x2) 8,000m x 11.43mm	CTD (x2) 8,000m x 11.43mm

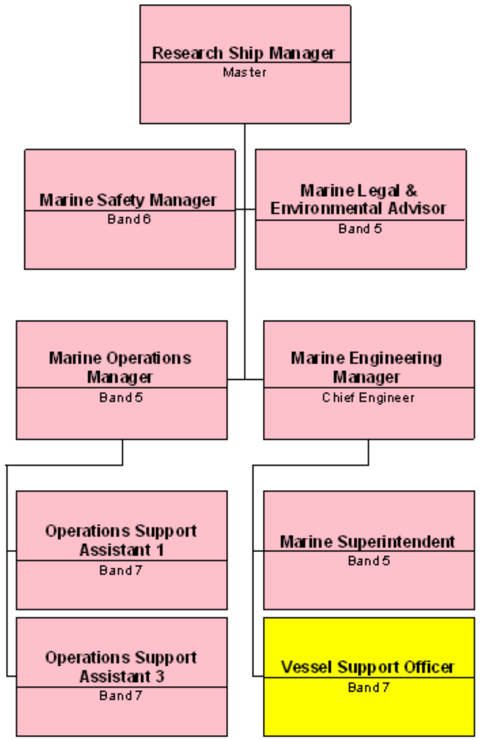
Institute	Marine Scotland	AFBI	Cefas	NERC	NERC
Vessel name	**Scotia**	**Corystes**	**Endeavour**	**James Cook**	**Discovery**
	Brattvaag DMM14185, 2 Brattvaag 2M4185, 1 Brattvaag M2202, 8 Brattvaag low pressure hydraulic winches	2 X 1000m X24mm warps 7t pulling powernet drum 2 X 1 t Lebus hydrographic 1.5 t towed body 1 t towed body 2 X 1 t hydrographic	winch with motion compensation and slip rings, double barrel survey winch with slip rings, double barrel towing winch with slip rings, 3 X Gilson winches – one fitted to stern A frame, side scan sonar winch with slip rings	Coring 8,000m x 28.0mm plasma FO Deep-tow 10,000m x 17.3mm Trawl 15,000m x 14.5/16.5/18.0mm (tapered) General Purpose 7,000m x 16.5mm	Coring 8,000m x 28.0mm plasma FO Deep-tow 10,000m x 17.3mm Trawl 15,000m x 14.5/16.5/18.0mm (tapered) General Purpose 7,000m x 16.5mm
Acoustic equipment	Simrad: EK500 echosounder EA500 oceanographic sounder EM 950 multibeam swathe echosounder SH80 short range sonar SR240 long range sonar SM2000P multibeam profiling sonar ES60 fishing echosounder ITI trawl instrumentation system Echosounding	Simrad: Skipper ED161 ES 60 Fishery Echo Sounder EK60 38kHz split beam 120kH transducer SH80 high frequency Multibeam Scanmar scanscreen c/w Trawleye Furuno CN-8 RDI 300kHz ADCP	Kongsberg simrad: HiPAP 500 positioning sonar, EK60, 38/120kHz scientific sounder, EA600, 50/200 kHz scientific sounder, ITI net mensuration system, SHBO high frequency omni-directional sonar, EM3000 swathe bathymetry sounder, Hull mounted Scanmar fishing computer transducers	SBP 120 3°x3°deepwater Sub-Bottom Profiler system. EM 122 1°x1°Multi-beam echosounder EM 710 2°x2° Multi-beam echo sounder system. RDI 75 and 150 kHz Acoustic Doppler Current Profiler EK 60 Fishery Research Echo Sounder 18, 38, 70, 120, 200 and 333 kHz	SBP 120 3°x3°deepwater Sub-Bottom Profiler system. EM 122 1°x1°Multi-beam echosounder EM 710 2°x2° Multi-beam echo sounder system. RDI 75 and 150 kHz Acoustic Doppler Current Profiler EK 60 Fishery Research Echo Sounder 18, 38, 70, 120, 200 and 333 kHz

Institute	**Marine Scotland**	**AFBI**	**Cefas**	**NERC**	**NERC**
Vessel name	**Scotia**	**Corystes**	**Endeavour**	**James Cook**	**Discovery**
	synchronisation system `RDI broad band ADCP Scanmar trawl instrumentation system			12 kHz EA 600 Hydrographic deepwater Echo Sounder 10 kHz Echo Sounding or equipment communication Scanmar S-1004/s-1007 Hydrophone system	12 kHz EA 600 Hydrographic deepwater Echo Sounder 10 kHz Echo Sounding or equipment communication Hydrophones for monitoring acoustic background and system performance Scanmar S-1004/s-1007 Hydrophone system
Routine Operations	Fisheries research in North Sea and North East Atlantic	Grab sampling, coring, scientific trawling with commercial equipment. Towed and drop camera systems, sidescan surveys, multibeam AGDS surveys, ROV surveys. Instrumented buoy deployment/recovery. Water sampling plankton surveys. Fisheries acoustic surveys.	Sampling Acoustic surveys Tow survey equipment Operate in dynamic positioning mode Deploy and recover floating and seabed monitors Make physical and chemical oceanographic	Single & Multibeam Echosounder Surveys Integrated Data Logging Multidisiplinary Science Projects Seismic Surveys Clean Seawater Sampling ROV Operations CTD Surveys	Single & Multibeam Echosounder Surveys Integrated Data Logging Multidisiplinary Science Projects Seismic Surveys Clean Seawater Sampling ROV Operations CTD Surveys

Institute	Marine Scotland	AFBI	Cefas	NERC	NERC
Vessel name	**Scotia**	**Corystes**	**Endeavour**	**James Cook**	**Discovery**
			observations	Deepwater Coring and Trawling/Towing	Deepwater Coring and Trawling/Towing
Boats	2 x work and rescue boats	Rescue boat	2 X 8m rigid work/rescue boats with suite of navigational equipment deployed on heave-compensated davits	Main laboratory Chemistry Laboratory Controlled Environment Laboratory Clean Chemical Laboratory Water Sampling Laboratory/Hangar Deck laboratory Meterology Laboratory Main deck hangar Prepared for 13 Laboratory, Services and Stores containers Clean seawater laboratory Scientific control room Server/Computer roo m	Main laboratory General Purpose Laboratory Controlled Environment Laboratory Clean Chemical Laboratory Water Sampling Laboratory/Hangar Deck laboratory Main deck hangar Prepared for 13 Laboratory, Services and Stores containers Clean seawater laboratory Scientific control room Server/Computer roo m

Institute	Marine Scotland	AFBI	Cefas	NERC	NERC
Vessel name	Scotia	Corystes	Endeavour	James Cook	Discovery
Laboratories	5 x containerised laboratories. Wet fish lab including hopper and conveyor system	Biological wet lab Multi-purpose dry lab Plot/control lab Acoustic/oceanographic control lab Darkroom Containerised laboratory (radiochemical capable)	8 networked laboratories, 4 serviced deck locations for containerised laboratories	DP(AM) Deck space for up to 18 x 20' containers (4 in hold) with services for 7 of these to be lab containers.	DP(AM) Deck space for up to 18 x 20' containers with services for 7 of these to be lab containers.
Special Features	Specialised or custom-built monitoring, measuring and observation equipment		One of the world's quietist research vessels, dynamic positioning system, intering anti-roll system, local area network with scientific data management system, ship-wide general information system, CCTV	Lloyds+100A1, Ice 1C, FS, +LMC, UMS	Lloyd's +100A1, Ice 1D, LMC, UMS, DP(AM), IWS, EP "Research Vessel"
Class	Lloyds+ 100A1 Ice Class 1D +LMC +UMS +SCM 'Fishery Research Vessel	DTp.Class VII	LRS 100A1+LMC UMS SCM CCS ICC IP ES (2) DP(CM) ICE class 1D		

Part 2 - Operational management information

Operational Management	Marine Scotland	AFBI	Cefas	NERC
No. Staff	Operated in conjunction with Marine Scotland Compliance vessels; Marine Superintendant Engineering superintendant Assistant to superintendants Scientific Ship Liaison Vessel H&S	Outsourced to Serco. Contract manager based in Belfast, supported by Serco Engineering Services in Greenock and Serco Marine Division in Portsmouth.	Master – 2 First (Chief) Officer – 2 Second Officer (Officers Mate)4 Chief Engineer – 2 Second Engineer – 2 Third Engineer – 1 Leading Hand – 2 Deckhand 1 – 7 Deckhand 2 – 2 Motorman – 2 Chief Steward – 2 Assistant Steward – 2 Cook – 2 Operation Manager – 1 Technical Superintendent – 1 Business Manager – 1 Finance and Administration – 2 Net Stores & Logistics – 4	

Operational Management	Marine Scotland	AFBI	Cefas	NERC
			H&S – 1 Cefas – Operations Manager-1 Cefas – Technical support – 4.5 Cefas – Administration – 1	

Operational Management	Marine Scotland	AFBI	Cefas	NERC
Extent of services	Full vessel, crew and equipment provision. Gear manufacture & maintenance. Mechanical and electrical engineering. Logistics Net stores	Contract let on 1/06/11 for 5 years (3+1+1). Contract covers, crewing, vessel management, logistics, maintenance, gear maintenance and storage. Net/equipment store in Belfast. All maintenance risk lies with Serco. Contract includes lubes but does not include fuel.	Outsourced: Vessel management Vessel operations Vessel maintenance. Logistics Net stores Maintenance of selected gear and equipment In house: Supplier management Vessel programming Specialist gear operations and maintenance	Full in-house management In addition scientific technical staff (ca. 50 FTE) Worldwide logistics freighting and stores support (ca. 6 FTE)

Annex 2. Research Vessels - International Relationships

As summarized in section 2, NERC participates in several schemes that facilitate the exchange of vessel time and equipment. Through NERC, the UK is involved in a number of international collaborations as detailed below. NERC considers these to be a high priority for supporting modern science at sea. This is because many of the issues facing marine science are global in nature and so require international solutions, such as the bartering (exchange) of ships and equipment. In addition, in comparison to other ship operators, research vessels constitute a niche area of activity in the shipping industry, so sharing of knowledge and best practice is vital.

The Oceans Facilities Exchange Group (OFEG) is a multi-lateral agreement and there are several bilateral agreements in place, as described below.

A2.1 Bartering

By bartering research vessel time, NERC can take advantage of the geographical location of ships operated by its partners, and avoid relocating its own ships for remote and/or one-off projects. Overall this results in reduced passage times and associated costs, providing scientists access to more diverse geographical areas for more of the year. Inevitably, this entails the respective planning teams working closely together to identify future opportunities when a barter has potential to eliminate an unnecessary voyage. A recent example of this is that when UK scientists were awarded funding to carry out a seismic survey on the Tonga Trench in the SW Pacific, it instantly became clear that none of NERC's vessels were planned to work in this area in the foreseeable future. As a consequence it was agreed to send the research cruise to sea on the German vessel, RV Sonne, which was working in the South Pacific for a year. In return German scientists have been given time on one of the UK vessels. Since 1994 NERC has exchanged ca. 3.5 years of ship time, and in one year alone (financial year 2008/09), saved over £1 Million in fuel costs.

In addition different institutes operate ships and marine research facilities such as ROVs that are highly specialized (and are often expensive to own), while their operation requires experienced and specialized personnel. Bartering is therefore also used to give scientists much wider access to specialised facilities and equipment operated by their barter partners than would otherwise be possible from within their own national capabilities.

NERC works within 2 types of barter frameworks:

Ocean Facilities Exchange Group (OFEG) which is a multi-lateral agreement;

Bilateral arrangements. NERC has individual agreements for exchanges with:

- National Science Foundation (USA) –an agreement which since mid-1980s has given NERC access to their 21 ships;
- Marine Institute (Ireland)– access to the RV Celtic Explore, RV Celtic Voyager and ROV Holland;
- CSIC-UTM (Spain) – a ground-breaking agreement which established a joint pool of geophysical equipment and shared staff.

A 2.1.1 Ocean Facilities Exchange Group

The Ocean Facilities Exchange Group (OFEG) is a group of six European institutes and ministries that, since 1996, have exchanged ship and marine equipment to the benefit of the marine science community. It represents Europe's leading oceanographic research organisations and provides a forum for exchange of equipment and co-operation across the research fleets operated by its members. The group meets twice a year to assess what exchanges can be achieved in the following year, and team is now looking to have coordinated planning cycles to ensure that these benefits are maximized to reduce costs and allow more important and world class marine science to be undertaken.

The current members of OFEG are:

- NERC (UK)
- Institut Français de Recherche pour l'Exploitation de la Mer (Ifremer) - France
- Bundesministerium für Bildung und Forschung (BMBF) - Germany
- Nederlands Instituut voor Onderzoek der Zee (NIOZ) - Netherlands
- Institute of Marine Research (IMR) - Norway
- Consejo Superior de Investigaciones Cientícas - Unidad de Tecnología Marina (CSIC-UTM) - Spain

OFEG comprises a system that regularly announces to its users what large equipment facilities are available and where the ships are provisionally planned to work in the coming year. Exchanges are based on an equivalent points per day for each ship or major equipment suite. The OFEG 'virtual' fleet currently comprises:

- All 8 non-polar Global Class European vessels;
- Both the polar Global class European vessels;
- 12 of 15 Ocean Class European vessels;

Table 1 OFEG Barter Point Values (per day) for Ships

Class	Points	France	Germany	United Kingdom	Nether-lands	Spain	Norway
Global	15		Polarstern*	James Clark Ross			
	12	Pourquoi pas?					
	11			James Cook			
	10	L'Atalante	Maria S. Merian Meteor Sonne	Discovery		Hespérides	
Ocean	9					Sarmiento de Gamboa	
	8	Thalassa					G.O. Sars
	7				Pelagia		Jan Mayen
	6		Poseidon				Johan Hjort Håkon Mosby
Regional	5	Le Suroît	Alkor Heincke			Garcia del Cid	

* Polarstern is currently available for joint cruises but not for exchange of ship time.

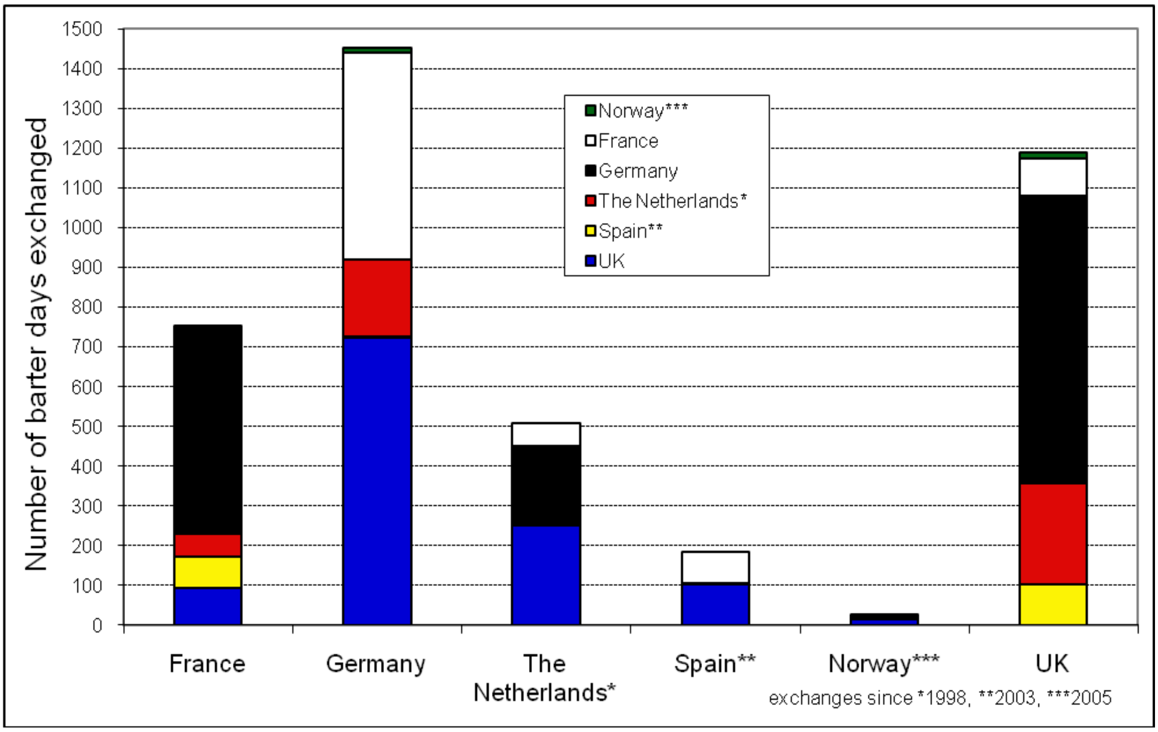


Figure 1. Barter Exchanges by Country through OFEG 1994 -2010

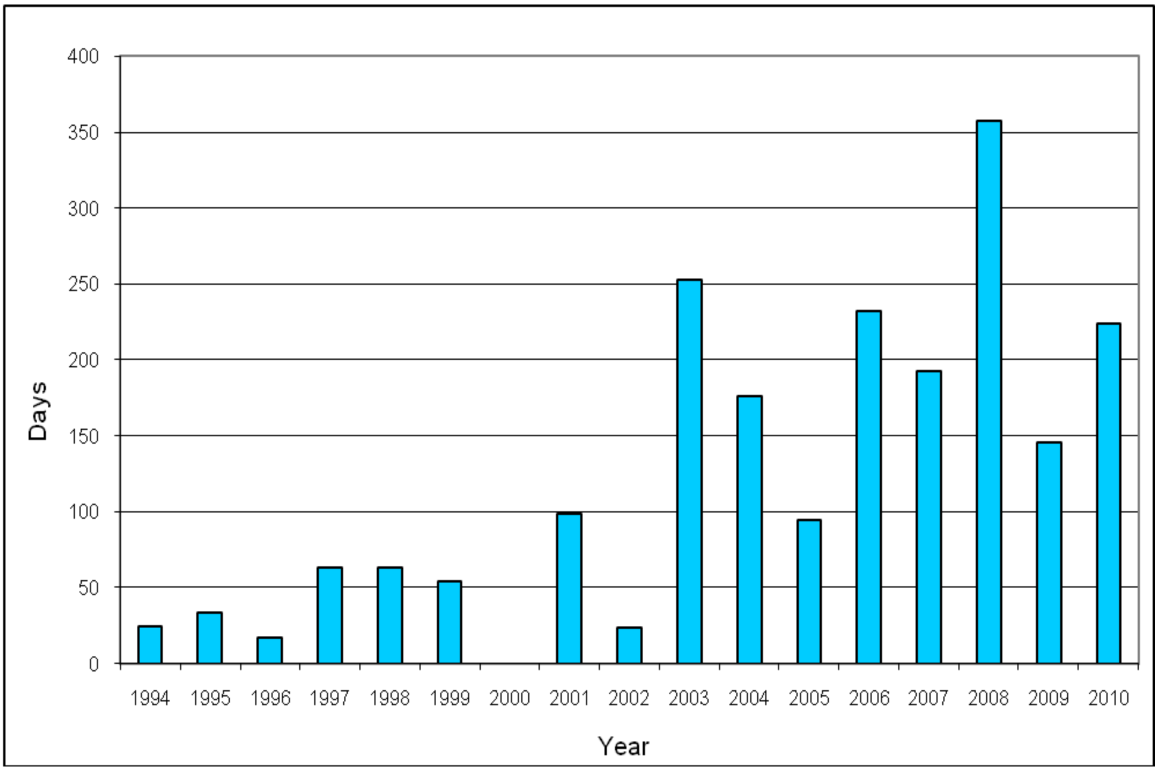


Figure 2. OFEG Barter Exchanges by Days 1994 – 2010

In addition OFEG is progressively developing its efforts on equipment, including ROVs, multichannel seismic systems, multibeam echo-sounders etc. As focus for this, OFEG has set up a sub-group, OFEG-Tech which was set up to provide the forum for the required communication and networking to support the development of major equipment barters and to improve cooperation between the OFEG partners. Specifically:

Improving knowledge of each others organizations allows each organization to benefit from new experience and knowledge which can be used to develop technical capabilities.

To develop an understanding of each others organization, structure and contacts.

To identify and develop the opportunity for exchange of knowledge and experience.

To investigate the potential for 'bilateral training' and technician exchange.

To identify common problems and elevate them to the OFEG/European level.

Table 2. OFEG Points Values (per day) of Major Equipment

	Points	France	Germany	United Kingdom	Netherlands	Spain	Norway
Deep Platforms	9	Nautile* ROV Victor*		ROV ISIS *			
	4		ROV Quest 4000 ** ROV Quest 6000 **				
	3			TOBI *			
	2						ROV Aglantha
Seismics	3	Digital Multichannel Seismics					
	2		Multichannel Seismics		Multichannel Seismics	Multichannel Seismics	
	1	Mobile Compressor	Mobile Compressors	Mobile Compressors	Mobile Compressors	Mobile Compressors	

* Includes technician support
** Planned to be included

A 2.1.2 National Science Foundation

The National Science Foundation (NSF) is an American government agency, with which NERC has a bilateral agreement for ship barter. The agreement principally allows the UK to barter with the University National Oceanographic Laboratory System (UNOLS), which coordinates oceanographic research undertaken by 61 academic institutions and the scheduling of scientific cruises aboard 21 research vessels. NSF also has observer status at OFEG and NERC has, on occasions, 'traded' its barter balances to provide access for other OFEG members to NSF/UNOLS. In addition to bartering, NERC is also invited to attend many of UNOLS' meetings including Research Vessel Operators Committee (RVOC) and the Research Vessel Technical Enhancement Committee (RVTEC). Meetings involve the exchanging of ideas and best practice to continually improve performance.

A2.2 Sharing of Best Practice

While bartering results in some very tangible benefits, it also fosters much better communication between its partners, and provides for the exchange of knowledge, experience and ideas. In addition though, NERC is a participant in a number of groups that have been specifically set up for the exchange of knowledge and best practice:

- International Research Ship Operators (IRSO) Meeting
- European Research Vessel Operators (ERVO) Meeting
- Eurofleets

A 2.2.1 International Research Ship Operators (IRSO)

Formerly known as ISOM (International Ship Operators Meeting), was founded in 1986, and provides a forum for managers of ocean research ship fleets to discuss issues and share information on best practice.The annual meeting is attended voluntarily and is hosted by one of the participating countries. From small beginnings; with just 17 attendees from 8 different countries at its first meeting in 1987, IRSO is now regularly attended by approximately 50 operators from 20 different countries representing over 100 of the world's research vessels. Topics discussed include:

- new research vessels
- marine scientific and ships' operational equipment
- changing scientific requirements
- voyage planning
- manning
- training
- classifications and certifications
- liabilities and insurances
- equipment exchange and vessel barters between members

One of the most significant achievements of IRSO was the formulation of the Code of Conduct for Marine Scientific Research Vessels, which was developed by delegates UK, USA and Ireland and adopted at the 2007 Meeting in Qingdao, China. The objective of the code is "*to minimise those impacts while adopting a pragmatic approach that facilitates the conduct of marine scientific research.*"

In 2010, ISOM was renamed to the International Research Ship Operators (IRSO) meeting to better reflect its membership and purpose. IRSO is currently chaired by NERC, who will hand over to CSIRO (Australia) after the 25th Meeting at NOC in 2012.

For more information see www.isom-info.org.

A 2.2.2 European Research Vessel Operators (ERVO)

Following a preliminary meeting of the European Research Vessel Operators (ERVO) group in Roscoff (France) in December 1999, it was decided to form a flexible forum which would meet annually to share experiences of common interest, to explore opportunities for co-operation between R.V. managers and to define the scope for such cooperation. The participants agreed that each institution would self-finance and every year, one of the RV managers would organise a meeting of the network. Since then ERVO has met annually and the number of regularly participating countries has risen from 7 to 14: Iceland, Ireland, United Kingdom, Norway, Finland, Denmark, Germany, The Netherlands, Belgium, France, Spain, Italy, Romania and Bulgaria. AFBNI, CEFAS, Marine Scotland, NERC, PML and University of Newcastle have attended one of more of the meetings, although some meetings have had no UK representation.

ERVO meetings address common issues/problems that affect research vessel operators for the purpose of identifying solutions for improving services to the scientific community and developing best practice in the operation of Research Vessels. Members present their National Reports on activities, including any future plans for acquisitions/upgrades.

Presentations on new vessel builds are invited and a number of special topics discussed at each meeting.

The ERVO Meetings provide an opportunity for RV Managers to exchange information on their national fleets, highlighting trends in the requirements for sea-going vessels and new technological developments for R.V. operations.

For more information see http://www.eurocean.org/np4/ervo

A 2.3 Eurofleets

Eurofleets is a €7.2M Framework 7 programme which aims to improve coordination and cost-effective use of the European research vessel facilities in order to support the efficient provision of essential research services for monitoring and sustainable management of the Regional Seas and Oceans and allow access to all European scientists. EUROFLEETS aims to:

Structure and integrate through an e-platform the way that the research vessels are operated and their interoperability;
Use the existing fleets more cost-efficiently
Facilitate a wider sharing of knowledge and technologies across fields and between academia and industry,
Promote greener and sustainable research vessel operations and responsibility,
Provide all European marine researchers with access to state-of-the-art research fleets;
Foster coordinated and joint development of European fleetcapacity and capability.

The EUROFLEETS Project is organised under Activities, Work Packages and Tasks.

Networking Activities

NA-1 Strategic Coordination Vision
NA-2 Virtual Research Fleet ePlatform and Portal
NA-3 Eco-Responsibility and Eco-Design for Existing and New Research Vessels
NA-4 Interoperability within European Research Fleets
NA-5 EUROFLEETS Scientific User Access Moderation and Peer Review
NA-6 Advanced Training and Education
NA-7 Eurofleets website and IPR
Transnational Access
TNA1: Ocean and Global Research Vessels and Equipment
TNA2: Regional Research Vessels and Equipment Wider access
Access for above through NA5
Joint Research Activities
JRA1 New Software
JRA2 Shared and Flexible Payloads for ROV, AUV and Observatories and Common Mission Planning Tool

NERC is leading NA3 work-package and is also involved in NA2 and JRA2.

A proposal for a follow-on programme, Eurofleets2 has recently been submitted, but NERC has already indicated that it will not be participating.

For more information seehttp://www.eurofleets.eu/np4/home.html