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# Towards a Better Understanding of the Income Requirements of Marine Protected Areas

MSc Environmental Management for Business by Research
Institute of Water and Environment

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## ABSTRACT

A growing understanding and appreciation of the environmental threats facing the seas, combined with the evident failure of many of the traditional approaches to marine conservation has resulted in a widespread call for new and more effective ways of protecting the marine environment. Foremost amongst the methods being proposed are marine protected areas (MPAs) – areas of the sea designed to protect the marine environment.

The recent World Summit in Johannesburg paved the way for the creation of a very significant increase in the global coverage of MPAs – the intention is to create a world-wide network by 2012.

In order for these new protected areas — and indeed the existing MPAs — to be effective, a comprehensive understanding of the variables that determine their success is required.

There are many factors that are understood to determine the efficacy of MPAs in achieving their objectives. An extensive body of research suggests that access to sufficient resources, including income, is a key variable. The aim of this project is to develop an understanding of the financial requirements of MPAs with a view to assisting policy analysis. The specific objectives are to establish a comprehensive profile of a range of significant characteristics of the protected areas and relate them to their income requirements and spending patterns. The focus of the study is primarily on the on-going management costs of the areas.

In order to achieve this goal, a global sample of MPAs was surveyed using a questionnaire. Among the most significant of the survey's findings was the apparent existence of three distinct groupings of MPAs found within the sample set which were distinguished by a number of characteristics — ranging from their purpose and visitor numbers to their size and spending patterns.

The first group comprises MPAs principally focused on fisheries and regulatory enforcement; these are typically in poorer southern countries and have lower visitor numbers. The second, largest group, consists of MPAs with a very wide range of purposes, from recreational to commercial – including the benefit to fisheries. This cluster seems to resemble most closely the multiple-use MPAs described throughout the literature. The final group is the smallest and the hardest to define. As with the other groups, this final group of MPAs engages in a range of purposes, but to a lesser extent — most notably with respect to fishing. Given the relatively low visitor numbers and significant occurrence of no-take areas, it is tentatively suggested that this group has more of a dedicated conservation bias than the two other clusters.

The differences between these three clusters are evident even where characteristics such as size and habitat type might be similar.

Another important finding was the breadth of values found in a number of key variables — namely MPA size, visitor numbers and level of income both current and desired. Taking MPA size as an example, the smallest area measured ten hectares and

the largest measured over thirteen million hectares. This had major implications for the ability to analyse and model the data for income-related patterns.

Notwithstanding the apparent cohesiveness of the three clusters found in the data, they did not appear to have any coherent income requirements. In order to look for trends and patterns in the income data, it was necessary to look across the sample set as a whole.

Across the entire sample, the range of values for income was very broad, consistent with the highly varied characteristics of different MPAs. The minimum funding requirement for the MPAs (the income that would allow them minimally to meet their objectives) ranged from around USD 9,000 to over USD 6,000,000, with a median of roughly USD 450,000. The percentage increase over current income that would be required for a given MPA to achieve its minimum funding requirement had a median of 15%.

In looking for the explanatory factors that might determine these income requirements, a simple bottom-up model was constructed based on the costs of pursuing particular activities. It proved difficult, however, to test this model owing to the very broad range of inputs, spanning several orders of magnitude. As an alternative, a top-down statistical approach was applied based upon the log data. This top-down model, discussed in Chapter 5 indicated that area and visitor numbers together accounted for approximately 46% of the variations in MPA funding requirements.

Although area and visitor numbers appear to be key factors in determining MPA income, it is clear from the extent of the unexplained residuals that there are probably a number of additional factors at play. Analysis of the data failed to show an association between any of the other factors surveyed, such as MPA purpose and habitat type and income requirements. It is highly likely that in reality, these and a range of other “contextual” factors such as the condition of the MPA will combine to heavily influence funding needs.

In concluding the analysis, it was suggested that although this study will hopefully provide a useful platform for developing the understanding of MPAs income requirements, there is more work to be done. Central to this work should be an attempt at quantifying the potential economic benefits of MPAs. The medium-term objective of any study of the costs of effective management should be an appraisal of the costs net of these economic benefits.

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## ABBREVIATIONS

| | |
|---|---|
| CBD | Convention on Biological Diversity |
| CITES | Convention on International Trade in Endangered Species |
| CNPPA | Commission on National Parks and Protected Areas |
| EEZ | Exclusive Economic Zone |
| GNI | gross national income (per capita) |
| GNP | gross national product |
| ICZM | integrated coastal zone management |
| IFR | ideal funding requirement |
| IUCN | International Union for the Conservation of Nature |
| MFR | minimum funding requirement |
| MLCD | Marine Life Conservation District |
| MNR | marine nature reserve |
| MPA | marine protected area |
| NGO | non-governmental organisation |
| NMS | National Marine Sanctuary |
| OECD | Organisation for Economic Co-operation and Development |
| PA | protected area |
| PPP | purchasing power parity |
| RSPB | Royal Society for the Protection of Birds |
| UNCLOS | United Nations Law of the Sea |
| USD | United States dollars ($) |
| WWF | World Wildlife Fund |

# CHAPTER 1:INTRODUCTION

## 1.1 Background

**"North Sea cod faces total elimination"**

*Daily Telegraph 23rd October 2001*

**"as oceans warm problems from viruses and bacteria mount"**

*New York Times 24th January 1999*

**"the world's tropical reefs could die out within 30 years"**

*The Guardian 24th April 2002*

**"reef-fish populations pushed to the brink of extinction may never recover"**

*Economist 2nd November 2000*

The woes of the seas seem little by little to be earning greater public recognition, yet the degeneration of marine resources continues. The pristine reefs that Jacques Cousteau explored are now few and far between while only vast productivity improvements in fisheries techniques allows for the maintenance of stable yields – and only then for some stocks.

It is in this context of over-exploitation and evident management failure that more strident calls for conservation and improved management are being made, along with the proposed use of relatively new and hopefully more effective management tools.

Central among the solutions advocated by marine conservationists has been the use of marine protected areas (MPAs): areas of the sea reserved to protect the marine environment. Barely a month goes by without the publication in the scientific and even the economic literature of some new evidence of how much MPAs can contribute to marine management.

Indeed, so strong has been the case made for MPAs, that the message has not fallen on deaf ears. From a marine conservation perspective, a key proposal to come out of the Johannesburg World Summit was to establish a global representative network of MPAs by 2012: a firm proposal that had no qualifying conditions and gave a time deadline.

In order to implement such a scheme, a vast amount of information will be required including, not least, an appreciation of what it will cost both initially and on an ongoing basis.

## 1.2 Aims and Objectives

This study is part of a larger initiative undertaken by a number of academic institutions and NGOs lead by the RSPB to develop a better understanding of the financial requirements of MPAs. Its aim is to establish the financial profile of a representative sample of MPAs from around the world with a view to clarifying at least some of the factors influencing their financial requirements and estimating their

ongoing management needs. It is anticipated that the information gathered could be used by decision making bodies both to benefit the management of existing MPAs and to facilitate the effective creation of new areas.

Central to the exercise was a survey of seventy nine MPAs through the use of a questionnaire with the objective of acquiring information relevant to understanding their income requirements. The specific objectives of the questionnaire and indeed of the study as a whole are to establish a greater understanding of the following issues:

(i) how much annual income each MPA receives and from what sources

(ii) how much each MPA spends each year and on what

(iii) the minimal and ideal level of income that would be necessary to manage the MPA effectively

(iv) the factors influencing spending patterns

(v) the factors affecting existing and future funding requirements

## 1.3 Thesis outline

The following report comprises the findings and conclusions of the study. It is prefaced in Chapter 2 by a literature review of existing work in the field, looking at both the nature and benefits of MPAs as effective management tools and what level of resources are required to manage them. Although some work has been published on the needs of terrestrial areas, little has been done on MPAs specifically. Chapter 3 looks at the methodology behind the study. Both Chapters 4 and 5 cover the results and discussion. Chapter 5 is dedicated solely to the issue of income requirements, given its centrality to the project.

Chapter 6 presents some conclusions and recommendations for further work. These recommendations are extensive. Although it is evident that there are some distinct patterns in the types of MPA found around the world, a clear understanding of how they relate to their income requirements will require further study.

# CHAPTER 2: LITERATURE REVIEW

## 2.1 Introduction

The starting point in developing an understanding of MPA income requirements, is an appraisal of their function and importance in modern marine conservation. Equally important is an initial study of what determines their success — including the significance of resourcing. This literature review covers these issues, beginning with a short assessment of why there is such urgency in conserving the natural benefits of the oceans.

## 2.2 The Conservation Imperative

**Benefits of the Ocean**

The benefits the oceans provide, both living and inert, are bountiful. Norse (1993) details an exhaustive list. As an entity, the oceans assist in climate regulation, playing a key role in the carbon cycle and in the production of oxygen. Less prosaically the oceans remain central to the global transportation system.

At the level of resources, the primary gift of the seas is food. About one billion people – one fifth of the world's population - rely on fish as their main source of protein (1998 figures - FAO 2000). Capture fisheries and aquaculture together employ an estimated 36 million people in a trade worth up to USD 51 billion (1998 figures - FAO 2000). Other resources include raw materials such as algae (seaweed) used for fertiliser and mangroves and coral used for building. Marine organisms are also a key source of material and information for the chemical and pharmaceutical industries (Thorne-Miller 1999).

Last but not least, the oceans play and have played a central role in human culture and recreation for peoples around the world (Kelleher 1999).

**Threats to the Oceans**

Notwithstanding the many benefits that the oceans provide, the threats to their continued provision are considerable and accelerating in magnitude. Gray (1997) provides a particularly comprehensive commentary detailing habitat loss, global climate change, over-exploitation of, and other effects of fishing and other resource extraction, pollution, alien species introductions and invasions, water-shed alteration, coastal changes, tourism and littering as the most significant forces of destruction.

From this litany of threats there appear to be two key issues of concern. Firstly, that habitat destruction is the primary driver of biodiversity loss (McNeely et al 1995, Salm et al 2000) and, secondly, that much of the loss is concentrated in the coastal zone – particularly in tropical areas (Kelleher 1999, Salm at al 2000). Both of these trends are primarily a function of human population growth.

Evidence for marine biodiversity loss and degradation of the seas occurring as a consequence of these impacts is neither as apparent nor as well understood as that occurring in the terrestrial realm. However, there are a number of clear indications that a marked deterioration is taking place.

In the first instance there has been a significant decline per unit of effort in capture fisheries since their peak in 1986. The FAO (2000) believes that about 50% of stocks are now fully exploited; another 18% are overexploited while 9% have been fully depleted.

Another indicator of loss might be the status of coral reefs around the world, with an estimated 58% of the world's coral reefs under threat (Eakin et al 1997 and Bryant et al 1998 in Wells 1998 b). Furthermore, although the status of many individual non-commercial marine organisms is not very well understood, it appears increasingly evident that a growing number of marine mammals, birds and turtles are threatened with extinction (NRC 2000).

## 2.3 Managing the Seas

### Legal Tools for Marine Conservation

According to Thorne-Miller (1999), the history of the governance of the seas can be analysed along three strands: the use of the seas for shipping and commerce; the appropriation of natural resources; and the law relating to the environment and conservation. It is the last of these that is of particular interest to this study.

The conservation-related laws cover a wide range of issues from resource use (e.g. fisheries) and endangered species to pollution and protected areas.

Foremost amongst the range of international treaties, agreements, programmes and initiatives considering conservation, is the United Nations Law of the Sea (UNCLOS) which came into force in 1994. Although the primary purpose of UNCLOS was to provide a framework for ownership and responsibility of the seas amongst sovereign nations, UNCLOS also dictates that states are obliged to conserve and manage the living resources both within and outside of their national jurisdiction.

The Convention on Biological Diversity (CBD), ratified in 1995, relates specifically to the conservation of and sustainable use of biodiversity – both terrestrial and marine[1]. The CBD requires member states to enact a range of action items with respect to the oceans, ranging from integrated coastal zone management (ICZM), the establishment of marine protected areas (MPAs) to the sustainable use of fisheries resources.

Other international agreements related to marine conservation concern the protection of individual species such as the Convention on International Trade in Endangered Species, Washington, 1973 (CITES), the Ramsar Convention on Wetlands of International Importance, Iran, 1971 and the International Convention for the Regulation of Whaling, Washington, 1946, which has had a moratorium on commercial whaling since 1982. The main fisheries agreements include the UN Agreement on Straddling and Highly Migratory Fish Stocks, New York, 1995, the

[1] It might be noted here that as de Fontaubert et al (1996) point out, the conservation of biodiversity is equivalent to the conservation of all living marine resources, as no individual species can be considered out of the context of the ecosystem of which it is a part.

FAO Code of Conduct for Responsible Fisheries, Rome, 1995 and the UN General Assembly Drift-Net Resolution 46/215, 1991[2]. It might be noted that ecosystems treated as a "whole" have virtually no protection with the exception of the UN originated multilateral agreement to protect Antarctic waters (MPA News January and December 1999/2000).

On a regional level, the United Nations Regional Seas programme has provided a conservation structure for several seas including the Mediterranean, Baltic and Red Sea. There have also been a number of regional fisheries agreements such as the Agreement to Reduce Dolphin Mortality in the Eastern Tropical Pacific Tuna Fishery, 1992.

Nationally, states legislate principally with respect to their 'exclusive economic zone' (EEZ) – the 200 nautical mile range from a state's shore over which it has national jurisdiction. Measures taken by individual states might include the implementation of international agreements such as the CBD, the creation of MPAs, enactment and enforcement of fisheries laws and introduction of regulatory limitations on land-based activities that might damage the marine environment. Ideally, these will be implemented as part of an integrated coastal zone management (ICZM) strategy.

**Obstacles to Successful Marine Conservation**

Notwithstanding the long list of legislation and initiatives that have been introduced, attempts to conserve the marine environment have been characterised – and indeed hamstrung – by a range of both physical features and almost universal socio-economic factors.

In the first instance, the marine environment is, by its nature, inherently global (Salm et al 2000, Roberts 2000). The seas are fluid in a literal sense, moved by currents on three dimensions, with nothing fixed to the bottom in the open oceans. This makes for ecosystems that are often vast in scale, with species and indeed pollutants dispersed over great distances and certainly ranging beyond most political boundaries. Very often the threat to the seas comes from events on land. Ticco (1995) lists agriculture, mining and land-based pollution as significant threats to the marine environment which, because of the open nature of the seas, can be distributed indiscriminately. As Agardy (1997) says, "(the oceans) can be degraded by impacts from a distance".

The constraints to conservation of such an open, unstructured environment are obvious. International co-operation at some level is required to achieve almost any goal; a difficult prospect under any circumstances, let alone one where the rules of ownership are as nebulous as they are for the seas.

Many commentators agree that it is a lack of ownership of the seas that is at the root of the difficulties encountered in establishing effective conservation programmes (Wells 1998, NRC 1999). The absence of ownership of the seas can be characterised by their "open-access" where possession is public not private (Roberts 2000). Unlike the land, private ownership of the seas is virtually unknown, with the exception of

[2] For more detail on each treaty and agreement see de Fontaubert et al 1996.

some small inshore areas that are held under customary tenure in parts of the Pacific (Wells 1998). Instead, there is often a history of unrestricted use of resources, giving rise to multiple conflicts concerning use and the over-exploitation of the resource (NRC 2000).

Imposing usage restrictions on resources which have either no ownership or a long-held tradition of entitlement poses enormous challenges to the conservation community. The issue is as relevant to a nation state's in-shore marine resources as it is to the high seas, where there is no single governing body or "final" authority.

A final point to raise here is the concept of "out of sight, out of mind". Suchanek (1994) sums up this issue with three points. Firstly marine populations are not visible to the mass of the population, secondly, our knowledge of the marine environment remains very limited; and, thirdly, that monitoring of the marine environment is poor.

Similarly, Brailovskaya (1998) talks about the inherent human detachment from marine life. When British environment minister John Gummer proposed the image of farmers dragging cows across fields in Land Rovers as an analogy for whaling, it was a rare case of a politician trying to bridge the conceptual terrestrial-marine divide.

Considering the issue of how little is known about the marine environment, the NRC (2000) makes a reference that is especially poignant. In the 1600s the Dutchman Hugo Grotius declared that the seas were too vast to be degraded by human activities – they could not be harmed by human deeds and therefore needed no protection. A view at the root of the freedom of the seas and one for which we are paying the price today.

## 2.4 Marine Protected Areas in Theory

**The Case for Marine Protected Areas: The New Paradigm**

The IUCN defines an MPA as:

"Any area of intertidal or subtidal terrain, together with its overlying water and associated flora, fauna and other historical and cultural features, which has been reserved by law or other effective means to protect all or part of the enclosed environment"

The key point to this definition is that MPAs are designed to restrict resource use on a spatial basis. Although MPAs are on the whole unable to control the activities that occur outside of their boundaries, within their area they have the potential to restrict a range of activities harmful to the environment, from pollution and extraction to anchor and diver damage.

By protecting the entirety of an area from these harmful activities, MPAs are potentially able to protect whole ecosystems (Salm et al 2000). It is this holistic approach that Barr and Thornton (1997) are referring to when they talk about the "new paradigm of ocean management". The "new paradigm" is a fundamental shift away from a management focus based around individual species (manifest within the history of fisheries management) to the concept of managing entire ecosystems.

Kelleher (1999) and the NRC (2000) break this holistic concept up into its main benefits: the conservation of biodiversity; habitat protection; and the maintenance of stable fisheries. Each of these three benefits is a function of taking a broad spectrum approach to protection which MPAs have the potential to offer by dint of placing restrictions on an entire area.

### Secondary Benefits of Marine Protected Areas

The protection of biodiversity and habitats plus a contribution to fisheries management can be classified as "fundamental" or "primary" benefits of MPAs i.e. benefits that are only likely to occur through the use of MPAs. In addition to these fundamental benefits there are a range of "secondary" benefits namely the economic, social and cultural benefits which accrue when and if the fundamental benefits are achieved. Some of these secondary benefits may be achievable via the implementation of other conservation mechanisms.

Exhibit 2.4.A gives a list of benefits based on Salm et al 2000. The benefits marked as † can be regarded as fundamental. This list can be taken as by no means exhaustive.

**Exhibit 2.4.A: The Benefits of Marine Protected Areas**

- Preserving biodiversity †
- Preserving genetic diversity
- Conserving ecosystems †
- Maintaining ecological processes
- Sustainable use
- Protecting commercially valuable species
- Replenishing depleted stocks
- Education and research
- Protection from natural hazards
- Social benefits e.g. cultural heritage, recreation
- Economic benefits e.g. tourism, bio-prospecting, improved fisheries yields †

Source: Salm et al 2000 †Fundamental benefits

### The Advantages of MPAs versus Other Tools of Marine Conservation

The nature and extent of the benefits of MPAs versus those provided by other conservation tools is at the heart of the debate of modern marine conservation thinking. The central advantage of MPAs is as has been discussed, that they are able to cast their net wide and limit the harmful and degrading activities within their boundaries. Assuming that the restrictions placed on environmentally damaging

activities within the MPA are substantial, no other single conservation mechanism can provide such a broad spectrum safeguard.

The greatest current interest is in the relative value of MPAs to marine conservation versus traditional fisheries management. Not only has fisheries management been the main avenue to conserve the marine environment up until now, as has been discussed both within this paper and exhaustively elsewhere, it is largely seen as having failed.

Notwithstanding advances in fishing methods – especially in gear types, the inability to deal comprehensively with by-catch and habitat impact (by e.g. bottom trawling) is an ever-present problem (NRC 2000). By protecting an environment from extraction as an MPA is able to do, these habitat and biodiversity conservation issues associated with many types of fishing are avoided entirely.

The issue of the contribution of MPAs to the third potential benefit of MPAs - fisheries management is currently the subject of heated debate. Once again, it can only be expected that fisheries populations are likely to recover and thrive if not subject to extraction – and it has indeed been proven repeatedly to be the case (Roberts 2000). The question is whether restricting fishing completely through the use of an MPA will provide a net benefit to a given area as opposed to managing the entire area "properly" using traditional fisheries management techniques. The answer appears to be that the jury remains out, with various case studies suggesting net losses (e.g. McClanahan 1999) and others suggesting a net benefit (e.g. Russ and Alcala 1996) Most of the cases made for MPAs as a net benefit relate to the advantages they have for a particular species or life stage of fish. Dayton et al (2000) believe MPAs can be particularly advantageous to artisanal fisheries.

What there does appear to be general agreement on however, is that MPAs have the advantage over traditional fisheries management tools in that they offer a stout form of defence against the stochastic shocks that fish stocks are given to (Kelleher 1999) and a buffer against the failure of traditional methods (Agardy 1997, Allison et al 1998). According to the NRC (1998), stock assessment methods are prone to errors of up to 50% even with expensive monitoring programmes in place.

**The Limitations of Marine Protected Areas**

As exciting as the prospective benefits of MPAs might be, they are nevertheless inherently limited. The absence of boundaries in the sea applies to the dynamics of MPAs in the same way that it frames and inhibits any other marine conservation activity. An MPA may prohibit all known harmful activities within its own boundaries, but it is often helpless in the face of destructive forces that take-place outside of its remit. Pollution in all its forms, from agricultural to development related and invasive alien species are two of the greatest threats that can enter unrestricted into an MPA's territory.

Another important weakness of MPAs is simply a mirror of a difficulty faced by terrestrial protected areas. The efficacy of any protected area will be inevitably undermined if the degradation of the surrounding environment is such that its internal conservation goals are unsustainable. The potential to become isolated islands of diminishing conservation efficacy is as great for marine as it is for terrestrial protected areas. Indeed, this issue may arguably be of even greater concern for marine protected

areas given the very wide ranging mobility of many marine species – particularly the migratory pelagic species of the high seas. As Agardy (1997) points out, functional ecosystems tend not to relate to arbitrary boundaries drawn for human purposes.

In the face of these limitations, many authorities in the field regard MPA success as dependent on the successful implementation of two key conditions. Firstly, that MPAs should exist only within the context of an integrated coastal zone management (ICZM) plan that accounts for all of the threats to the marine area being conserved. As Kelleher et al (1995) explain:

"… the establishment and management of MPAs is likely to prove to be a futile exercise unless it occurs within regimes which provide for the integrated management of all uses of the adjacent land and sea area."

The second condition is that MPAs are not left as stand-alone units, defenceless and useless in the face of a widely degraded environment and conservation requirements that do not fit within their spatial limits. Rather MPAs should exist only within broader networks that encompass large areas of the marine environment. This view, presented by Ballantine (1995) amongst others appears now to have considerable currency within the international conservation community with the proposal for the development of an integrated international MPA network being one of the few conservation successes to come out of the recent Johannesburg Summit.

In sum, by restricting environmentally harmful activities on a spatial basis, MPAs have considerable potential to conserve and restore entire habitats and the concomitant biodiversity. The nature of the marine environment however, is such that MPAs can only ever be one part of the equation. Without being sited within an integrated conservation structure that can control all of the threats to a given area, including those from outside, MPAs are limited to being little more than token gestures. Given the vast threats from ever increasing coastal development all around the world, by concentrating on MPAs the marine conservation community clearly runs the risk of "fiddling while Rome burns".

## 2.5 Marine Protected Areas in Practice

### MPA Objectives

Bridging the worlds of theory into practice requires consideration of how the potential benefits of MPAs can be actually realised through the identification and implementation of a given selection of management objectives.

The primary generic objective of an MPA is to conserve to some degree the environment within its boundaries. This basic conservation objective is only the beginning however. Beyond an intention to protect the area within a given set of boundaries, the objectives of an MPA can range from defining the extent and nature of the ecological protection, to a much broader set of other objectives.

Jones (1994 – Appendix 1) gives a very comprehensive selection of possible objectives of marine nature reserves (MNRs)[3], classifying them into four groups – scientific, economic, cultural and ethical. All of the objectives can be aligned to the benefits given in Exhibit 2.4.A. The range of objectives and the set of local circumstances and conditions vary so much that arguably no two MPAs are the same. There do appear to be some distinct trends however, over both time and place. The stated objectives of MPAs have changed as the movement has grown over the last fifty years. In addition, there have been some clear distinctions between the priorities of the North and the South[4].

**The History of Marine Protected Areas**

Like marine conservation generally, the history of MPAs has been brief. The first MPA was created in 1935 (Gubbay 1995), with a slow trickle over the next thirty to forty years. The main driver for their establishment came in 1982 following the III World Congress on National Parks held in Bali, Indonesia. The Bali Action Plan called for the incorporation of marine and coastal protected areas into the worldwide protected areas network. In the mid 1980s there were an estimated 430 MPAs – a figure that has probably since multiplied five-fold (Author's estimate).

According to Agardy (1997), the initial impetus for creating MPAs was recreation, with the development of marine parks in the West. The early protected areas conformed to the time-held tradition of open access and unbridled utilisation. Conversely, many MPAs created in subsequent years placed a priority on protection (Hockey 1997); another 'first-world' initiative, which typically sought to exclude alternative uses, specifically human ones.

**Current Trends in MPA Formation**

A view widespread across the literature is the recognition that a broad range of human issues relating to potentially competing economic and social uses have now been introduced into the objectives of modern MPAs. Hockey (1997) identifies these trends as beginning in the early 1980s. As pressures from increased development and resource use have grown, it is seen as inevitable that MPAs should cater to at least some extent to these burgeoning human needs. This approach has been particularly the case in the developing world where the privilege of protection alone is largely an unaffordable luxury (Salm et al 2000). Similarly in the West, the trend towards large multiple-use areas also recognises the growing need for MPAs to resolve wide-ranging user conflicts.

It is worth noting at this point that patterns of usage within multiple-use MPAs are often proscribed through "zoning" where a zone representing a given area of the MPA caters for certain activities. These zones may be very varied, ranging from harvest refugia or "no-take" zones where all extraction including fishing is disallowed, to

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[3] Although the objectives Jones gives apply specifically to MNRs, they appear to be equally applicable to the definition of MPAs used here.

[4] North and South are used here as abbreviations for developed and developing countries. These definitions are discussed in further detail in Section 4.2.

zones for recreation and zones for shipping. Studies undertaken in the Caribbean for example, suggest that 76% of Wider Caribbean MPAs engage in the zoning of some human activities (Mascia 1999) with 40% employing zoning as a tool for fisheries management (Geoghegan et al 2001).

**MPA Classification**

Agardy's (1997) classification of MPAs into three groups usefully encompasses most commentators' categorisations of contemporary MPAs:

(i) Extensions of terrestrial parks

(ii) Small scale reserve or parks established to meet a single objective e.g. conservation of a single species

(iii) Large coastal MPAs zoned for multiple uses

An additional group — those MPAs established for the purposes of fishery management — might also be included (NRC 2000, Palumbi 1998) although arguably these form a subset of the second group.

While grouping MPAs into two broad categories, Agardy notes that in practice the various MPAs, as defined by their objectives, occupy a continuum between small restricted-use protected areas and large multiple-use MPAs. This continuum is best expressed by the IUCN framework for protected area categories given in Exhibit 2.5.A, with the restricted use MPAs sitting at the top of the scale, perhaps at level one and the large multiple use MPAs at the bottom – possibly at level six.

**Exhibit 2.5.A: IUCN Protected Area Management Categories**

*(IUCN 1994)*

| | |
|---|---|
| Category I | **Protected area managed mainly for science or wilderness protection** (Strict Nature Reserve / Wilderness Area) |
| Category II | **Protected area managed mainly for ecosystem protection and recreation** (National Park) |
| Category III | **Protected area managed mainly for conservation of specific natural features** (Natural Monument) |
| Category IV | **Protected area managed mainly for conservation through management intervention** (Habitat / Species Management Area) |
| Category V | **Protected area managed mainly for landscape / seascape conservation and recreation** (Protected Landscape / Seascape) |
| Category VI | **Protected area managed mainly for the sustainable use of natural ecosystems** (Managed Resource Protected Area) |

Source: Kelleher et al 1998

When interpreting the IUCN categories, it should be kept in mind that these are not intended to represent a strict ranking tool for MPAs. For example, a Level-I protected area might feasibly be contained within a Level-VI MPA, possibly as a zoned section.

**The Range of Objectives**

The extensive range of objectives and the subsequent difficulty in categorising MPAs is something of concern to several authors.

Gubbay (1995) notes that the variety of objectives makes comparisons between MPAs difficult. Palumbi (1998) argues that this inability to make comparisons between MPAs is in turn problematic as it limits the opportunity to learn from experience.

Ballantine's (1999) concern is that by allowing so many objectives to be valid purposes of MPAs, the focus on conservation is diminished beyond recognition. He notes that in some of the Natural Marine Sanctuaries (NMSs) in the USA, for example, the only activity that is not allowed is oil drilling. Brailovskaya (1998) and Agardy (2000) are similarly concerned about the lack of strict protection in some MPAs, particularly in the USA, although neither author believes this to be a function of the range of MPA objectives.

A slightly different but not wholly unrelated concern to Ballantine's is that of Attwood (1997). Attwood is most concerned by the fact that despite the range of possible MPA objectives, the opportunism driving the creation of a good number of MPAs, combined with ineffective management, means that many have no obvious purpose whatsoever.

## 2.6 The Success of Marine Protected Areas

The case for MPAs being able to deliver an extensive range of ecological, economic and social benefits has been clearly articulated by many authors. However, it is obvious that MPAs will have little hope of meeting expectations if they are not effectively managed (Hockings and Phillips 1999). As Stolton and Dudley (1999) explain:

"(the) establishment of a protected area does not necessarily guarantee protection for the biodiversity, environmental and cultural features it contains."

What constitutes effective protected area management is in practice a nebulous subject. A straightforward and useful definition might be that given by Hockings (2001), who defines effective management on the basis of whether a protected area (either terrestrial or marine) is achieving its stated objectives.

A number of surveys have been done to assess the adequacy of MPA management. The most extensive and important of these was undertaken by Kelleher et al (1995). In this study of 1,306 MPAs, Kelleher et al found that of those for which data was available, 31% had a high level of management and generally achieved their management objectives, with a further 40% having a moderate level of management and partially achieving their management objectives. The remainder had a low level of management and generally failed to achieve their objectives.

A survey of tropical MPAs by Alder (1996) discovered that 41% had put in place management plans (although this figure fell to 23% when Australia was excluded). Without a management plan it can be assumed that the existence of effective management is unlikely.

In other studies, McClanahan (1999) believes that less than 10% of the MPAs in the Western Indian Ocean can be regarded as successful. Wells (1998) states that the WWF's Mediterranean programme estimates up to 70% of the Mediterranean's MPAs are protected in name alone. According to White (2001), only 10% of MPAs in the Philippines are achieving their objective of habitat conservation while Pet-Soede (2001) estimates that less than 20% of Indonesian MPAs are functional. Similarly Rogers and Beets (2001) argue that the considerable numbers of MPAs in the Caribbean should not be taken as a representation of the level of protection that marine resources in the area receive. Their particular concern is with the failure of two of the oldest MPAs in the world – the US Virgin Islands National Park and Buck Island Reef National Marine Sanctuary.

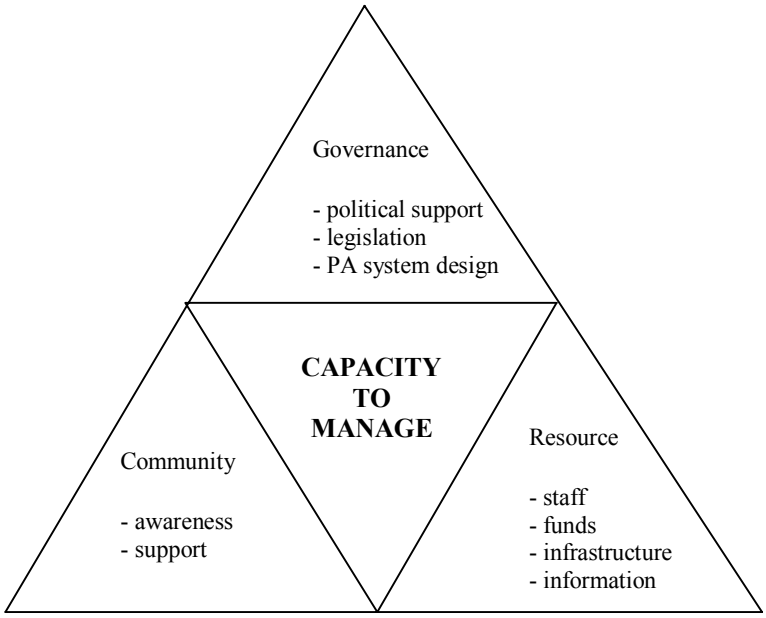
**What Determines MPA Success?**

The literature provides an extensive range of factors that are regarded as potential determinants of MPA success. They are a combination of theoretical predictions and empirical findings from surveys, with variables relevant to both terrestrial and marine areas. An aggregated list of these factors is given in Exhibit 2.7.A.

There is considerable overlap amongst the variables given by different authors. Although a number of surveys (e.g. Pollnac et al, 2001) indicate that certain factors are relevant to the success of a particular type of MPA in a particular area (in this case community MPAs in the Philippines) there seems to have been little research done as to the applicability of these factors to other types of MPA in other places.

Intuitively, it would appear that there are few if any factors that would be relevant exclusively to the success of a certain group of MPAs. Kelleher (2000) is of the opinion that the variables he gives (listed in Exhibit 2.7.A, marked *) are universally applicable to MPAs the world over. Similarly Hockings et al (2000) give a theoretical framework of the elements essential to the "capacity to manage" a protected area. The three key dimensions are governance, the community and resources. This framework (See Exhibit 2.6.A) applies to all protected areas, but seems to usefully encompass all of the variables in Exhibit 2.7.A.

**Exhibit 2.6.A: Dimensions of the "capacity to manage"**




Source: Hockings et al 2000

## Funding as an MPA Success Factor

It is an interesting point to note that although lack of funds is cited repeatedly as a cause of MPA failure by numerous authors (including for example: Alder et al 1994, Gladstone 2000, IUCN 2000, White et al 2002), adequacy of funding for start-up, recurrent, and / or capital costs are rarely given as the only success factor. Funding is seen as being just one variable among many — a necessary but not a sufficient condition for success. It is the issue of management costs – the combination of the recurrent and capital that is of concern here.

Notwithstanding the necessity of some kind of funding, there appear to be very few estimates published as to how much money is actually required for the implementation of an MPA management plan. In the first instance, very little information is available on what is currently spent. Wilkie et al (2001) suggest that this may in part be due to the fact that governments are often reluctant to disclose funding information in case it is used against them (i.e. it is shown to be insufficient) and that donors and NGOs consider such information proprietary. James et al (1999) also note that government expenditures on protected areas are generally not given in international financial statistics. What information exists tends to be unpublished "grey" literature on protected area spending, produced by foreign aid agencies and development banks, for example. This material generally has very limited availability and is not systematically catalogued.

The most comprehensive estimate of protected area funding requirements was produced by James et al (1999). This survey, relating to terrestrial protected areas only, found that the mean global protected area expenditure was USD 893 per km sq with an enormous range in the adequacy of MPA funding between the different regions, with developing country budgets being only 30% adequate at USD 157 per km sq.

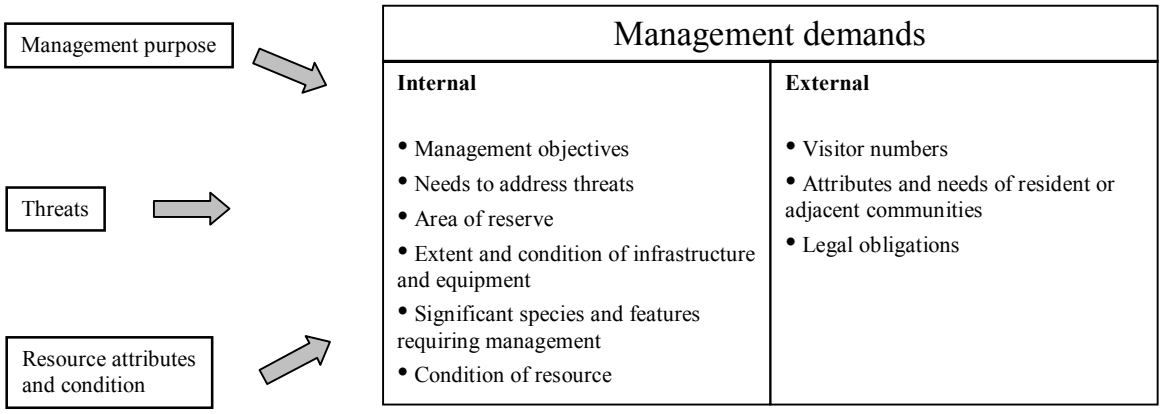
**The Factors Determining MPA Funding Requirements**

Broad estimates of protected area funding requirements, perhaps calculated on a per hectare basis, are interesting but are likely to be of only limited use to policy makers involved in allocating MPA budgets. As has been seen, there are over a thousand MPAs in countries across the world, which have between them a great range of objectives. It is highly unlikely that the level of income they require will be uniform.

Several authors suggest what they regard to be the key drivers of protected area income requirements. Combined, they represent an understanding of the biological, social and cultural environment i.e. context of the protected area (Hockings and Phillips 1999). This context essentially illuminates the background to the level and nature of inputs (including funds) required to successfully manage a protected area, be it marine or terrestrial.

Hockings et al (2000) provide a particularly comprehensive and interesting list of factors that might constitute this all important context for management demands (see Exhibit 2.6.B).

**Exhibit 2.6.B: Influences on management demands**




Source: Hockings et al 2000

The factors are divided between those based upon the internal features of the protected area (e.g. area size) and the external drivers (e.g. visitor numbers). It is obvious that almost anyone of these variables could in theory at least have a significant impact on what management inputs a protected area would need. It does not seem unreasonable for example, to suggest that a protected area of ten million hectares protecting several distinct ecosystems with several hundred thousand visitors per year and facing an extensive range of threats would have somewhat greater demands in terms of inputs than a tiny area protecting a solitary snail with no visitors and limited threats.

Having said that the income needs of a protected area will vary according to its context it is not to say that all variables will differ between all protected areas or that some variables will not be more significant in determining need than others. A

number of authors have attempted to establish what factors if any are the most significant in determining income requirements.

For example, the James et al (1999) study found that in the first instance, there was some variation between the requirements of countries with differing protected area sizes. The results demonstrated a higher per kilometre need of regions with smaller protected areas such as the Pacific, Caribbean and Baltic versus those with larger protected areas such as Africa and South America. In 2002 Balmford et al published a study aggregating a large range of estimates of funding requirements for a 139 protected areas taken from a variety of sources. The study found that the costs of effective conservation increase with the extent of local development and population density, the size of the protected area and a number of economic variables including per capita GNP. Both the James et al and the Balmford et al work referred to terrestrial areas only.

## 2.7 Conclusion

A growing body of evidence clearly demonstrates that the seas are being despoiled at an alarming rate on an almost global basis. No other resource has been so touched by what Hardin (1966) called the "tragedy of the commons" – a common resource, over-exploited by all parties in the face of no or little accountability. MPAs are an instrument of growing importance to marine conservation. Despite their widespread implementation over the last twenty years or so, there is general agreement that many of the areas are protected in name, but are ineffectual in practice. In some parts of the world, less than 10% of the MPAs are believed to be effective, at least in conservation terms. There appear to be many reasons for this lack of success, but central amongst them is the lack of resources. Various surveys have attempted to quantify what level of resources is required and what factors determine the amount. The intention behind the forthcoming analysis is to develop further this understanding of the nature of MPAs and in particular how this shapes their income requirements.

**Exhibit 2.7.A: Factors determining MPA success**

- protected area's economic potential (tourist potential and / or other)
- current uses of protected area
- proximity of MPA to urban areas
- past uses of protected area
- ability to resolve jurisdictional disputes
- assessment of local biological and socioeconomic conditions of an area prior to the establishment of an MPA
- zoning of human activities within an MPA
- the use of both sanctions and incentives to increase compliance with MPA restrictions
- availability of adequate financial resources
- availability of trained personnel
- community support
- NGO presence
- population size of local community
- perceived crisis in fish stocks prior to MPA establishment
- high levels of community decision making
- the contribution of advice from the organisation implementing the MPA
- inputs from local government
- supportive and committed leaders
- the ability to enforce user rights
- satisfactory legal and policy support
- ability to develop leadership capability
- participation by the community and other stakeholders (in e.g. decision making and enforcement)
- a clear understanding of project objectives
- the ability of the MPA to show tangible benefits and outcomes e.g. improved fishery yields
- a positive attitude towards rules and collective action
- availability of technical support
- political feasibility
- commitment to the protected area amongst all stakeholders
- design and site selection
- straightforward not over-complex legislative framework
- central co-ordination
- explicit objectives *
- regular monitoring programmes and assessment of management effectiveness *
- education programmes
- MPA manager integrity *
- financial sustainability *
- ensure consideration is given to both resource use and conservation i.e. sustainable use and environmental protection *
- design and management of MPAs must be both "top down and bottom up" *
- the MPA must be embedded within a integrated ecosystem management scheme such as an ICZM programme *
- the application of science to MPA management
- must be tailored to local conditions, attitudes and needs
- objectives and management should be adaptable to changing circumstances
- staff training
- political support
- communication with stakeholders
- involvement of local community in protected area management
- co-ordination between agencies implementing the protected area
- satisfactory legal framework
- existence of management plan
- existence of regional planning framework
- properly defined protected area boundaries
- perpetual commitment of resources
- MPA design reflects ecological reality
- independent, non-partisan management derived from multi-user groups
- participation of the community in the development of the MPA *

Source: Taken from work by the following authors: Agardy 1997; Alder 1994; Allison 1998; Attwood 1997; Geoghegan 2001; Gladstone 2000; * Kelleher 1999, 2000 (MPA News 2/7 - 2001); Machlis and Tichnell 1985 in Gubbay 1995; Mascia 1999; Pollnac 2001; Stolton and Dudley 1999; Wells 1998; White et al 2002

# CHAPTER 3: METHODOLOGY

## 3.1 Introduction

The study of the literature illustrates *inter alia*, two key points. The first is that MPAs have developed in a variety of ways and with a variety of objectives. The second is that protected areas' general funding requirements differ greatly, determined by a wide range of factors.

In order to shed light on both of these themes a questionnaire was developed for distribution to MPAs around the world. It aimed at establishing a broad operational and financial profile of the MPAs surveyed, with the ultimate objective of bringing the two together to produce a better understanding of the specific funding requirements.

The specific objectives of the questionnaire were to discover:

(i) how much annual income each MPA receives and from what sources

(ii) how much each MPA spends each year and on what

(iii) the minimal and ideal level of income that would be necessary to manage the MPA effectively

(iv) the factors influencing spending patterns

(v) the factors affecting existing and future funding requirements

In this chapter, the methodology relating to this questionnaire will be detailed, covering to whom it was distributed and how, its design and how the data was prepared to allow for a comparative analysis across the responses.

## 3.2 The Sample Frame

The survey was designed to target the managers of the worldwide MPA universe, with as broad a distribution of mailings as possible. The aim was to obtain a sizeable sample covering all types of MPAs in all parts of the world, capturing the full range of potential environmental, social and economic objectives from small, protection-oriented units to large recreational areas.

A decision was taken to approach directly the managers or other persons responsible for the protected areas and not to approach any managing agencies. It was felt that the response of managing agencies might be more "political" than that of the 'hands-on' MPA managers. For example, a protected area agency might be less likely to report that the MPA in question is under-funded, as the respondent could in theory be personally involved in allocating MPA funding.

There were a number of difficulties in adopting this approach. Firstly, for some countries, or for certain groups of MPAs within a given country, the MPA manager was not in possession of the financial information requested. Instead financial resources were allocated on a top down basis across a number of protected areas and detailed financial budgets were not given to the potential respondents. Secondly,

having the questionnaire completed by the MPA manager or other responsible individual placed quite considerable restrictions on the questionnaire's distribution. Although addresses of managing agencies of MPAs are readily available, the contact details of the MPAs themselves and particularly of the managers are harder to identify. The extent of this difficulty varies from country to country. For some, mostly affluent countries where the marine protected areas have large public usage the contact details are generally available, often posted on the internet. For other countries, particularly where there are more non-government funded MPAs, contact details are very difficult to obtain. This is especially the case for local community-funded MPAs where in many cases it is not even widely known that an MPA exists.

The distribution of the questionnaire was also limited by language. The questionnaire was written to be completed by an individual with at least a moderate command of English. Fortunately, this did not appear to be a deterrent to MPA managers in a good number of countries where English is not the first language.

## 3.3 Logistics

Approximately 500 questionnaires were distributed either by email or by post in several tranches between November 2001 and May 2002. If no reply was received within a two to three week period following the distribution a reminder was sent.

There was a strong preference to communicate with the potential respondent individually and by email as it was felt that the response rate would be greater due to ease of response and personal contact.

Contact details for the MPAs were obtained from a very wide range of sources, but primarily through personal contacts and the internet. The Kelleher et al (1995) "Global Representative System of Marine Protected Areas" provided the primary list of MPAs for which to find details. The language barrier was of course not just a deterrent to the completion of the questionnaire but also to obtaining the MPA contact details. Because of this there were considerable gaps particularly in the contact lists for the MPAs of the Arabian Seas and the Northwest Pacific.

## 3.4 Questionnaire Design

A copy of the questionnaire is reproduced in Appendix 2. Although the questionnaire is long and asks for quite a complex amount of financial information, it was felt that it was not possible to establish a comprehensive financial profile of an MPA with greater brevity, the profiles being inherently complex. The questions were grouped into five categories:

(i) **Respondent Details**. This group of questions was aimed at establishing a comprehensive set of details on the individual replying to the questionnaire. In many cases the questionnaire was completed by someone other than the individual to whom it was sent.

(ii) **Marine Protected Area Details.** The intention behind this section was to obtain a profile of all aspects of an MPA to relate to the subsequent financial information in an attempt to understand some of the key variables in

determining current and desired income levels and spending. Kelleher et al's (1995) list of criteria for MPA selection provided the basis of MPA purposes given in the questionnaire which the respondents to the questionnaire were asked to rank. The intention was to establish the relative importance of all of the MPAs' different purposes.

(iii) **Income.** This section sought information on the total level of funds the MPA receives and the nature of the funding source(s).

(iv) **Spending patterns.** This section sought information on how the MPA spent its income, on the basis of "type" and "activity". Spending "type" refers to how the MPAs' spending patterns may be categorised in terms of their function, such as wages and salaries, operational costs and capital investment. "Activities" are defined as the various pursuits in which the MPAs engage. Several suggestions of possible activities were presented (protection, research, visitor facilities), but the intention was to allow the respondent to categorise the spending by activity at their discretion, without forcing responses into inappropriate categories.

The respondent was asked for details on activities in either currency or percentage terms to make it slightly easier to complete the questionnaire.

A question on the five year spending history of the MPA was added as it was felt that the current year's spend would not fully capture the "lumpy", "one-off" nature of capital investment.

The final question asked the respondent to clarify any difference between funds in and monies spent, possibly as a result of overspending, borrowing costs or an inability to spend the full amount of income received.

(v) **Future Funding Requirements.** This question aimed at establishing whether current funding levels were sufficient to fulfil the MPAs' objectives (based on the subjective opinion of the respondent), and if not, what level of income would be desirable.

The question was divided into minimum and ideal income requirements in order to gain a more detailed understanding of the MPAs' financial needs. If a general question had been asked on income requirements there might have been a tendency to respond purely in terms of ideal income which would have disguised many of the subtleties between what is needed for an MPA to exist and for it to thrive.

The last part of the question asked the respondent to detail in the same way as for current spending, what activities an increase in income would be spent on.

The sections on income and spending were broadly based upon those in the "Questionnaire on Investments in Protected Areas 1995" (James et al 1999) but in this case the questionnaire was targeted directly at the managers of the protected area and not the overall managing agency.

## 3.5 Data Normalisation

Details of the MPAs' finances were provided by the respondents in a range of currencies and for a range of financial years. In order to analyse this financial information it was necessary to "standardise" it into data that could be compared across all replies. This essentially involved conversion into a common currency (US dollars) and calenderisation towards a fiscal year ending in December 2001.

It should be noted that cross-border financial comparisons are typically complicated by differences in price levels for equivalent goods and services across different countries. For this reason, it is usual to compare economic data on the basis of purchasing power parity (PPP) exchange rates, which might differ from actual exchange rates because of variations in local price levels. The OECD (2002) describes the PPP rate as "the number of units of a national currency required to purchase the same amount of goods and services as a numeraire currency unit (e.g. one USD) would buy in the numeraire country."

Unfortunately, PPP rates are readily available only for OECD countries and many countries involved in the survey are non-OECD. For these countries, a PPP factor was calculated indirectly from World Bank data. This approach relied on the relative values of PPP GDP (2000) and equivalent USD GDP (2000), as published by the World Bank. More up-to-date figures (for 2001) were not available at the time of the data analysis.

The overall procedure followed for non-OECD countries can be summarised as follows:

(i) **Adjustment to December 2001.** The data were first adjusted to a December 2001 year end, using an inflation assumption. The inflation data came from a variety of sources. For some smaller countries, where 2001 inflation rates were not yet available, an inflation rate was estimated based on the prior year value.

(ii) **Translation into US dollars**. The rates used were the twelve-month average spot rates for 2001.

(iii) **Adjustments for PPP differences.** A PPP adjustment factor was then applied, derived from World Bank data as described above.

For the OECD countries, US Dollar based 2001 PPP rates were already available from their member organisation. Instead of first translating the raw data into USD for these countries therefore, the data was simply converted using the available 2001 PPP rates.

Appendix 3 gives details of the USD exchange rates, PPP rates and factors inflation rates and their origin used for each country. The conversion technique expressed mathematically is as shown below.

| | | |
|---|---|---|
| Non-OECD countries: | T = | translated data |
| | R = | raw data |
| T = R x (1 + I x D)/ (C x F) | F = | PPP factor |
| | C = | USD translation rate (average spot) |
| | I = | 2001 inflation rate |
| OECD Countries: | D = | 2001 calendarisation factor |
| T = R x (1 + I x D) / O | O = | OECD PPP rate |

## 3.6 Conclusion

In summary, the goals of developing an understanding of MPA funding were achieved through the distribution of a questionnaire soliciting information from as many as MPAs as was possible from around the world. Prior to analysing the data, it was necessary to normalise it – taking into account the varying currencies, dates and differentials in purchasing power. The remainder of this study presents the findings and explores the patterns in the data.

# CHAPTER 4: RESULTS AND DISCUSSION

## 4.1 Overview of the results

The large response to the survey and the length of the questionnaire combined to produce a great deal of very interesting data on the profile of MPAs. This section of the report covers the description, analysis and discussion of the findings.

Exhibit 4.1.A gives a summary of the bivariate findings. As is immediately apparent, the sample produced a great breadth of results: the MPAs come in a great range of shapes and sizes with a variety of objectives and requirements.

**Exhibit 4.1.A: Summary of findings**

**MPA DETAILS**

- the survey produced responses from 79 MPAs in 35 countries. 42 were from the North and 37 were from the South
- the habitats protected by the MPAs are quite wide ranging. Coral predominates, followed by sea grass. Only five MPAs protect the ocean / pelagic realm
- all but five of the MPAs are legally protected
- the range in size of the MPA was enormous from 10 ha to 13 million ha. The average was 248,500 ha and the median was 4,150 ha
- about half the MPAs demarcate their protected area into zones
- visitor numbers ranged from 0 (for 18 MPAs) to 6 million people per annum. The overall average was 300,000 (median 10,000)
- the range of permanent staff employed was 0 to 64 with an average of 13 (median 7). The average number of field staff was 10 (median 4) and the average number of administrative staff was 5 (median 2)
- habitat protection is the most important purpose of the protected area, followed by species protection. Research and monitoring, archaeological protection and recreation also featured widely
- half the MPAs were designed to benefit adjacent fisheries – most of these were found in the Indo-Pacific region

**INCOME**

- 23% of the MPAs claimed to be "paper parks" i.e. had no funds at all
- total income ranged from USD 0 to USD 5,500,000 with an average of USD 570,000 and a median of USD 121,000
- the average income received per hectare is USD 1,429 and the average income per visitor is USD 270
- the biggest source of funds overall is the Government followed by Visitors and then Foreign sources of funding

**SPENDING**

- wages form the largest component of spending, followed by other operational spend
- overall research and monitoring and enforcement are the top spending priorities

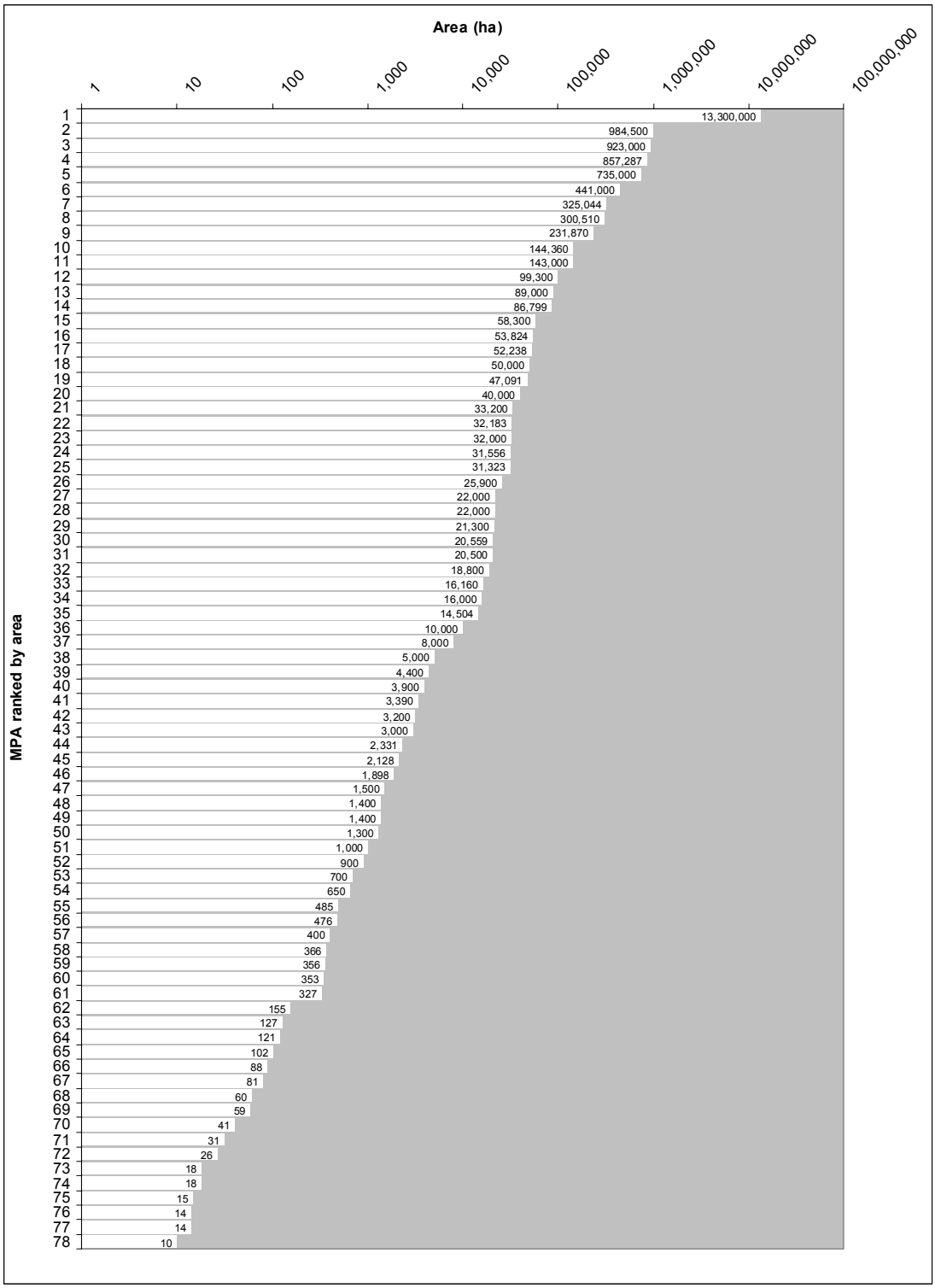
**FUTURE FUNDING REQUIREMENTS**

- about half of the respondents replying to the question (48 responded in total) indicated that they had a sufficient income to manage their MPA effectively
- the MPAs wanted on average a 105% minimum increase in their income and a 174% ideal increase in income. This would give an average minimum income of USD 967,085 and an average ideal income of USD 1,130,159.
- The analysis suggested that 45% of MPA minimum funding requirements can be explained by a combination of area and visitor numbers
- as with current spending, research and monitoring is top of the "wish list" of activities on which to spend the ideal increment, with enforcement not far behind

Source: MPA survey

**Exhibit 4.1.B: MPA ranking by area**

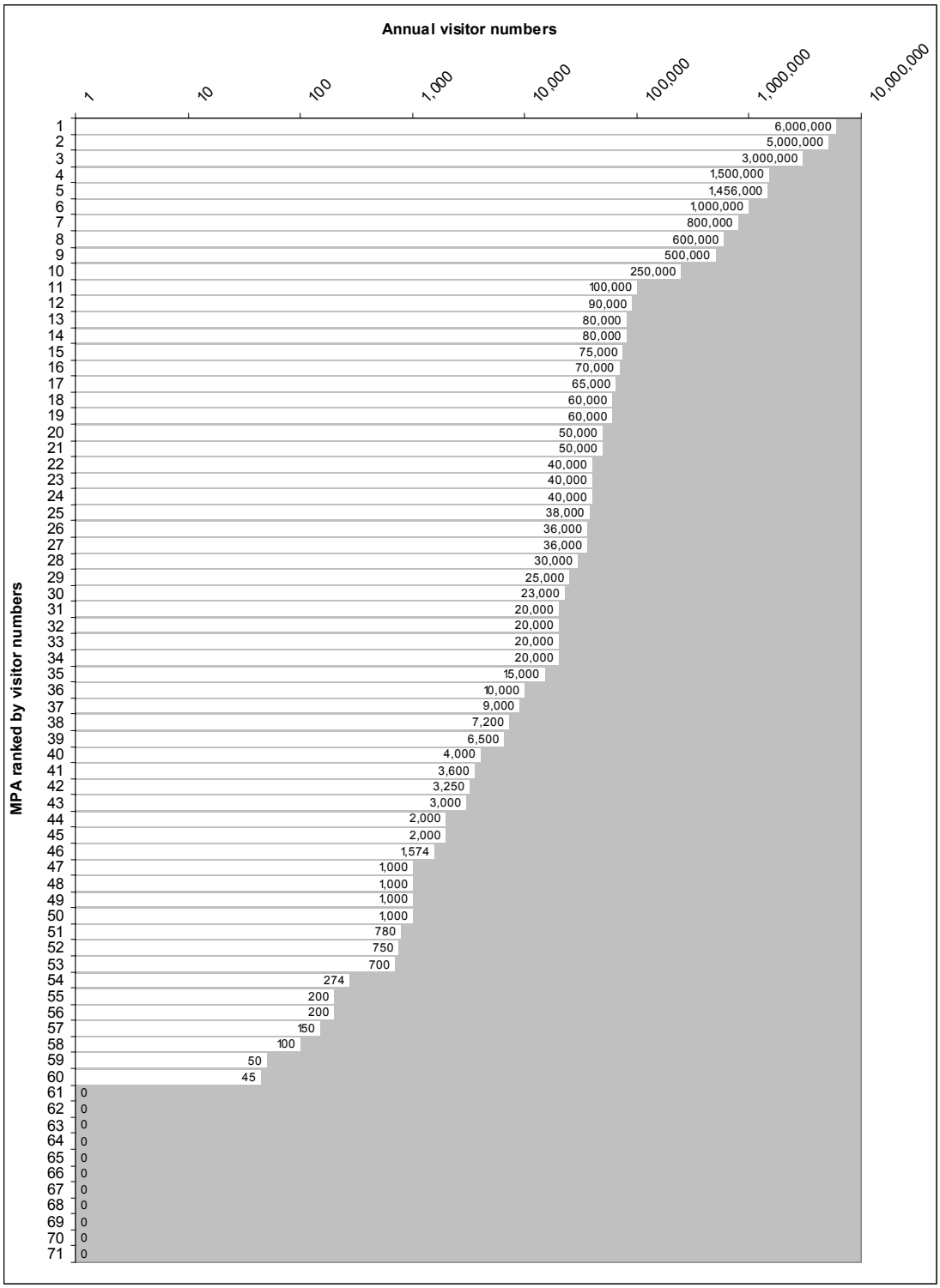
*(MPA area in hectares; log scale)*




Source: MPA survey

**Exhibit 4.1.C: MPA ranking by visitor numbers**

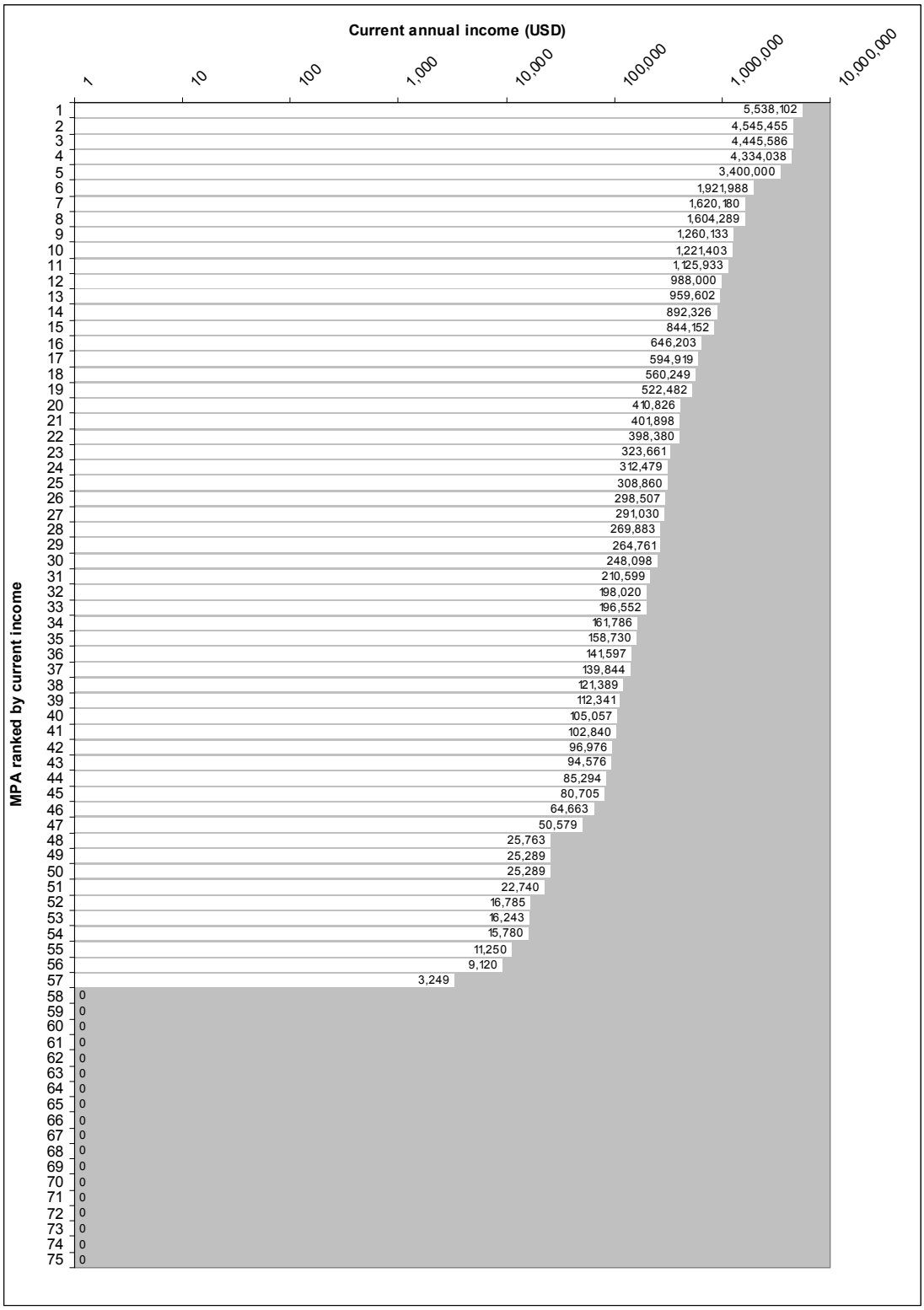
*(number of visitors per year; log scale)*




Source: MPA survey

**Exhibit 4.1.D: MPA ranking by current annual income**

*(2001 USD; log scale)*




Source: MPA survey

**MPA Income, Size and Visitor Numbers**

Possibly the most striking feature of the results was the extraordinary scale found in the MPAs in terms of three key defining features – size, visitor numbers and annual income. For all three factors the sample shows a range of responses covering many orders of magnitude — from the very small, indeed tiny, to the very large. For example, the smallest MPA measured just 10 ha while the largest reached 13 million ha.

This distribution is illustrated in Exhibit 4.1.B, Exhibit 4.1.C and Exhibit 4.1.D. It is interesting to note that the results are not bunched around any particular "average" figure. On a logarithmic basis, they are relatively evenly distributed across each log cycle.

This very wide range has implications for the analysis of the data and raises particular challenges when it comes to building a model for determining funding requirements. Although useful correlations can be established by examining data on a log basis, a bottom-up model would normally be constructed using unlogged data. Unfortunately, when linear regressions are attempted on data which are distributed across multiple log cycles, excessive weight tends to be given to the larger data points, often creating falsely high apparent correlations. For this reason, great care was taken when interpreting the results of linear regression analysis, with a particular focus on the quality of fit around the smaller values.

**Issue of non-linearity**

While linear regressions were used as a basic tool to uncover patterns of inter-relationships, there were many cases where there was no theoretical reason for the relationship to be linear. This applied particularly to relationships that might reflect potential economies of scale, such as income requirements in relation to MPA size. In these cases, theoretical models were developed and expressed in a mathematical format conducive to testing by linear regression analysis.

**Trends and Patterns within the Data**

It will come as no surprise that the results demonstrate considerable variety across the protected areas. However, analysis of the data reveals some clear patterns and these can be used to characterise the MPAs surveyed into a small number of distinct groups.

The central finding of the analysis was that the MPAs responding can be categorised or profiled into a number of "clusters" that are defined by a range of characteristics from their visitor numbers and purpose to their income and spending patterns.

In summary, the survey found that three main groupings of MPAs exist. The first group comprises MPAs principally focused on fisheries and regulatory enforcement; these are typically in poorer southern countries and have lower visitor numbers. The second, largest group consists of MPAs with a very wide range of purposes, from the recreational to the commercial – including the benefit to fisheries. This cluster seems to resemble most closely the multiple-use MPAs described in Section 2.4. The final group is the smallest and is the hardest to define. As for the other groups, these MPAs engage in a range of purposes, but to a lesser extent– most notably with respect to fishing. Given the relatively low visitor numbers and significant occurrence of no-take

areas, it is tentatively suggested that this group has more of a dedicated conservation bias than the two other clusters.

The differences between these three clusters are apparent even where characteristics such as size and habitat type might be similar.

## 4.2 Approach to the Analysis

The data was analysed on both a bivariate and a multivariate basis. The intention was to look for patterns and trends within the data which would help illustrate and define the characteristics of the MPAs being surveyed. A range of tests were undertaken which looked for any statistically significant relationships between a number of individual variables and all aspects and features of the MPAs.

**The variables used**

The selection of variables used for the analysis reflected both the literature and a broader sense of what factors might be influential. In essence, variables have been put forward for testing where there seems to be a reasonable chance that they might have some bearing on the financial profile of MPAs, and specifically the funding requirements. The variables selected were as follows:

(i) **Size** (area in hectares)

(ii) **Purpose**

(iii) **Habitats or species protected**

(iv) **Annual visitor numbers**

(v) **Geographical location**

(vi) **GNI per capita** (of the host country)

(vii) **Zonation** (extent to which all or part of the MPA is protected from fishing)

(viii) **Source of funds**

MPA Size, Purpose, Habitat protected and Visitor numbers have been taken from the existing literature on protected area management. As was discussed in Section 2.5 of the Literature Review, Hockings et al (2000) categorise these factors as being central to defining protected area resource requirements. Whether the MPA has as an objective the intention to benefit fisheries outside of the reserve has been included as a key MPA Purpose.

Geographical location and GNI per capita are standard biogeographical and economic considerations. In addition, these factors have been shown in a number of existing surveys (e.g. James et al 1999) to have an important bearing on current if not ideal income requirements. The MPAs have been grouped on two different geopolitical levels on the basis of their location. The first grouping consists of five categories: the USA, Europe, the Caribbean and Bermuda (excluding the USA), the Indo-Pacific

(excluding the USA) and Australia / New Zealand. These five categories or "areas" were then in turn grouped along a North / South divide, with the North comprising of responses from the USA, Europe and Australia / New Zealand and the South replies from the Caribbean and Bermuda (excluding the USA) and the Indo-Pacific (excluding the USA). The use of the terms North and South are a shorthand abbreviation for developed and developing countries.

Zonation and Source of Funds are potentially influential factors which may determine income requirements but have received scant attention in the literature. In this analysis MPA Zonation is categorised into two groups: protected areas that protect more than 5% of their area from fishing and those that have "no-take" areas of less than 5%. Source of Funds refers to the primary contributor of a protected area's funds. For the purposes of analysis the sources of MPA income have been classified into three groups: Government, Foreign and Visitor Fees. Government funded could refer to either national, state or local funding while Foreign funded is income received from another country or countries — possibly an international NGO, charitable foundation or foreign government. Visitor Fees refers to revenues raised and retained by the MPAs from visitors. Other sources have not been included as a category as they are not a primary source of funds for any of the MPAs surveyed. The MPAs are grouped into these three categories on the basis of which source provides the greatest proportion of their income.

All of the variables are factors present within the data itself, with the exception of GNI per capita which is taken from World Bank (2000) data.

**Analytical Methodology**

The data was first explored using a bivariate analysis whereby each separate element of the responses was tested against the variables detailed above. A wide range of tests were used depending upon the nature of the input i.e. whether it was categorical / nominal or interval / ratio etc. To maximise the quality of the statistical output, parametric tests have been used where possible, which in a number of cases involved a re-categorisation of the data. In all tests, a relationship or "difference" has been recognised if the test concerned rejects the null hypothesis at the level of significance of 5% or lower i.e. $p = / < 0.05$. The tests used to analyse the data are given in Appendix 4.

Having analysed the data on a bivariate basis, the next stage was to take a "top-down" approach using multivariate techniques to see if the findings could be aggregated into distinct patterns or groupings. An important tool in this context was cluster analysis. The specific details of the methodology used for the cluster analysis are given in Appendix 5. However, a couple of points are worth noting here.

The aim of the clustering was of course to aggregate the data using the independent variables detailed. Because there is not a complete data set for each response (because not all respondents completed all parts of the questionnaire) the total sample clustered was reduced to 53 surveys. In order to get a sample even of this size it was necessary to drop the variable of Zonation as the response to this question was particularly weak when used in the cluster group. GNI per capita was also deleted as this variable tended to make the clustering "too heavy" in terms of the geographical location of the

MPAs. Both of the variables were re-introduced when presenting the data in Appendix 6.

## 4.3 Results of the Bivariate Analysis

### Spread of responses

The survey produced responses relating to 79 MPAs from 36 countries. These replies were distributed across 14 of the 18 CNPPA (Commission for National Parks and Protected Areas - IUCN) designated marine systems. 42 of the responses were from the North and 37 were from the South.

**Exhibit 4.3.A: Breakdown of Responses by Geographic Area**

*(Number of responding MPAs for each region)*

| USA | Europe | Caribbean | Indo-Pacific | Australia / New Zealand | TOTAL |
|---|---|---|---|---|---|
| 23 | 14 | 10 | 27 | 5 | 79 |

Source: MPA survey

Although the overall sample is meaningfully large — it equates to 6% of Kelleher et al's (1995) global total of 1,306 MPAs — there are a couple of points to note about its profile. In the first instance, all the replies represent MPAs which are actively managed, as an inevitable consequence of the sampling method. There are apparently a number of "paper parks" in the sample — parks which have been defined in theory but remain unimplemented in practice (Stolton and Dudley 1999) — but these have at least one individual responsible for them, to the extent that they are in possession of a range of key facts about the protected area. Since the responses are self-selecting for active management they might represent the "crème de la crème" of global marine protected areas.

In the second instance, although the survey has a broad geographical and political range, there are some regions that are notably under and over-represented. The Arabian Seas and the North West Pacific are completely absent. Responses from the Atlantic were thin on the ground while the entire Australia / New Zealand area sample consists of only five replies. These omissions are largely a function of two factors, already discussed in Chapter 3 on Methodology. The language limitations of the authors prevented address gathering for some locations, while in the case of certain countries, specific financial information about individual MPAs was not available as the protected areas were managed centrally.

Looking at the over-representation of particular countries and regions, there is only one area which provided a particularly generous response — Hawaii. In many cases, the Hawaiian MPAs have shown certain unique trends and characteristics. Where this is the case and it has had a significant impact on the findings, the "Hawaiian" affect has been separated out.

In terms of MPA "type", there are a number of notable omissions. Only two replies from community-based MPAs were received — both from the South Pacific. The reasons for this appear to be two-fold. Firstly, as was also covered in Chapter 3 on Methodology, there was some difficulty in obtaining contact details for community-

based MPAs. Secondly, many community-based MPAs might not have budgetary information in the form requested by the survey. It is likely that many do not have either individually allocated income streams or identifiable spending patterns. The other major absences were from "open-ocean" and voluntary MPAs. In both of these cases, the primary difficulty was in obtaining contact details.

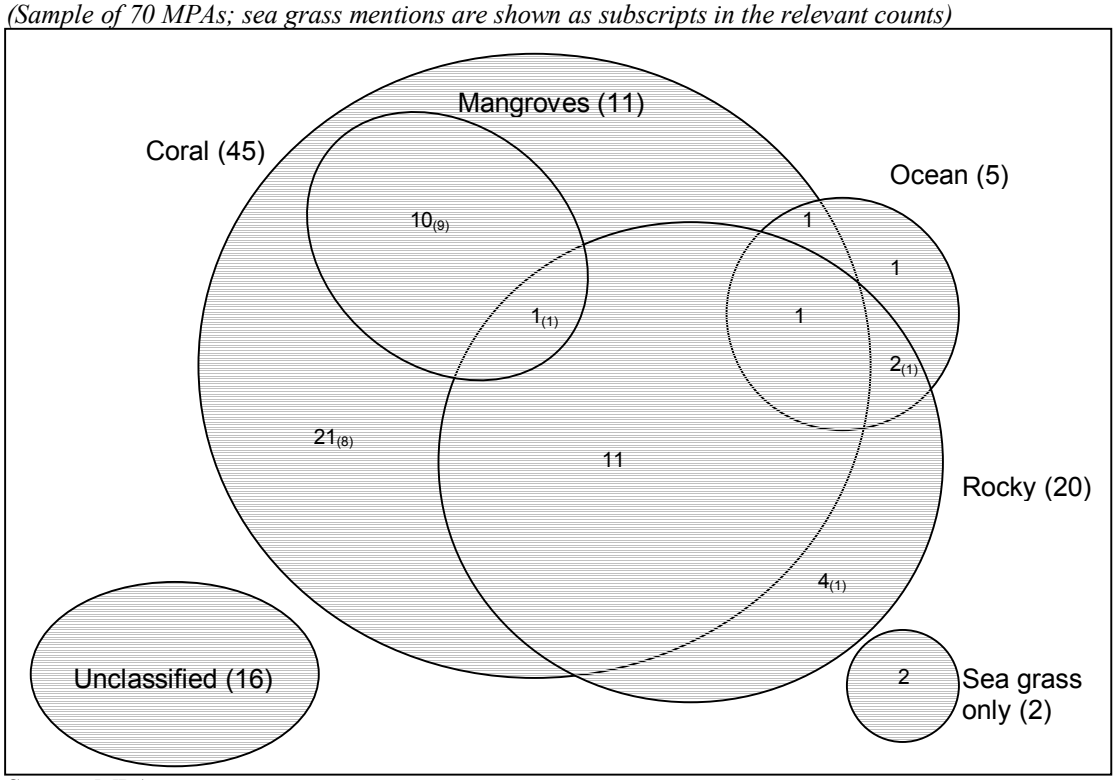
Appendix 7 lists the responses, including country, CNPPA marine system, geographic region and area.

### Main habitats / key species protected

The habitats protected by the sample of MPAs are wide ranging. Coral (reef, atolls etc) predominates, mentioned by just over half the respondents, followed by sea grass mentioned by about 30% of respondents. As Exhibit 4.3.B shows a good number of MPAs protect both coral and sea grass. Rocky substrates are protected by 25% of the MPAs. Only 5 respondents referred to the open ocean / pelagic realm.

**Exhibit 4.3.B: Distribution of habitats protected**

*(Sample of 70 MPAs; sea grass mentions are shown as subscripts in the relevant counts)*




Source: MPA survey

Key species were mentioned by just over half of all respondents. These appeared to be a combination of species specifically protected by the MPAs and important species "incidentally" protected. The species cited were very varied, with a third mentioning fish (7 of which were particular species, including 2 species of grouper). A quarter of the MPAs protect birds and/or mammals. Sixteen MPAs protect turtles while 8 specifically protect dugongs.

Most MPAs protecting sea grass, mangroves and fish are in the Indo-Pacific while most MPAs protecting rocky areas are in the USA. Of the 20 MPAs protecting rocky

areas, it might be noted that 11 are in Hawaii. The MPAs protecting coral habitats are evenly distributed between the USA and the Southern zones.

**Legal Protection**

All but five of the MPAs are legally protected. The legal designations include Marine Life Conservation District, Commonwealth Reserve, National Seashore, Federal National Marine Sanctuary, National Park, Biosphere Reserve, National Monument and Ramsar site. Five of the legally protected MPAs are protected by fisheries laws. Of the five MPAs which are not legally protected, two are traditional community-declared MPAs in the South Pacific.

**Total Area Protected**

The MPAs showed an enormous variation in size, ranging from 10 hectares to over 13 million hectares. On a log basis, the protected areas are broadly distributed in terms of size. The mean size is 248,461 ha and the median is 4,150 ha. Evidently, as a result of the logarithmic scaling relationships in the distribution, these statistics carry little significance.

There is no statistical relationship between park size and geographical location. Australia and New Zealand have the largest median park size, although it might be noted that the sample size is very small. The USA has a number of parks concentrated at both ends of the spectrum. Most of the smaller parks in the USA are in Hawaii. MPAs protecting coral tend to be amongst the smallest and largest protected areas. Those protecting pelagic areas are the largest overall.

Exhibit 4.1.B shows the MPA size by geographic zone using a logarithmic scale. Exhibit 4.3.C shows a geographic breakdown of MPAs by size category.

**Exhibit 4.3.C: Geographic breakdown of MPAs by size range**

*(Number of MPAs falling into each size range, defined in hectares)*

| | 1-99 | 100-500 | 501-5,000 | 5,001-35,000 | 35,001-100,000 | > 100,000 | TOTAL |
|---|---|---|---|---|---|---|---|
| USA | 10 | 3 | - | 5 | 2 | 4 | 24 |
| Europe | - | 1 | 8 | 2 | 2 | 1 | 14 |
| Caribbean | - | 2 | 2 | 1 | 2 | 2 | 9 |
| Indo-Pacific | 3 | 5 | 7 | 7 | 2 | 2 | 26 |
| Australia /NZ | - | - | - | 2 | 1 | 2 | 5 |
| TOTAL | 13 | 11 | 17 | 17 | 9 | 11 | 78 |

Source: MPA survey

## Zonation

Just over half of the 65 MPAs that responded to this question either demarcate or are planning to demarcate their protected area into zones of some kind. There was considerable variation in the purposes of the zones. A selection of the different zones included: no-take, multi-purpose, vessel restriction, anchorage, swimming, snorkeling, diving, fishing, single-species protection, tourism, sustainable harvest, seasonally protected, traditional or controlled fishing methods, recreational, ecological and buffer.

About a third of the MPAs have zoned harvest refugia of 5% of their area or more. As can be seen in Exhibit 4.3.D, most of these MPAs are in either the USA or the Indo-Pacific. It should be noted, however, that eight out of the ten US MPAs with no-take zones of more than 5% are in Hawaii meaning that zonation is mostly an Indo-Pacific phenomenon.

**Exhibit 4.3.D: Zonation patterns**

| | USA | Europe | Caribbean | Indo-Pacific | Australia/NZ | Total |
|---|---|---|---|---|---|---|
| Zonation <5% | 14 | 10 | 5 | 6 | 4 | 39 |
| >5% | 10 | 3 | 3 | 9 | 1 | 26 |
| TOTAL | 24 | 13 | 8 | 15 | 5 | 65 |

Source: MPA survey

The findings on MPA zonation confirm at least in part the understanding of the functional, pragmatic role of MPAs in developing nations as put forward in the literature. It is highly likely that the harvest refugia in the Indo-Pacific have been implemented with a view to benefiting fisheries and subsequently the local communities.

This supposition is supported to a certain degree by looking at the relationship between larger no-take zones and whether an objective of the MPA is to benefit fisheries outside of the protected area. Exhibit 4.3.E shows that 60% of the MPAs with no-take zones of more than 5% are intended to benefit external fisheries. Of these eleven, nine are in the South, one is in Europe and one is in the USA.

**Exhibit 4.3.E: Benefit to fisheries in relation to patterns of no-take areas**

| | | No-take area < 5 % | No-take area > 5 % | Total |
|---|---|---|---|---|
| MPA provides a benefit to fisheries | YES | 27 | 15 | 42 |
| | NO | 12 | 11 | 23 |
| Total | | 39 | 26 | 65 |

Source: MPA survey

The impetus behind the extensive creation of no-take zones in Hawaii is not clear as only one of the Hawaiian MPAs with refugia of more than 5% are intended to support fisheries.

It is really only the very large MPAs that tend not to cater for extensive no-take zones: no-take zones are present in areas ranging from the very small up to 35,000 ha (Exhibit 4.3.F).

**Exhibit 4.3.F: MPA size in relation to patterns of zonation**

*(size categories in hectares)*

| | | Size Category | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 1-99 | 100-500 | 501-5000 | 5001-35000 | 35001-100000 | >100101 | Total |
| Zonation | < 5% | 4 | 4 | 8 | 10 | 6 | 7 | 39 |
| | > 5% | 7 | 5 | 4 | 6 | 2 | 2 | 26 |
| TOTAL | | 11 | 9 | 12 | 16 | 8 | 9 | 65 |

Source: MPA survey

As a final point, it is also interesting that with only a couple of exceptions, all of the larger no-take zones are found in coral habitats. This may not be simply a function of the geographical location of the MPA but also the fact that harvest refugia were originally developed in coral areas (Callum Roberts, personal communication) and the trend has not yet spread to other habitat types.

## Visitor Numbers

Data on visitor number were available for 71 protected areas. As with MPA size, visitor numbers demonstrated a considerable range, from zero to six million persons per annum. A total of eleven MPAs indicated that they had no visitors, although it is not entirely clear in all cases as to whether in practice there was nil data as opposed to zero counts.

The overall average annual number of visitors was 300,000 and the median was 10,000. On a log basis, overall visitor numbers seem broadly evenly distributed.

Visitor numbers show a clear regional trend. The average annual number of visitors in the North is over 500,000, but only 31,000 in the South. The median numbers are 25,000 and 3,250 respectively. On a visitors per hectare basis the relationship remains. Similarly, there is a reasonable correlation between GNI per capita and visitor numbers ($r=0.404$ $p<0.001$). This correlation is similar for visitors per hectare ($r=0.397$ $p<0.001$).

Looking at the different geographic zones, the USA has the highest average number of visitors followed by Europe, Australia / New Zealand, the Indo-Pacific and then the Caribbean.

These data on visitor numbers appears to demonstrate the greater focus on recreation of MPAs in the richer nations. The higher levels of visitors in the North may reflect the fact that the MPAs in the region were originally established for recreational purposes and therefore are designed to cater for and attract visitors. In addition, there is undoubtedly a greater recreational desire to access the water in the North, be it to sail, swim, fish or dive. This may be a function not only of wealth – the money and time to afford leisure pursuits, but also of cultural preference.

A broad-brush analysis of the regional averages, disguises some important subtleties however. Examining the data in a little more detail it appears that although the North has a far higher average number of visitors in all cases, Europe has a very low median level of visitors – far lower than the median level for the Caribbean. Not only does Europe have high visitor levels for a large proportion of the sample, but it also has a significant number of MPAs with very few visitors (half of the European sample have less than a thousand visitors a year). Although these (mainly) Scandinavian MPAs all claim to have a wide variety of purposes, they seem to most closely fit the description of the small, conservation area that many of the commentators have defined. Excluding these nil visitor MPAs, the European median visitor level rises significantly, to nearer the American level.

Unlike Europe and the USA, the Caribbean has no "mega-parks" – protected areas receiving more than a million visitors per annum. Most of its MPAs do receive a substantial number of visitors a year – at least ten thousand. It is unlikely that the Caribbean MPAs are attracting a local visitor base – it is more probably foreign tourists. Given that more of the Caribbean MPAs have visitors as their primary source of funds than any other area, it does not seem unreasonable to suggest that perhaps they are purposefully attracting visitors to ensure some sort of financial independence – a leisure based pragmatism borne out of the proximity to a great source of potential revenue i.e. the North American tourist market.

The Indo-Pacific stands out quite clearly as having the lowest visitor numbers on any measurement. The raison d'etre of the Indo-Pacific MPAs is bourne out not by their visitor numbers but by amongst other things, their purposes, as the section on the benefits to fisheries indicates.

Looking at visitor numbers with respect to habitats protected, MPAs protecting mangroves receive by far the lowest number of visitors, probably for obvious reasons although they are nearly all in the Indo-Pacific where visitor levels are already low.

There is no relationship between MPA size and visitor numbers or between zonation and visitor numbers.

As a final point, MPAs which include Commercial activities as a purpose of their MPA have high levels of visitors, regardless of where they are located. Half of all of the MPAs with Commercial activities as a purpose, relate them to visitor / tourist activities.

Exhibit 4.3.G gives a range of statistics relating to visitors on the basis of the geographic areas. Exhibit 4.3.H shows the log of MPA visitor numbers in relation to per capita GNI.

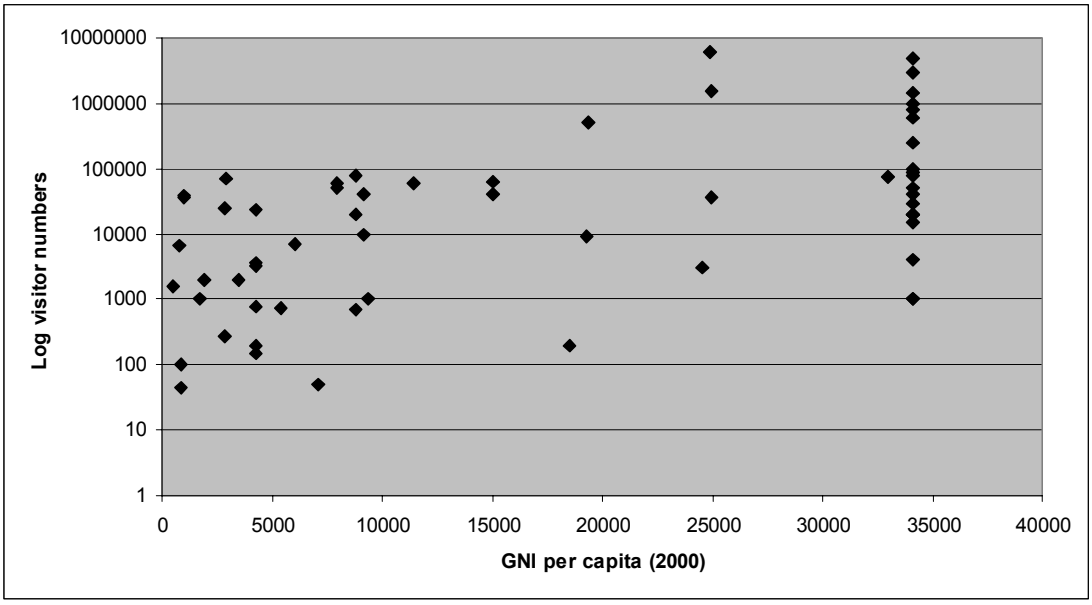
**Exhibit 4.3.G: Geographical breakdown of visitor numbers**

| | USA | Europe | Caribbean | Indo-Pacific | Australia / N.Zealand | AVERAGE |
|---|---|---|---|---|---|---|
| MEAN | 571,682 | 556,636 | 30,665 | 33,563 | 384,050 | 312,880 |
| Std.Error | 259,133 | 544,375 | 9,890 | 20,730 | 372,079 | 220,861 |
| 95% Confidence level – lower bound | 32,784 | -656,308 | 8,291 | -9,321 | -800,073 | -226,868 |
| 95% Confidence level – upper bound | 1,110,579 | 1,769,580 | 53,038 | 76,448 | 1,568,173 | 852,627 |
| MEDIAN | 45,000 | 1,000 | 21,500 | 2,000 | 18,100 | 16,267 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 0 |
| Maximum | 5,000,000 | 6,000,000 | 80,000 | 500,000 | 1,500,000 | 3,180,000 |
| Interquartile Range | 637,750 | 50,000 | 63,012 | 33,087 | 1,133,950 | 329,588 |

Source: MPA survey

**Exhibit 4.3.H: Visitor Numbers and GNI Per Capita**

*(Log visitor numbers y-axis; GNI per capita in 2000 US $ x-axis)*




Source: MPA survey

**Staff Numbers**

The number of staff employed by the protected areas ranges from 0 to 64, or 1 to 64 excluding zero counts[5]. The average number of permanent employees is ten (with a median of four). Excluding zero counts these figures increase to an average of 13.5 (median of seven).

As a region, the South employs more staff than the North although this difference is not statistically significant. The means are 15 and 12 permanent staff respectively (excluding zero counts).

The average number of hectares per permanent staff member employed ranges from 12,500 to 17,000 with a median of between 400 and 1,100 (including and excluding zero counts respectively). On a per hectare basis the regional trends are reversed from those of total staff numbers: the South has fewer employees per hectare than the North.

On a per visitor basis, the average MPA employs one permanent member of staff for between every 13,000 and 20,000 visitors (including and excluding nil values). The Northern zones employ dramatically fewer staff per visitor than their Southern counterparts.

Field and Administrative Staff

The average number of field staff employed by MPAs is 10 excluding nil values (7.5 including nil values). The range is from 0 to 54. The majority of field staff is rangers, although a number of MPAs employ separate boat crews.

The number of administrative staff employed by MPAs (both including and excluding nil values) averages approximately 5, with a range from 0 to 33.

The direction of the relationships between numbers of field and administrative staff and geographical region and area, are the same as those discussed above for total staff numbers. The South employs more field and administrative staff overall than the North, although the difference is not a statistically significant one. The ratio of field to administrative staff is approximately 2:1 in both the North and the South.

Other Employees

Twenty two MPAs employ staff that is neither field nor administrative. These include employees involved in education, research, guiding, security, maintenance, cleaning and peasantry. A number of MPAs classified their manager under "Other employee".

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[5] Analysis of staff numbers is complicated by two factors. The first is the existence of one very large US MPA which employs 150 permanent members of staff and 124 field staff - more then double the next highest figure. For the purposes of this analysis therefore, this outlier has been removed. The second issue is the large number (21) of zero counts for permanent employees. Although there seems to be some evidence of "paper parks", it would appear that all of the protected areas counting zero employees have some kind of authority responsible for them as in each case they have had an informed individual completing the survey on their behalf. The employee data will therefore be detailed both including and excluding zero employee counts.

Only about half a dozen MPAs referred to the employment of seasonal staff – all of which were in Northern countries, as were the eight MPAs employing consultants/contractors. The consultants appear to perform a range of tasks, although in most cases very little detail was given.

Exhibit 4.3.I shows employee numbers excluding nil values on the basis of geographical zones.

**Exhibit 4.3.I: Average number of MPA Employees by geographical zone**

*(excludes zero counts)*

| | Total Permanent Employees | Field Employees | Admin Employees | Hectares per Employee | Visitors per Employee |
|---|---|---|---|---|---|
| USA | 16 | 14 | 5.2 | 26,517 | 26,039 |
| Europe | 10 | 7 | 4.8 | 5,810 | 31,758 |
| Caribbean | 7 | 5 | 2 | 25,750 | 6,172 |
| Indo-Pacific | 19 | 13 | 8 | 16,042 | 4,829 |
| Australia / New Zealand | 3 | unknown | unknown | 17,325 | 196,500* |
| AVERAGE | 13.5 | 10 | 5 | 17,143 | 20,506 |

Source: MPA survey * very small sample

Although there are few statistically meaningful differences in the staffing levels between the different regions, it is interesting to note how well staffed the Southern MPAs are. As James et al (1999) point out; staffing levels are a vital input into a protected area's resourcing and should not be ignored when assessing a protected area's resource levels.

In terms of the other variables it is hardly surprising to note that total staff numbers are quite closely related to MPA size and visitor numbers. Correlating MPA size and total permanent staff numbers (excluding nil counts) gives an r of 0.4 (p=0.002) while the correlation of visitor numbers and permanent staff shows an r of 0.401 (p=0.004).

MPAs protecting sea grass and mangroves employ the most staff. It is not immediately clear why this might be the case as neither of these two habitats are either large or with high visitor numbers.

More obviously, MPAs that have Commercial or Recreational Activities are not a purpose of their MPA employ notably more staff than those that do not. It would seem likely that both of these two activities are related to higher visitor numbers which seem to give rise to higher staff levels.

MPAs funded primarily by Foreign sources employ the most staff on a total, per hectare and per visitor basis. This may be for two reasons. Firstly, the NGO / Other Foreign donors may more fully resource the MPAs that they sponsor. Secondly, as is

discussed below, MPAs funded by Foreign sources tend to be on the smaller side with lower visitor numbers meaning that staff levels per unit will tend to be higher than for MPAs funded by other sources.

Neither the existence of a large harvest refugia (>5% of the MPA) or the objective to benefit surrounding fisheries have any bearing on staff numbers.

For the purposes of consistency, the data excluding zero values have also been used for field and administrative employees. These data should be treated with particular caution however as there are likely to be a number of MPAs which do not employ any field or administrative staff.

**Purposes of Protected Area**

The findings on the purposes of the MPAs surveyed were very surprising. Instead of finding a divide, or at least a sliding scale between the protected areas that had a limited number of objectives e.g. specifically conservation oriented, to those with many objectives e.g. the multiple use MPAs, the data showed that the majority of MPAs had an extensive range of purposes. Only a handful of MPAs had exclusively conservation goals. Most catered for a number of human uses.

For the sample as a whole, Habitat Protection was of the greatest importance, closely followed by Species Protection. With respect to the other purposes, there was a range of geographical differences – mostly subtle ones.

Commercial fishing was ranked more highly in the South than in the North. Possibly related to this is the fact that Species Protection was ranked considerably higher in the Indo-Pacific than in any other area. Both of these points may well reflect the more pragmatic focus in the area to protect fisheries as opposed to a broader biodiversity.

About three-quarters of MPAs in both the North and South and across all of the geographic regions cited other Recreational Activities[6] as being a purpose of their area but the importance which the MPAs attach to recreation is slightly higher in the USA than elsewhere. Having Recreational Activities as a purpose is naturally related to visitor numbers. The dozen or so MPAs that do not list Recreational Activities have less than one thousand visitors a year.

Commercial Activities[7] are more popular in the USA and Caribbean than elsewhere, but are ranked the most highly in the USA. This is unsurprising given that, as has already been mentioned on page 39 Commercial Activities are closely related to

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[6] The recreational uses were of course largely water related. Diving is allowed in just over a third of protected areas. Classifying all of the various recreational activities such as water sports and camping into tourism, recreational tourism takes place in just over 50 MPAs. Only two MPAs referred specifically to wildlife tourism. It would appear that many of the tourist activities were also commercial in so far as some party would receive a revenue from their participation (albeit) not necessarily the MPA), but unfortunately this was not always clear from the responses.

[7] The main commercial activity was tourism cited by half of the forty or so responses to this question. Aquaculture had six mentions. The three MPAs that referred to industrial activities as purposes of their protected area were all in the USA.

tourism across the sample. Given that the Caribbean receives a greater proportion of its income from visitors than for any other area, it may be expected that commercially driven tourist activities will be an important purpose.

Another activity bridging the hemispheres was Archaeological Protection, which although very highly ranked in the USA, was more frequently cited as a purpose in the Caribbean.

Protection of Geographical Features, Research & Monitoring [8] and Recreational Fishing showed limited geographical variation across the sample.

Subsistence Activities[9] are a purpose of a similar number of MPAs (about a third) in both the North and South. As Exhibit 4.3.L shows, these MPAs are not evenly distributed across the areas however, but are concentrated in the USA and the Indo-Pacific - only one MPA in Europe regards Subsistence Activities as a purpose of its area and none in the Caribbean do so. Notwithstanding the good number of USA MPAs which allow for Subsistence Activities however, there is a clear negative relationship between GNI per capita – the lower a country's GNI per capita the more likely are its MPAs to allow for Subsistence Activities. In addition it is worth noting that MPAs protecting mangrove habitats are the most likely to count Subsistence Activities as a purpose.

There was also a relative lack of information about Other Activities. Half of the nineteen MPAs referring to Other Activities mentioned their area as having either an educational or cultural purpose. Although there is no statistically significant relationship between either region or zone and Other Activities, twice as many MPAs in the USA than elsewhere regard their protected area as being intended for this purpose. The MPAs in the USA were the only protected areas to mention cultural purposes as being a function of their area.

Overall, there were very few differences in MPA purposes when examined geographically or using any of the other variables such as zonation and habitat type. Of greatest note was the fact that most of the MPAs gave a range of purposes extending over both the environmental and human. In terms of the individual purposes, the most pronounced findings were the relative importance of "fisheries" related issues in the Indo-Pacific and Recreational and Commercial purposes in the USA and Commercial purposes in the Caribbean.

Exhibit 4.3.J shows the number of purposes the MPAs serve. Only a couple has two or three purposes – most have five or more. Exhibit 4.3.K gives a count of the total number of times each purpose was selected and Exhibit 4.3.L illustrates the relative selection of MPA purposes across the different areas.

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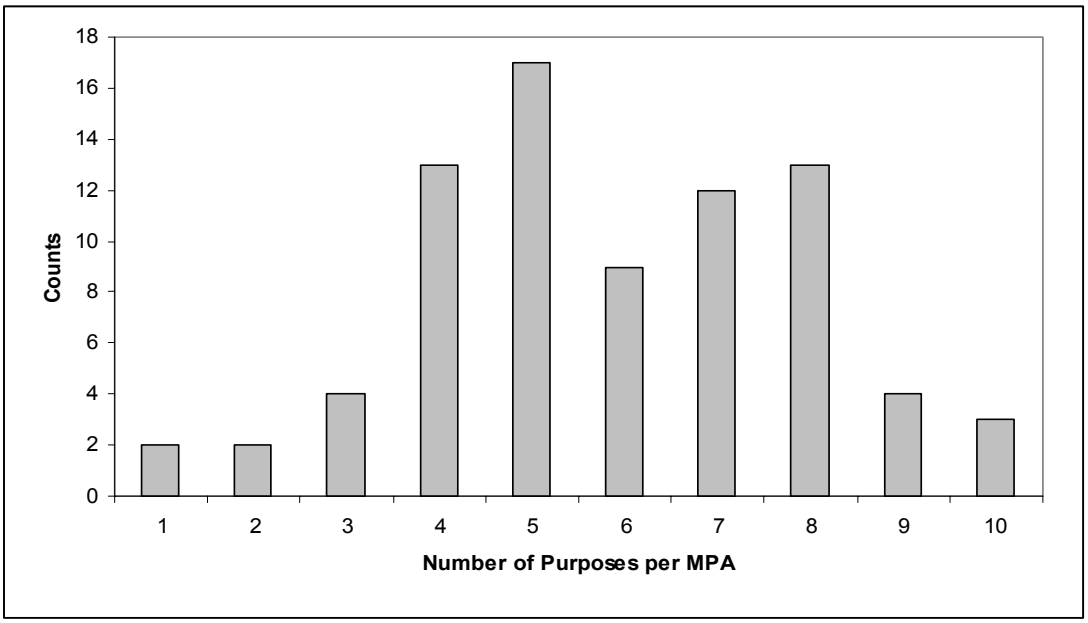
[8] All but a couple of MPAs across all regions and areas regard Research & Monitoring as a purpose of their MPA.

[9] Little detail was provided on the nature of the Subsistence activities undertaken in one third of the MPAs. Of the ten that provided some information, nine allowed subsistence fishing.

**Exhibit 4.3.J: Number of purposes given by MPAs**

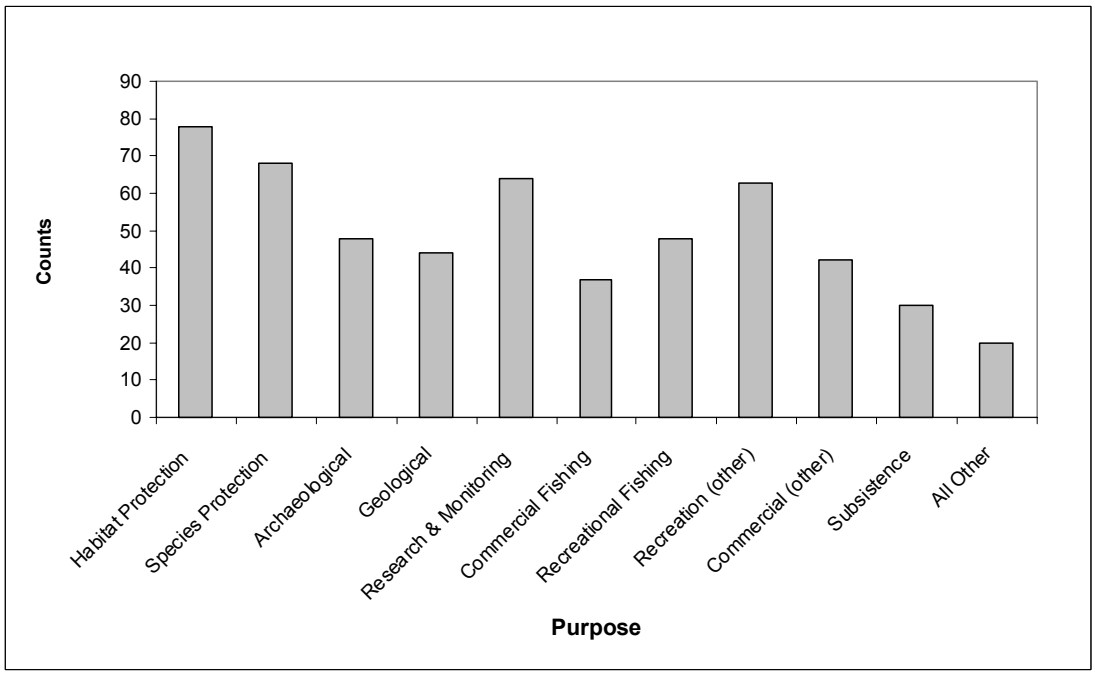
*(counts of total number of purposes)*




Source: MPA survey

**Exhibit 4.3.K: Number of times each MPA purpose was selected**

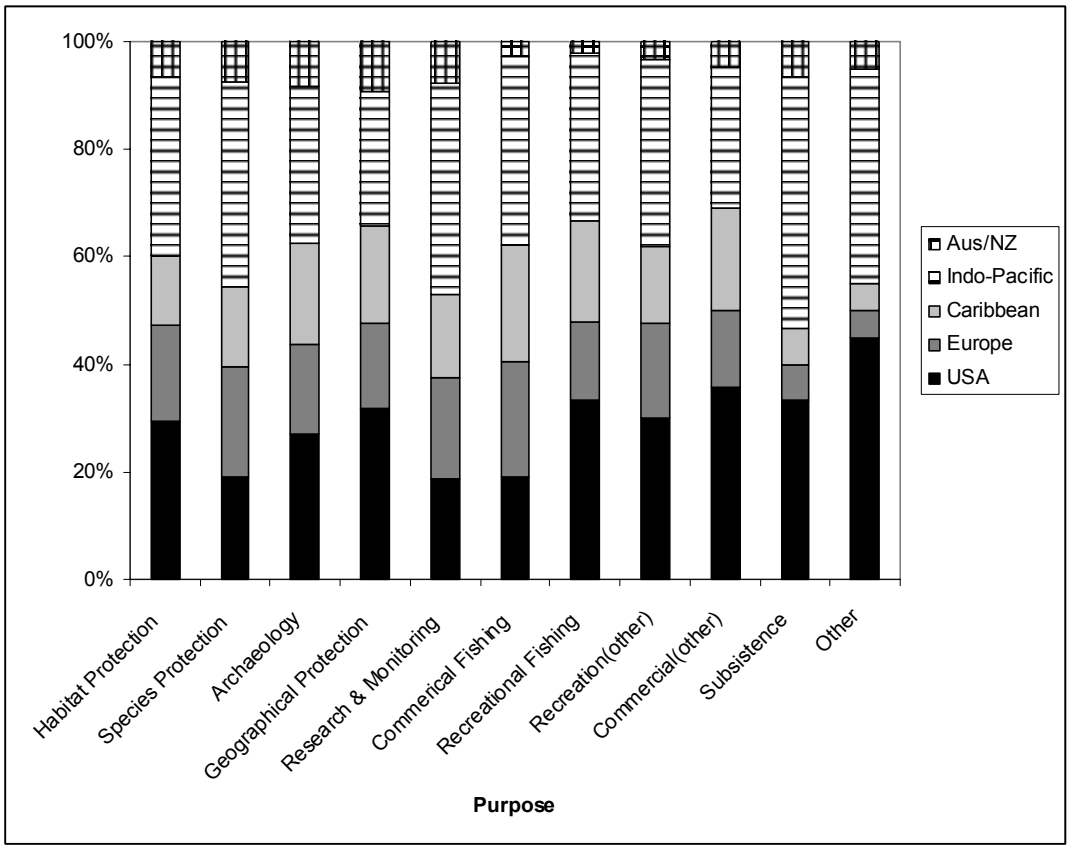
*(counts of each purpose)*




Source: MPA survey

**Exhibit 4.3.L: Selection of various MPA purposes by geographical zone**

*(% breakdown)*




Source: MPA survey

## Benefit to Fisheries

Thirty two (40%) of the MPAs answered that their protected area was designed to benefit adjacent fisheries. Only a third of this number gave a ranking to this purpose – of which nearly all gave it the highest priority. A further fifteen percent of the total number stated that their MPA did provide a benefit to adjacent fisheries, but that the benefit was incidental – it was not an original purpose of the MPA.

There is a very close relationship between where the MPA is located and whether it is designed to provide a benefit to adjacent fisheries (see Exhibit 4.3.M). Twenty three of the MPAs intended to benefit fisheries are in the South, and seventeen of these are in the Indo-Pacific. There is similarly a very strong relationship between the GNI of a country and the purposeful benefit an MPA provides to adjacent fisheries – half are in countries with incomes below USD 6,950 per capita, with the majority of these in countries with an income below USD 3,500.

There is no statistical relationship between the geographical location of an MPA and whether it provides an incidental benefit to fisheries however.

Just as with the issue of Zonation, the objective of benefiting fisheries in most developing countries is undoubtedly driven by the economic requirements of the local communities. Having said this, it may well be that the economic demands affecting

many of the Northern MPAs are also great, but the concept of associating MPAs with fisheries benefits is still a Southern phenomenon - it has not yet spread to the North.

With respect to the other variables, MPAs designed to benefit fisheries are amongst the most likely to protect sea grass and mangrove habitats, allow Commercial fishing, and have fewer visitors (less than 40,000 per annum) than those that do not. The association of fishing benefits with mangroves, sea grass and Commercial fishing are apparent. The reason behind having lower visitor numbers is probably because most of the MPAs supporting fisheries are in the South which has generally lower visitor numbers.

The size of an MPA has no bearing on whether it provides a benefit to fisheries.

**Exhibit 4.3.M: Geographical breakdown of the benefit to fisheries**

| Benefit to fisheries | YES | NO | TOTAL |
|---|---|---|---|
| USA | 4 | 20 | 24 |
| Europe | 5 | 9 | 14 |
| Caribbean | 6 | 4 | 10 |
| Indo-Pacific | 17 | 9 | 26 |
| Australia / N.Zealand | - | 5 | 5 |
| TOTAL | 32 | 47 | 79 |

Source: MPA survey

## Level of income

Eighteen of the MPAs responding claimed to have zero income i.e. are “paper parks”. As with employee numbers (above), the issue of zero values with respect to MPA income is not entirely straightforward. In some cases the MPA claiming nil income is adjacent to, or is part of a terrestrial protected area that does receive an income. The support for the terrestrial component is very likely to provide as a by-product some measure of protection for the marine area. In other instances the fact that there is an individual of authority completing the survey on behalf of the protected area indicates that it might have some resource attached to it, albeit indirectly. Finally, there are a couple of instances for which it appears that the income receivable is unknown as opposed to zero, but it is not clear in the response. Ten of the paper parks to respond to this survey are in the USA.

Because of these issues relating to nil income, the subsequent description and analysis shall in most cases be done both excluding and including nil values.

Including counts for zero income, the spread in total income received by the MPAs is vast: from zero to USD 5,500,000. The average is about USD 500,000 and the median USD 120,000. Excluding zero counts, the average is approximately USD 750,000 and

the median USD 265,000 with the range starting at USD 3,249. Notwithstanding the broad range of income received, on a log basis it is more evenly distributed.

The average income received per hectare is USD 1,429 including zero counts and USD 1,923 excluding nil values. The median is USD 10 and USD 16 respectively.

Although there is no statistically meaningful difference in total income and income per hectare between the different geographical areas, total MPA income is related – at least to some extent to the GNI per capita of the host country ($r = 0.213$ $p=0.11$).

On a per visitor basis however, the picture is very different. The average income received per visitor is USD 192 (median USD 3.4) including nil counts and USD 269 (median USD 19.2) excluding nil counts. In this case there is a very close relationship ($p=0.007$) between income earned and geographical location. The South receives almost double the average income per visitor than the North. Looking at the different zones, the Indo-Pacific receives considerably more on a per visitor basis than all of the other areas. If the very small sample of Australia and New Zealand is excluded, the USA earns the least. Similarly, there is a negative relationship between income per visitor and the per capita income of a country. The correlation coefficient of - 0.296 excluding nil values ($p=0.048$) shows that the greater the GNI per capita, the less income per visitor an MPA receives.

This relationship between income and location is an interesting one – and it is inseparable from the issue of visitor numbers.

To expand, visitor numbers are positively related to the total income an MPA receives ($r = 0.534$ $p<0.001$ excluding nil values). In turn, visitor numbers are also closely related to MPA location – the Northern countries have more visitors than their Southern counterparts. In other words, wealthier countries do have a higher total MPA income than their developing counterparts, but they also have far more visitors. Given that there is no difference in the income per hectare between the various regions across the world, it would suggest that the "driver" for income in this case is visitor numbers and not the location of the MPA. The relationship between income and visitors is explored in much greater detail in the next chapter on funding requirements.

The other strong association with total income is MPA size. The correlation between total income and MPA area gives an r of 0.572 ($p<0.001$). This relationship will also be discussed in more depth in Chapter 5 on funding requirements.

There is no association between the total level of income or the income received per hectare under management and most of the other variables, such as the habitat protected, purposes, how the MPA is funded, how it is zoned or whether it provides a benefit to fisheries. However, there is often a significant difference between the levels of income on a per visitor basis and most of these variables. Regardless of the variable, in each case the more visitors an MPA has the more income it will receive in total and less per individual.

It is interesting to note that MPAs engaging in Commercial Activities have a far higher total income and income per hectare than those that do not. They also have very high visitor numbers and as a consequence a lower income per visitor.

Exhibit 4.3.N, Exhibit 4.3.O and Exhibit 4.3.P give a breakdown on a geographical basis of total income, income per hectare and income per visitor respectively. All exclude nil values.

**Exhibit 4.3.N: Total MPA Income on a geographical basis**

*(USD; excludes nil values)*

| | MEAN | Std.Error | 95% Confidence level – lower bound | 95% Confidence level – upper bound | MEDIAN | Minimum | Maximum |
|---|---|---|---|---|---|---|---|
| USA | 1,491,531 | 472,209 | 471,384 | 1,384,179 | 925,964 | 25,289 | 5,538,102 |
| Europe | 700,726 | 354,045 | -78,519 | 1,479,975 | 168,932 | 3,249 | 4,334,038 |
| Caribbean | 266,272 | 81,062 | 82,296 | 449,648 | 224,880 | 15,780 | 844,152 |
| Indo-Pacific | 535,749 | 240,210 | 31,085 | 1,040,412 | 196,552 | 9,120 | 4,545,455 |
| Australia / N.Zealand | 357,189 | 44,709 | -210,897 | 925,274 | 357,189 | 312,479 | 401,898 |

Source: MPA survey

**Exhibit 4.3.O: Total MPA income per unit area by geographical region**

*(USD per hectare; excludes nil values)*

| | MEAN | Std.Error | 95% Confidence level – lower bound | 95% Confidence level – upper bound | MEDIAN | Minimum | Maximum |
|---|---|---|---|---|---|---|---|
| USA | 6,193 | 5,905 | -6,564 | 18,951 | 35 | 1.42 | 82,927 |
| Europe | 161 | 80 | -15 | 336 | 58 | 0.56 | 994 |
| Caribbean | 67 | 32 | -6 | 140 | 10 | 0.32 | 281 |
| Indo-Pacific | 870 | 576 | -340 | 2,079 | 14 | 0.34 | 9915 |
| Australia / N.Zealand | 11 | 3.65 | -36 | 57 | 11 | 7 | 14 |

Source: MPA survey

**Exhibit 4.3.P: Total MPA income per visitor by geographical region**

*(USD; excludes nil values)*

| | MEAN | Std.Error | 95% Confidence level – lower bound | 95% Confidence level – upper bound | MEDIAN | Minimum | Maximum |
|---|---|---|---|---|---|---|---|
| USA | 29 | 20 | -15 | 73 | 1.5 | 0.15 | 223 |
| Europe | 49 | 25 | -19 | 118 | 25 | 0.72 | 140 |
| Caribbean | 54 | 45 | -50 | 158 | 9 | 0.64 | 416 |
| Indo-Pacific | 615 | 269 | 48 | 1182 | 106 | 3 | 4368 |
| Australia / N.Zealand | 6 | 5.5 | -64 | 75 | 6 | 0.21 | 11 |

Source: MPA survey

## Sources of Income

The biggest source of income overall are Governments and other state bodies, followed by Visitors and then Foreign sources of funding. Only eight MPAs received an income from any other source. Half of these were in the Indo-Pacific. These other sources of income included tourism, various charitable foundations and a trust fund established from bio-prospecting revenues.

Exhibit 4.3.Q shows the percentage breakdown of total income by source across the different geographic regions. Exhibit 4.3.R gives the breakdown of MPAs according to their primary source of funds.

**Exhibit 4.3.Q: MPA income by source**

*(% breakdown)*

| | Government Funding | Carried over | Domestic Donations | Foreign Sources | Visitor fees | Other |
|---|---|---|---|---|---|---|
| USA | 92 | 0 | 0 | 0 | 5 | 2 |
| Europe | 77 | 9 | 0 | 9 | 6 | 0 |
| Caribbean | 52 | 7 | 1 | 11 | 22 | 6 |
| I. Pacific | 47 | 3 | 1 | 39 | 14 | 3 |
| Aust / NZ | 100 | 0 | 0 | 0 | 0 | 0 |
| TOTAL | 77 | 5 | 0 | 12 | 14 | 3 |

Source: MPA survey

**Exhibit 4.3.R: Breakdown of MPAs according to primary source of funds**

*(Number of MPAs in each category)*

| | Government | Foreign | Visitors | TOTAL |
|---|---|---|---|---|
| USA | 13 | - | 1 | 14 |
| Europe | 11 | 1 | - | 12 |
| Caribbean | 6 | 1 | 3 | 10 |
| Indo-Pacific | 8 | 8 | 2 | 18 |
| Australia / NZ | 2 | - | - | 2 |
| TOTAL | 40 | 10 | 6 | 56 |

Source: MPA survey

There is a significant regional difference between funding sources. MPAs in the South are far less reliant on the Government for income, but receive a greater proportion of funds from Foreign bodies and Visitor Fees.

Associated with the above point, there is also a strong association between GNI per capita income and an MPA's main source of income. Of the fifteen MPAs funded by either Foreign sources or Visitor fees, eleven were in countries with a GNI per capita income of less the USD 6,950.

Although it would of course automatically be "assumed" that foreign / donor aid would be directed most towards the poorer regions and countries, poverty is probably only part of the explanation for the Indo-Pacific to receive such heavy foreign receipts.

It may be that the low visitor numbers in the Indo-Pacific mean that the MPAs are currently unable to raise sufficient revenue for themselves in some form of visitor fees. The eight Indo-Pacific MPAs which receive most of their revenues from Foreign sources have an average of just over one thousand visitors a year. The Caribbean MPAs which have considerably more visitors, certainly on a median level (see Exhibit 4.3.G) are less dependent on Foreign sources, receive more of their total income from Visitor fees and are subsequently more self-sufficient.

The fact that the Caribbean and Europe receive similar amounts of foreign donations can probably be explained by the distribution of EU funds in Europe, as opposed to the receipt of aid *per se*.

There is also a close relationship between MPA size and funding type. The small to mid-range protected areas are more likely to receive a significant part of their funding from a Foreign source. One reason for this could be that these smaller reserves (mostly in the Indo-Pacific) are insufficiently large to provide themselves with alternative sources of revenue. This is unlikely however as both visitor numbers and MPA purposes are consistently unrelated to size throughout the sample.

Another option is that Foreign donors might face budgetary constraints and therefore will limit their assistance to the smaller reserves. Alternatively, it might be the case that Foreign aid tends to be distributed on a "flat fee" basis across the board, but for the larger MPAs the Foreign donations are not the major source of funds. This supposition cannot be tested on the basis of the available data.

In addition only the reserves at the smaller end of the scale receive a sizeable amount of their income from Visitors. The reasons for this are not immediately apparent.

The purposes, habitats and species protected and zonation of an MPA have no bearing on what is the major source of its funds.

**Spending patterns**

Current spending by type

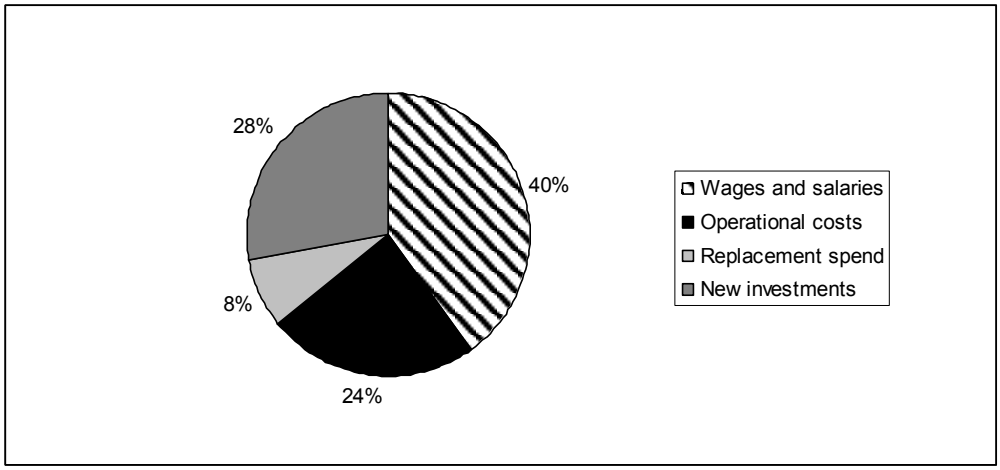
As mentioned in Chapter 3 on Methodology, spending type refers to how the MPAs' spending patterns may be categorised in terms of their function, such as wages and salaries.

The aggregated MPA spending breakdown is dramatically impacted by one large investment spend of USD 10,000,000 by an MPA in the USA. The aggregated figures are therefore presented twice – once with this exceptional charge included and once with it taken out. The figures have been presented both including as well as excluding the charge as there is an argument that although the charge is unusually large for the year under consideration, it may well be repeated across a number of the other MPAs in any other given year i.e. looking at the sample both as a whole and over time it is not exceptional.

Overall, wages form the largest component of spending, followed by "other" operational spend. Exhibit 4.3.S and Exhibit 4.3.T and show the breakdown of spending by type across all MPAs including and excluding the major USA investment.

**Exhibit 4.3.S: MPA spending breakdown by type**

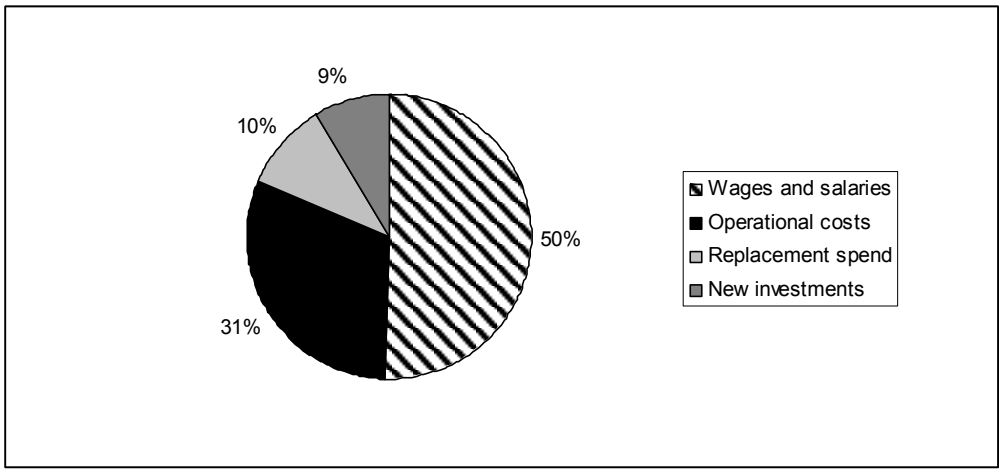
*(includes the major USA investment)*




Source: MPA survey

**Exhibit 4.3.T: MPA spending breakdown by type**

*(excluding the major USA investment)*




Source: MPA survey

There are a number of variations in spending breakdown across the different MPAs. The primary difference appears to be in the proportion of income spent on wages and salaries and on capital replacement.

The percentage of its income an MPA spends on wages appears to be positively related to per capita GNI. The relationship between GNI per capita and the percentage spend on replacement capital is negative however, albeit not significantly so. GNI per capita also shows a negative correlation with the percentage spends on operational costs, new investments and five year capital spend. Exhibit 4.3.U details these relationships.

**Exhibit 4.3.U: Relationship between GNI per capita and MPA spending by type**

*(correlation statistics for specified relationship)*

| | | % Wages | % Operational Costs | % Replacement spend | % New Investments | % New Investment excluding the major USA investment |
|---|---|---|---|---|---|---|
| GNI per capita | R | 0.297 | -0.303 | -0.24 | -0.121 | -0.191 |
| | Sig (2-tailed) | 0.024 | 0.021 | 0.070 | 0.364 | 0.152 |
| | N | 58 | 58 | 58 | 58 | 58 |

Source: MPA survey

It is not unexpected that wages as a % of spending should trend in the contrary direction to all of the other elements of spending in relation to GNI per capita. Labour rates rise faster than GDP (owing to productivity growth) resulting in the richer countries having to pay a proportionately greater amount for labour and the poorer countries paying a relatively lower amount. The spending patterns for the other items subsequently show patterns inverse to the labour cost patterns. This might explain why MPAs intended to provide a benefit to fisheries spend more of their income on operational items than those that do not.

There is a negative correlation between the percentage of an MPA's income spent on wages and salaries and its size (r= -0.23 p=0.083). Conversely there is a positive relationship between MPA size and replacement spend (r= 0.298 p=0.024). Both of these correlations are also "obvious" – at least superficially. Along similar lines, MPAs for which Commercial Activities are a purpose, spend more of their funds on replacement capital and new investments than those for which it is not a purpose.

The spending profile of MPAs with no-take areas of >5% differs in no significant respect with those with a no-take area of <5%.

Capital spend on new facilities

Over the past five years the total capital spend on new facilities has been on average approximately USD 320,000 (USD 182,000) per annum. This compares to an average of USD 375,000 (USD 75,000) in the North and USD 250,000 (USD 50,000) in the South. The range within these averages has been considerable. Forty six MPAs have spent nothing on new facilities over the period.[10]

An MPA's pattern of no-take areas, type of habitats and species protected, size or visitor numbers seem to have no bearing on the medium term patterns of capital spending. This analysis runs contrary to what might have been expected. Any one of these factors could potentially have an influence on capital spend. Taking visitor numbers for example, it would not have been unreasonable to assume that greater numbers of visitors gave rise to a greater capital investment needs.

Having said that location has no bearing on capital spend, correlating it with GNI per capita shows a negative relationship. As income rises, the five year capital spend falls (r=-0.247 p=0.035). Why this is the case is not apparent from the data, especially given that visitor numbers increase in relation to GNI per capita.

MPAs for which Commercial Activities are a purpose however, have a five year capital spend level that is higher than for the other MPAs. In this case the MPAs for which Commercial Activities are a purpose spend USD 567,829 (USD 317,829) per annum and those that do not spend USD 17,206. The relationship between Commercial Activities and tourism and visitor numbers has already been noted.

Current Spending by Activity

Data on current spending by activity is not as comprehensive as that provided in the earlier questions in the survey. This is particularly the case in USD terms. Often the respondent recorded that an activity took place, but did not give a figure as to how much money was spent on it. For this reason the analysis of spending by activity is done in two ways. In the first instance it is analysed looking at the percentage of the total spend an MPA outlays on a given activity. The second approach is to consider just the number of mentions an activity received as an item of current spend.

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[10] The figures in brackets in the sub-section on Capital Spend denote the 5-year average annual capital spend excluding the USA MPA which has a particularly high capital spend

Activities mentioned have been grouped into categories based upon the responses to the questionnaire. Because the categorisation was discretionary, there are several areas of potential ambivalence in interpretation. "Operational activities" for example might include activities classified elsewhere such as educational spend, but a specific breakdown has not been given. Similarly, the dearth of responses indicating that income is spent on habitat related activities such as restoration might imply that this activity was covered in many cases under "Other operational activities". A good number of respondents referred separately to both "education" and "visitor activities". There is a distinct possibility however that many other MPAs include education under visitor activities and *vice versa*.

**Exhibit 4.3.V: Current MPA spending by activity: ranked by average % spend**

*(average % spend and number of mentions)*

| Activity | Average % spend | Number of mentions |
|---|---|---|
| Research & Monitoring | 37 | 41 |
| Enforcement | 34 | 34 |
| Administration | 13 | 19 |
| Education | 9 | 17 |
| Visitor related | 7 | 17 |
| Other | 5 | 7 |
| Other operational activities | 4 | 17 |
| Community activities | 3 | 10 |
| Equipment | 2 | 8 |
| Outsourcing | 0 | 9 |
| Infrastructure | 0 | 4 |
| Financial | 0 | 2 |

Source: MPA survey

Because of these two limiting factors – lack of data and ambivalence in categorisation, the information on spending by activity should be taken as useful in indicating priorities and direction of spending only, as opposed to an analysis of exact spending patterns.

As shown in Exhibit 4.3.V overall research and monitoring appears to be the top spending priority in terms of both number of mentions and percentage of total spend. Enforcement is also highly ranked. As discussed above, the absence of references to habitat related activities is striking.

Key findings on current spending by activity

In terms of how the current spending priorities vary amongst the MPAs there are some very marked differences.

The data shows a clear trend to spend more on enforcement in the South than in the North. Amongst the geographic areas, the Indo-Pacific made by far the most references to enforcement. There are several possible reasons for this. The first is that in the North, enforcement is not always a primary responsibility of the MPA, but of other authorities such as the coastguard. The law itself may also be a sufficient deterrent in the wealthier countries. Alternatively, the immediate threats to the Northern MPAs might not be so great – certainly not of extraction such as poaching. This last point may well tie in with the focus on the benefit to fisheries, especially in the Indo-Pacific. If the MPAs were designed with fisheries enhancement in mind, it is likely that there is a real, ongoing competition for stocks in the area and the threat of encroachment will be ever present.

Not only do the Southern MPAs spend more on enforcement, but so do the larger areas. The larger MPAs have a clear inclination to spend more on enforcement than their smaller counterparties. It is interesting that the relationship between area and enforcement is not linear: the larger MPAs must require a "step-change" in requirements.

The North spends a greater proportion of its income on research & monitoring than the South (to a statistically significant degree), although in terms of mentions, the two regions are fairly evenly matched. It may be that research & monitoring is more expensive in the North than in the South, or alternatively it may be a higher priority for the Northern MPAs.

MPAs protecting sea grass state that spending on community activities is a higher priority than the other MPAs. It is difficult to understand what might be at the root of this relationship without any information on what these community activities are.

Another finding, in this case an obvious one, was that the more visitors an MPA has, the more it spends on visitor related facilities. This relationship should have been supported by the results on GNI per capita and MPA location, but unfortunately the data was not sufficiently comprehensive. GNI per capita is clearly related however to education spend – another finding that associates the MPAs in the North with less pragmatic activities.

Neither the benefit of the MPA to adjacent fisheries nor the zoning of the MPAs have any bearing on current spending patterns.

**Difference between income received and level of spending**

For 29 of the MPAs total income did not match total spend. As Exhibit 4.3.W shows, the split between under- and over-spend was fairly even. Interestingly enough there is little geographical variation between the two. The average under-spend was USD 96,687 ranging from USD 55 to USD 696,180. The average over-spend was USD 91,432, ranging from USD 3,448 to USD 542,048. (This over-spend figure excludes the very considerable capital investment made by a USA MPA, previously noted.)

About half of the MPAs accounted for the spending mismatch. The reasons given for under-spending included a lack of staff to spend the money, balancing items and timing issues. Insufficient income was of course given as the primary reason for over-spending.

The most likely reason behind these MPAs which did not account for the spending mismatch was because of the difficulty in expressing an internal budget in the form the questionnaire requested. Some, if not many MPAs will have internal budgets which break spending down by activity. Activities, as discussed above might include for example enforcement or research and monitoring. Separate elements of spending type such as wages are then difficult to extract from budgets for the various activities. Several MPAs appear to budget by both spending type and activity.

**Exhibit 4.3.W: Profile of under and over-spend by Geographical Area**

*(Number of MPAs in each category)*

| MPAs | Under-spending | Over-spending |
|---|---|---|
| USA | 1 | 2 |
| Europe | 3 | 1 |
| Caribbean | 4 | 4 |
| Indo-Pacific | 5 | 5 |
| Australia / N.Zealand | 2 | - |
| TOTAL | 16 | 13 |

Source: MPA survey

## 4.4 Clustering the Findings

The findings of the bivariate analysis suggest that there are clear patterns in the data which pivot largely on a combination of the geographical location and purposes of the various MPAs. A basic cluster analysis performed on the majority of the key variables found within the data, confirmed that the MPAs could be aggregated into three groups.

The analysis was done on 64 MPAs and produced nine groups in total. There was insufficient data to cluster the outstanding fifteen MPAs. Three of the groups were substantial in number while the remaining six comprised of a total of just eleven MPAs. In order to produce the three main groups it was necessary to cluster into nine aggregations as the process tended to shave off the out-lying MPAs first before leaving the remainder in homogenous sets. Exhibit 4.4.A summarises the characteristics of each group.

The first group – A, is the most distinct. It comprises of eighteen MPAs almost exclusively from the southern hemisphere in countries with low levels of GNI per capita – averaging below USD 5,000 per annum. These protected areas are both the smallest in size with by far the lowest visitor numbers and are typically funded more by Foreign bodies or Visitor fees than by their own governments. They have as a clear objective an intention to benefit fisheries and are most likely to have no-take zones of more than 5% of their area. These MPAs also tend to focus their spending activities heavily on enforcement and allow for subsistence activities.

Of the MPA typologies detailed in Section 2.4 Group A sits somewhere in between the single objective MPA (in this case the objective is fisheries management) and the multiple-use type. Fisheries management is cited as a purpose by nearly all of the members of this group, while the range of other purposes, although present, are ranked more lowly. It is clear from the analysis however, that pragmatic "human-oriented" uses are of the greatest priority to this cluster.

Groups B and C are less distinct than group A. Group B consists of 22 MPAs from both the North and South, with most of the Southern members from the Caribbean. This group is characterized by the highest area and visitor levels. Its constituent members have the greatest participation in a full range of "human" activities ranging from the protection of geological and archaeological features to fishing. These multiple uses also extend to providing a benefit to fisheries. This group fits most closely with the typology of the large multiple-use MPA which caters for a wider range of activities and demands.

Group C is composed of 13 protected areas largely from the North and has the highest per capita GNI. It comes across as a "watered-down" version of group B. The average level of visitors is slightly less and the MPAs tend to have a reduced range of purposes. It is very tempting to propose that because of this reduced engagement in a number of "human" activities such as fishing, in conjunction with the high levels of zonation, that this cluster is the most conservation oriented of the three. Although not particularly small, these MPAs may well have been established with conservation as the foremost priority. As with group A, this cluster seems to be positioned between the single-objective and multiple use MPA typologies. Its members do have a considerable range of purposes, but not as many as in group B, which combined with the lower visitor numbers and prevalence of zoning, seems to indicate more of a conservation orientation.

Overall, these three groups bear some resemblance to the MPA typologies described in Chapter 2. Although it is interesting to note that all of the groups cover a wide range of purposes, none of the MPAs seem to be exclusive in terms of their objectives.

**Exhibit 4.4.A: Characteristics of the three main MPA groupings**

*(see key)*

| | **Cluster A** | **Cluster B** | **Cluster C** |
|---|---|---|---|
| Region (% breakdown) | 95 South, 5 North | 50 South, 50 North | 77 North, 23 South |
| Area (% breakdown) | USA = 11<br>Caribbean = 6<br>Indo-Pacific = 83 | USA = 27<br>Europe = 18<br>Caribbean = 32<br>Indo-Pacific = 18<br>Australia / NZ = 5 | USA = 31<br>Europe = 23<br>Caribbean = 8<br>Indo-Pacific = 15<br>Australia / NZ = 23 |
| Funds (% breakdown) | Government = 47<br>Foreign entities = 47<br>Visitors = 6 | Government = 80<br>Foreign entities = 10<br>Visitors = 10 | Government = 80<br>Visitors = 20 |

| | Cluster A | Cluster B | Cluster C |
|---|---|---|---|
| GNI per capita (USD) | 4656 | 16534 | 25641 |
| Size (mean ha) | 21012 | 160429 | 67908 |
| Visitor numbers (counts) | 49940 | 259674 | 145062 |
| Coral | 94 | 50 | 54 |
| 1 | 100 | 100 | 100 |
| 2 | 100 | 100 | 85 |
| 3 | 50 | 100 | 69 |
| 4 | 22 | 100 | 100 |
| 5 | 100 | 86 | 77 |
| 6 | 44 | 100 | 0 |
| 7 | 56 | 86 | 0 |
| 8 | 83 | 100 | 77 |
| 9 | 33 | 100 | 54 |
| 10 | 72 | 91 | 8 |
| 11 | 33 | 32 | 8 |
| Benefit to fisheries | 89 | 23 | 15 |
| No take zone >5% | 64 | 41 | 58 |
| Current Income (USD mean) | 219834 † | 790372 | 89781 ‡ |
| Current Income per hectare (USD mean) | 46 † | 70 | 573 ‡ |
| Current Income per visitor (USD mean) | 294 † | 140 | 13 ‡ |
| Minimum required funding (USD mean) | 354741 † | 1158546 | 131349 ‡ |
| Minimum required funding per hectare ( USD mean) | 148 † | 127 | 805 ‡ |
| Minimum required funding per visitor (USD mean) | 365 † | 225 | 47 ‡ |

Source: MPA survey

**KEY**

| | |
|---|---|
| REGION | NORTH , SOUTH |
| AREA | Including: US, EUROPE, CARIBBEAN AND BERMUDA EX USA |
| | INDO-PACIFIC EX USA, AUSTRALIA / NEW ZEALAND |
| FUNDS | PRIMARY SOURCE OF MPA FUNDS |
| GNI PER CAP | GNI PER CAPITA OF HOST COUNTRY |
| SIZE | MPA SIZE IN HECTARES |
| VISITOR NUMBERS | ANNUAL MPA VISITOR NUMBERS |

| | |
|---|---|
| Coral | PROTECTION OF CORAL: 1 = YES, 0 = NO |
| 1 | HABITAT PROTECTION: 1 = YES, 0 = NO |
| 2 | SPECIES PROTECTION: 1 = YES, 0 = NO |
| 3 | ARCHAEOLOGICAL / HISTORICAL PROTECTION: 1 = YES, 0 = NO |
| 4 | PROTECTION OF GEOLOGICAL FEATURES: 1 = YES, 0 = NO |
| 5 | RESEARCH & MONITORING: 1 = YES, 0 = NO |
| 6 | RECREATIONAL FISHING: 1 = YES, 0 = NO |
| 7 | COMMERCIAL FISHING: 1 = YES, 0 = NO |
| 8 | OTHER RECREATIONAL USES: 1 = YES, 0 = NO |
| 9 | OTHER COMMERICAL USES: 1 = YES, 0 = NO |
| 10 | SUBSISTENCE USES: 1 = YES, 0 = NO |
| 11 | OTHER USES: 1 = YES, 0 = NO |
| Benefit to Fisheries | Purpose of MPA is a benefit to fisheries |
| No-take zone >% | Whether an MPA has a no-take zone of more than 5% of its area |

The units in the above table are as follows: % breakdown of responses (where marked); USD mean– all income related data; Coral, MPA purpose, benefit to fisheries, zonation - % of respondents answering "YES". † excludes one outlying MPA with a current income per hectare two hundred times larger than the average for the group. ‡excludes one outlying MPA with a current income per hectare one hundred and fifty times larger than the average for the group.

Another point worthy of attention is the geographical distribution of the group members. The North is represented most closely by multiple-use and conservation (groups B and C), while the South is represented by fisheries management and multiple-use (groups A and B). The Southern contingent is in turn also clearly defined, with fisheries management largely the province of the Indo-Pacific, while most of the Caribbean MPAs are multiple-use.

Appendix 6 gives a comprehensive breakdown of the cluster analysis providing the data for each response.

## 4.5 Conclusion

A preliminary analysis of the data demonstrated a broad range of findings. The central finding of the analysis was that the MPAs responding can be categorised or profiled into a number of "clusters" that are defined by a range of characteristics from their visitor numbers and purpose to their income and spending patterns.

In the next section the characteristics of the MPAs examined in this chapter will be investigated further with a view to developing a better understanding of how their overall profile and objectives determines their income requirements

# CHAPTER 5: TOWARDS A BETTER UNDERSTANDING OF MPA INCOME REQUIREMENTS

## 5.1 Introduction

As already described in Section 4.3 the funding available to MPAs in the sample covered a very broad range. Some MPAs had no income, some had annual budgets of less than USD 100,000 while the most affluent enjoyed annual incomes measured in millions of dollars.

In this chapter, the income data will be reviewed and analysed in greater detail, with a view to achieving a better understanding of the drivers of income requirements. Among the analytical tools used are bivariate and multivariate models, applied to both the absolute and log data.

A practical goal of this section — referring back to the core objective of the project — is to achieve a better understanding of MPA funding patterns, with a view to assisting the policy analysis undertaken by various conservation agencies.

## 5.2 Actual Income and Desired Income

In order to analyse MPA funding requirements, it is first necessary to establish whether current income levels actually reflect the true funding needs of MPAs. If a significant proportion of MPAs are currently failing to meet management objectives as a result of under-funding, any funding model derived from current income data will incorporate a bias towards under-funding.

In anticipation of this issue, the questionnaire asked MPAs not only to report on current income levels but also to give an estimate of how much additional funding would be required in order for them to meet their objectives. More specifically, respondents were asked to bracket their estimates between the incremental funding that was required at a minimum and the increase that would take them to a funding level regarded as ideal. Respondents were also asked how they would spend any additional income. For the avoidance of confusion, the desired *increment* in funding will be referred to below as the *additional* funding requirement. The *target* total funding (that is, current income plus any desired increase) will generally be referred to as the minimum funding requirement (MFR) or ideal funding requirement (IFR).

**Exhibit 5.2.A: Response rates to questions concerning additional funding needs**

| | | Gave estimate of ideal funding level | | |
|---|---|---|---|---|
| | | Yes | No | Total |
| Gave estimate of | Yes | 43 | 6 | 49 |
| minimum funding level | No | 16 | 14 | 30 |
| | Total | 59 | 20 | 79 |

Source: MPA survey

As illustrated in Exhibit 5.2.A, not all respondents answered the question on additional funding needs. Out of the 79 questionnaires returned, only 43 attempted an estimate of both minimum and ideal additional funding needs, while 14 declined to answer on either point. Of the remainder, 16 gave an answer on ideal funding requirements but left blank the question about minimum additional needs while 6 offered an estimate of the minimum but not the ideal figure.

The mixed nature of the responses to the funding requirement questions presents a number of practical modeling challenges that will be discussed shortly. However, there are also inferences that might be made from some of the patterns within the responses.

In this connection, it should be noted that no detailed procedure was laid down for estimating minimum or ideal funding needs. Respondents were asked simply to state a monetary value. This means that the responses reflected a degree of subjectivity in how each respondent interpreted the criterion and in how the additional income requirements were estimated on a practical basis. The subjectivity of the answers on funding requirements is not particularly surprising, given the complex and varying objectives of the different MPAs.

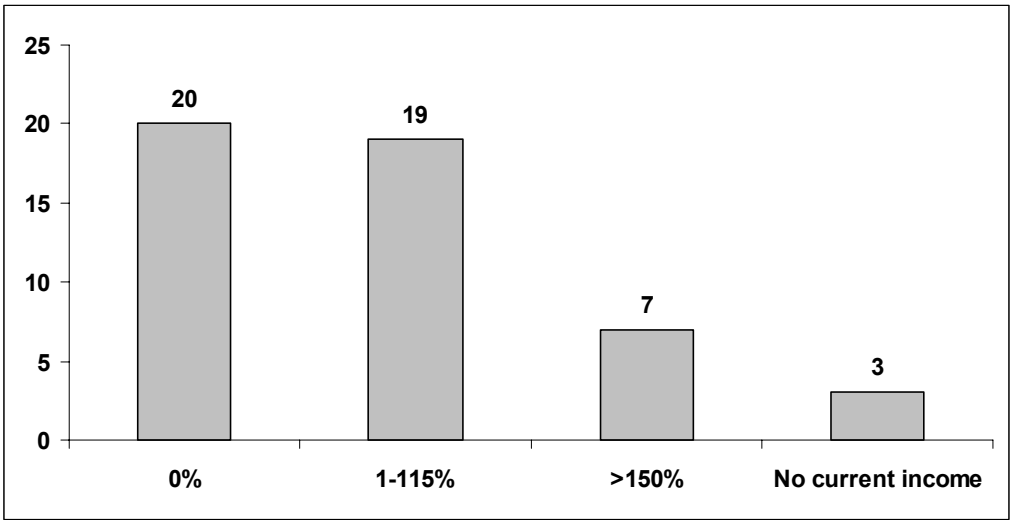
This issue of subjectivity has potentially significant implications for this analysis and is considered in greater detail in the following section.

### The "Funding Gap"

Exhibit 5.2.B illustrates the distribution of answers from the 49 MPAs which gave an estimate of their minimum additional funding requirement. Of these, 20 respondents said they were already functioning with at least a minimum level of income and therefore set their minimum additional funding requirement at nil. The remaining MPAs fell into three groups.

**Exhibit 5.2.B: Distribution of additional funding needs**

*(ranges based on minimum additional requirement as % current income)*




Source: MPA survey

The first group — 7 in number — estimated that they would require a very substantial increase in current income if they were to achieve their minimum objectives. The targeted minimum income within this group ranged from a 2.5-fold to more than a 10-fold multiple of current income.

The second group — 19 in number — estimated that their minimum funding requirement was in a range between their current income and approximately twice that number (strictly speaking, 2.15 times current income was the cut-off point, chosen arbitrarily, for this group); the average percentage increase from current income to reach the minimum funding requirement was 53% for this group. The third group comprised three MPAs which had no current income, making a percentage increase figure meaningless.

Characteristics of the funding gap

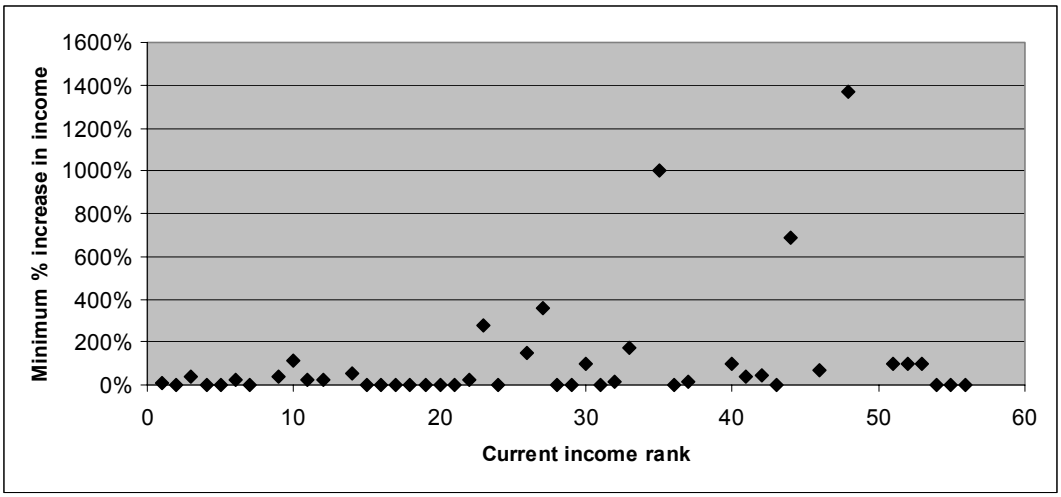
Before using the required income information for modeling purposes, it is important to understand the factors that might explain a shortfall in an MPA's current income compared with the funding need estimated by the respondent.

In the first instance, one would expect the most under-resourced MPAs to specify the largest additional funding requirement measured as a percentage of current income. Furthermore, under-resourced MPAs are likely to be placed more lowly in the rankings (based on current income) than their overall characteristics would suggest. Therefore, one might expect to see some relationship between the percentage additional funding requirement and rank on current income.

Exhibit 5.2.C illustrates how the minimum additional funding requirement — measured in relation to current income — relates to rank by current income. It does seem to be the case that the very large funding gaps are concentrated in the lower rankings. In fact, none of the respondents wanting a very significant "n-fold" increase in their incomes are currently ranked in the top twenty MPAs in terms of current income. Overall, however, the pattern of correlation is only moderate (r = 0.27).

**Exhibit 5.2.C: Minimum additional income needs versus current income rank**

*(minimum additional income as % current income)*

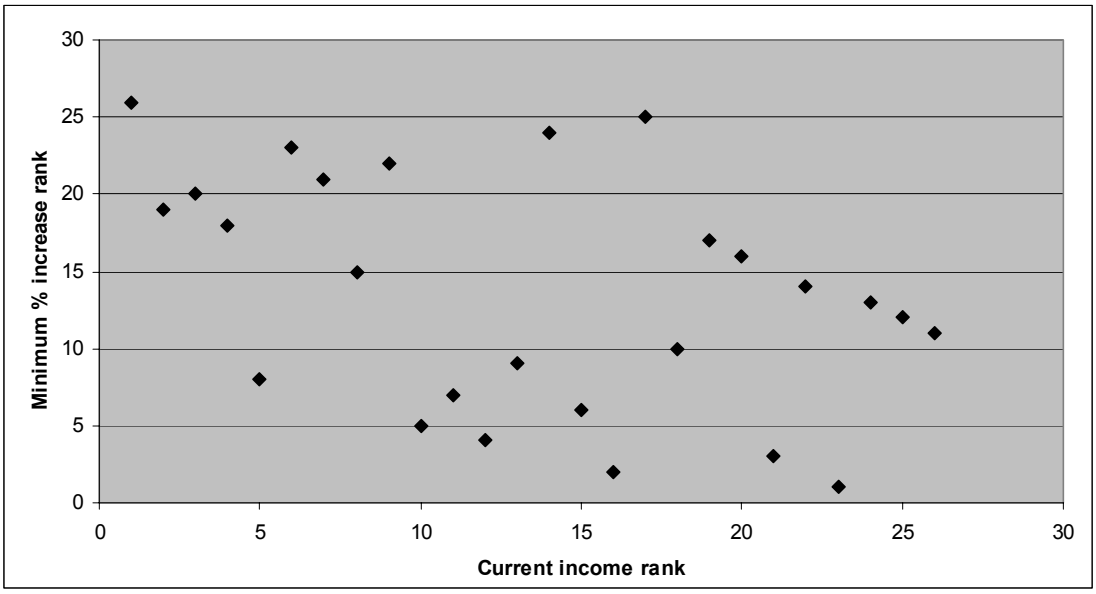



Source: MPA survey

Exhibit 5.2.D approaches the data from a slightly different perspective. In this chart, the MPAs are ranked according to minimum additional funding needs (measured by the required percentage increase over current income). This is then compared with ranking by current income. This rank-based test aims to reduce the influence of outliers — such as the MPA which suggested that its minimum funding need was a 14-fold multiple of current income. (Note that nil values were excluded from this analysis.)

**Exhibit 5.2.D: Minimum % increase rank versus current income rank**

*(ranking based on minimum additional income as % current income)*




Source: MPA survey

The distribution in Exhibit 5.2.D shows a weak correlation, with an r of -0.17. It is true that relatively few of the top-ranked MPAs by current income rank highly in terms of the percentage funding gap while many of the lowly-ranked MPAs are high in the rankings for percentage funding gap. However, overall, the likelihood of an MPA with an annual income of USD 50,000 estimating a larger funding gap than an MPA with a budget of USD 5 million does not seem to be statistically well established.

Further study of this issue is required. The author is tempted to speculate that the absence of a strong correlation in Exhibit 5.2.D might reflect to an extent the psychology of aspiration. Managers of MPAs might be conservative in their ambitions and cap their expectations in reference to their budgetary circumstances. For example, a severely under-funded MPA might "dream" simply of being able to afford more fuel for its boats, while a wealthier peer might consider its minimum needs in terms of the resources it requires for, say, community relations.

<u>The relationship between ideal and minimum funding</u>

The ratio of minimum funding requirement to current income occupies a broad range within the sample (from one up to approximately 14). As might be expected, the ratio of ideal funding requirement to the minimum funding requirement occupied a narrower range.

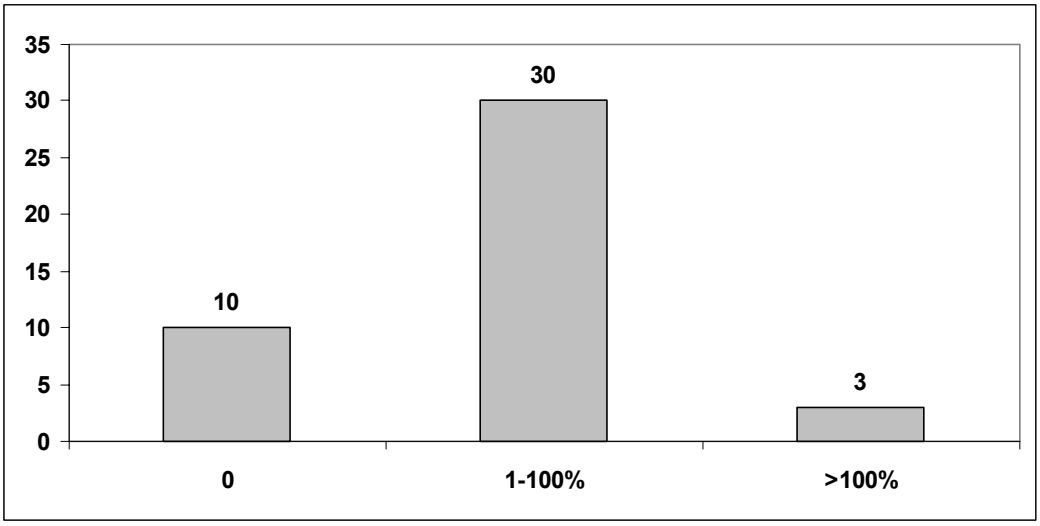
Data was provided on ideal and minimum funding needs by 43 of the MPAs. In ten cases, the figure for ideal funding requirement was the same as the figure for minimum funding requirement. The reasons why the opportunity was not taken by these respondents to specify a "nice-to-have" ideal sum is not clear. It might be that these respondents had philosophical reservations about the difference between bare sufficiency and ideal resourcing. It might also be the case that some of the MPAs were reluctant to disclose a minimum funding figure as part of a tacit bargaining strategy. More practically, some respondents might simply have lacked the time or inclination to complete the questionnaire on the basis of lengthy calculations.

Beyond these ten, the majority of the sample — 30 in number — supplied different figures for MFR and IFR. In most of these cases, the proposed ratio of ideal to minimum funding requirement was less than or equal to 2. Only three MPAs believed that their ideal funding requirement was more than double the minimum, with the most ambitious suggesting that the ideal funding requirement was a threefold multiple of the MFR. Exhibit 5.2.E shows a distribution of the responses.

There is some evidence to suggest that the ideal figures might have been estimated by some respondents simply by adding an *ad hoc* increment to the minimum figure. In more than one instance, the estimated ideal funding level was precisely twice the estimated minimum level — possibly a case of "think of a number and double it". This observation is not intended as a criticism, but merely seeks to highlight the difficulty respondents might have had in answering a question of this nature.

**Exhibit 5.2.E: Distribution of ideal income as a % increase over minimum income**

*(number of MPAs responding in each range)*




Source: MPA survey

Out of the whole sample, only 5 MPAs thought they were currently receiving an ideal amount of funds. The other 41 MPAs responding to this question put forward an ideal funding requirement corresponding to a mean percentage increase over current income of 174% (and a median increase of 81%). The mean absolute increment was USD 450,000 (and the median was USD 156,800).

**Exhibit 5.2.F: Minimum and ideal % uplift and total funding requirement**

*(uplift as a % increase over current income; amounts in USD)*

| Mean % minimum uplift | Mean minimum funding requirement | 95% confidence level lower bound | 95% confidence level upper bound | Median minimum funding requirement |
|---|---|---|---|---|
| 104% | 1,025,110 | 608,816 | 1,441,405 | 444,441 |
| Mean % ideal uplift | Mean ideal funding requirement | 95% confidence level lower bound | 95% confidence level upper bound | Median ideal funding requirement |
| 174% | 1,149,314 | 665,082 | 1,633,545 | 315,171 |

Source: MPA survey

Exhibit 5.2.F shows both the mean desired % uplift and target funding requirement on both a minimum and ideal basis. It might be noted that the mean ideal funding requirement shown is only 12% greater than the mean minimum funding requirement, owing to the nature of the sample sets. This also explains why the median IFR is lower than the median MFR.

Given that the average MPA requires a 104% uplift in its income to fulfil its minimum funding requirements, the sample of 47 MPAs has a total annual income requirement of USD 48,180,170.

Factors explaining the funding gap

Overall, the typical size of any percentage funding shortfall across the data set showed a very limited relationship with the independent variables used in the survey. Neither MPA size nor visitor numbers appeared to have any association with either the minimum or ideal funding gap (measured as the percentage difference between the MFR or IFR against current income).

On a geographical basis, although there appeared to be some variations between different regions, the differences were not statistically significant in light of the sample sizes. Looking at the full data set in Appendix 8, the disparities seem to be based on a small number of very large funding gaps found (perhaps by chance) in some areas but not in others.

In fact, only one variable appears to be significantly related to the size of the funding gap, namely source of funds.

Exhibit 5.2.G below illustrates how the source of an MPA's funds has a material bearing on the percentage gap between the minimum funding requirement and current income. MPAs whose main source of funds are either Foreign entities or Visitors, generally propose the need for a smaller percentage uplift in their current income than Government-funded MPAs.

**Exhibit 5.2.G: Additional funding needs versus primary source of MPA funds**

*(number of MPAs; categorised by minimum additional income needs as % current income)*

| | | 0 | 1-30% | 31-100% | > 100% | TOTAL |
|---|---|---|---|---|---|---|
| Source of funds | Government | 9 | 6 | 9 | 8 | 32 |
| | Foreign entities | 5 | 1 | 1 | 1 | 8 |
| | Visitors | 5 | - | - | - | 5 |
| | TOTAL | 19 | 7 | 10 | 9 | 45 |

Source: MPA survey

There could be a number of reasons for this relationship. In the first instance, it might be that MPAs funded by Foreign sources are simply better resourced – their needs being more fully catered for by a generous sponsor in tune with their requirements.

Visitor-funded MPAs on the other hand might require a lower relative increase in their income if they are largely self-sufficient. These MPAs might have already attempted to narrow their funding gap through the management of visitor fees and other potential sources of revenue.

Self-sufficiency is not an option for the Government-funded MPAs, which are forced to depend on a sponsor which faces competing calls for funds. More cynically, one notes that many of the Government-funded MPAs are in the northern hemisphere where there is, perhaps, a more developed culture in lobbying for state funding, possibly resulting in amplified claims for additional funding.

## 5.3 Developing an Income Model

The purpose of this chapter is to analyse the relationships between the variables assessed in the survey[11] and MPA income requirements. By understanding the associations between funding needs and various factors, the aim is to be in a position to estimate for a given MPA the funds needed to meet its management objectives.

Before going into further detail, it is important to highlight some of the inherent difficulties in achieving this goal. Firstly, it may not be possible to measure accurately the relationship between a given variable and income requirements. Secondly, the variables examined here form only a partial picture of the context in which the MPAs operate. There are others that have not been surveyed in this study, such as the condition of (or threats to) the resource. These might possibly have a very significant impact on funding requirements.

[11] To re-cap, the variables used in the study are MPA size, purpose (including the benefit to fisheries), habitat protected, annual visitor numbers, geographical location, GNI per capita of the host country, zonation and source of MPA funds. For further detail on the definition of these variables please refer back to section 4.2.

Because of these qualifications, it is very unlikely that it will be possible to build a comprehensive model of MPA funding needs on the basis of the survey results. The best that can be hoped for is to move towards a better understanding of how MPA income requirements are associated with and determined by a range of factors and characteristics.

Selecting the data for analysis

The findings of the questionnaire, elaborated in the previous section show quite clearly the extent of current MPA under-funding. The percentage increase in current income required to reach a minimum level of funding showed a median of 15% and mean of 104%. On this basis, a model of income requirements based on current funding levels would have a built-in bias to under-funding. The approach adopted here, therefore, will be to model the level of funding that would allow an MPA to meet its objectives. Furthermore, the focus will be on the minimum and not the ideal funding requirements.

There are two principal reasons behind the decision to focus on the minimum funding requirement. Firstly, it is more likely that a funding body will base its decisions on fulfilling the most urgent priorities (the "must-haves", not the "nice-to-haves"). Secondly, as was discussed earlier in this chapter, the author has some reservations as to how the ideal income figures might have been derived by respondents and to what extent they represent careful estimates based on an ideal set of activities. Although this observation could also be leveled at the minimum income estimates, there is a sense that the MFR figures form a more relevant base for modeling purposes. This is not to say, however, that the MFR data will fully reflect all of the contextual requirements of the MPA, but simply that they seem to form the most useful platform for building a funding model.

It might be noted at this point that in fifteen cases (as illustrated in Exhibit 5.2.A) a figure for the IFR was provided by the respondent but the question on the MFR was left unanswered. In these cases, an MFR for the MPAs was estimated in order to increase the sample set for the purposes of the principal modeling exercise (which concentrated on the MFR, not the IFR, data). This was done by calculating the ratio of MFR to IFR for those MPAs which had answered both questions. This ratio (approximately 0.4) was then used to estimate MFR values for MPAs which had supplied only IFR data.

Factor selection

The first step in developing a funding requirement model was to explore the association between the different variables used in the analysis and the minimum funding requirement. The tests used for this are detailed in Appendix 4.

The results of this analysis were quite straightforward. Area and visitor numbers were the only factors to show any statistically significant relationship with the minimum funding requirement. (This was also true, incidentally, for the ideal figures.) The correlation statistics for area and MFR were $r = 0.53$ ($p < 0.001$), while for visitor numbers the correlation statistics were $r = 0.513$ ($p < 0.001$).

The following analysis considers how these variables of area and visitor numbers might be used to develop a funding model.

Bottom-up versus top-down

An important medium-term goal of a study of MPA income requirements would be to construct a predictive model of funding needs based on an understanding of the particular characteristics and activities of an MPA. Such a model could be statistical in nature (that is, based on observed relationships between variables without a detailed attempt to understand the underlying causality) or it could be bottom-up, with an attempt to discover typical execution costs for particular combinations of activities.

Ultimately, the most satisfying approach would be the latter, since it would permit a linkage to be drawn between a theory of MPA cost structures and the empirical evidence of how MPAs operate in the real world.

In the next section, an attempt shall be made to construct a simple bottom-up model — based on a fixed cost/variable cost approach — and test it against the survey findings. As we shall see, although it is not difficult to hypothesise a possible form for a model, testing it against the data presents serious challenges, owing to the very wide range of values that each of the variables in the sample occupies.

Constructing a bottom-up model

In principle, a bottom-up model for income requirements would look at the costs of pursuing various activities. The total running costs of an MPA would then take the form:

$$C_T = C_1 + C_2 + C_3 + \ldots \; C_i \ldots$$

$C_T$ = total cost

$C_i$ = cost associated with activity i

There could be many drivers of $C_i$, but a basic model might assume that $C_i$ comprised both fixed and variable costs. The fixed costs (or overhead) might reflect, for example, the need for management staff. The variable cost would depend on the value of a particular factor (e.g. area, visitor numbers). This simple hypothetical model might take the form:

$C_i$ = Fixed costs + (Variable cost per factor unit x Factor value)

Or, where several factors are involved:

$$C_i = O_i + u_{i1} \times F_1 + u_{i2}F_2 + \ldots . u_{ij}F_j + ..$$

$C_i$ = Cost associated with activity i
$O_i$ = Overhead needed for activity i
$F_j$ = Value of Factor j

$u_{ij}$ = Variable unit cost with respect to Factor j in pursuing activity i

Summing across different activities (and assuming — perhaps without justification — that no economies of scale exist across the various overheads) gives the following general model:

$$C_T = \sum C_i$$

$$C_T = \sum O_i + F_1\sum u_{i1} + \ldots \; F_j\sum u_{ij} + \ldots$$

$C_T$ = total cost
$C_i$ = Cost associated with activity i
$O_i$ = Overhead needed for activity i
$F_j$ = Value of Factor j

$u_{ij}$ = Variable unit cost with respect to Factor j in pursuing activity i

In this form, $\sum u_{ij}$ would represent the total variable costs associated with Factor Fj summed across all activities that depend on that factor. In effect, this general model forms the basis for a linear multivariate analysis.

As a starting point for exploring relationships in the data, the multivariate model can be simplified to a model that focuses on only one factor. In the case of area, for example, the model would take the form:

Total cost = Overhead + Variable cost per hectare x Area

$\Rightarrow$ Total cost per hectare = Overhead/area + variable cost per hectare

$$C_T = O + u_a A$$

$$\Rightarrow C_T/A = O/A + u_a$$

$C_T$ = Total cost
O = Overhead
A = Area
$u_a$ = Variable cost per hectare

For visitor numbers, the model would take the form:

Total cost = Overhead + Variable cost per visitor x Visitor numbers

$\Rightarrow$ Total cost per visitor = Overhead/visitor + variable cost per visitor

$$C_T = O + u_v V$$

$$\Rightarrow C_T/V = O/V + u_v$$

$C_T$ = Total cost
O = Overhead
V = Visitor numbers
$u_v$ = Variable cost per visitor

In both examples we have shown two formulations of the equation. The second is in each case a simple rearrangement of the first, but focuses on the total cost per hectare or per visitor rather than the total cost *per se*.

Testing the bottom-up model

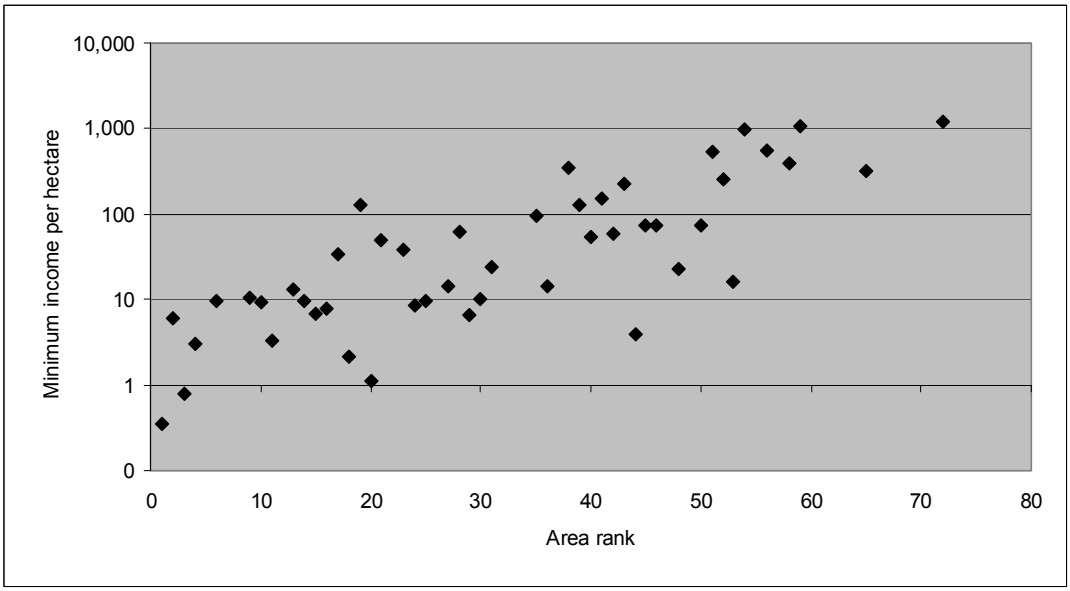
The simplified bivariate models discussed above provide the basis for a preliminary exploration, using linear regression techniques, of how each variable influences income requirements. This can be done using either formulation. In the examples below, we use the second form, which focuses on the total cost per hectare or per visitor. When testing for a linear relationship with this model, it is necessary to use the reciprocal of area (or visitor numbers respectively) on the x-axis to ensure that the model properly corresponds to the equation of a straight line.

Before examining the linear regression findings in detail, it is helpful to review the overall characteristics of the data. Exhibit 5.3.A shows the minimum income per unit area for each MPA (equivalent, in the model, to the total cost divided by the area). This figure is compared with how each MPA ranks in terms of area.

It should be noted that respondents did not estimate their minimum income needs in this form — the data in Exhibit 5.3.A has been derived from their absolute USD figure.

**Exhibit 5.3.A: Minimum income per unit area versus area rank**

*(USD per hectare)*

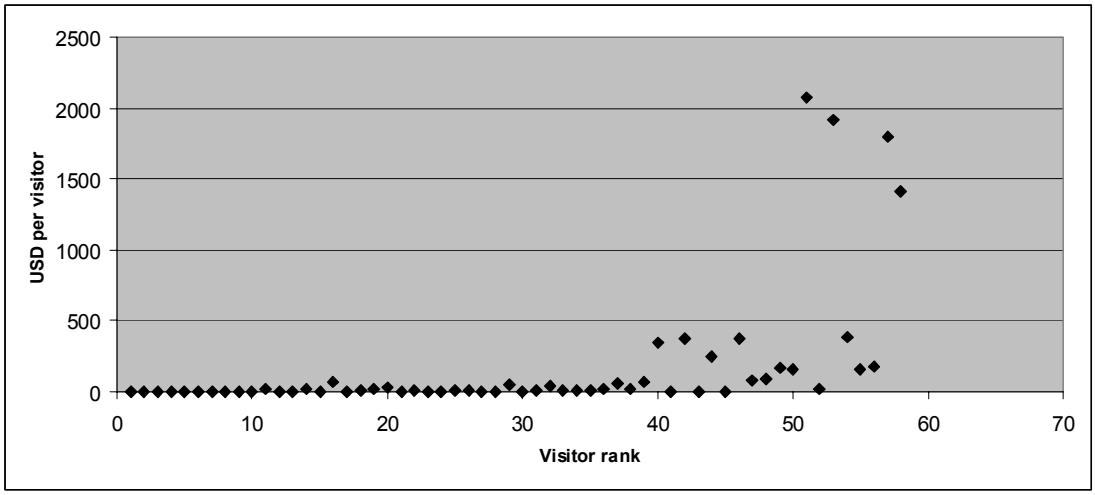



Source: MPA survey

For the fifteen largest MPAs — all with an area greater than 50,000 ha — the minimum income per unit area is typically less than USD 10/ha. Among these, two MPAs estimated their minimum funding needs at less than USD 1/ha. Moving down the rankings to smaller MPAs, the minimum income per unit area rises rapidly, with MPAs ranking below 50 in terms of size having minimum income needs per unit area ranging from USD 100/ha up to more than USD 10,000/ha for the smallest.

**Exhibit 5.3.B: Minimum income per visitor versus rank by visitor numbers**

*(USD per visitor)*




Source: MPA survey

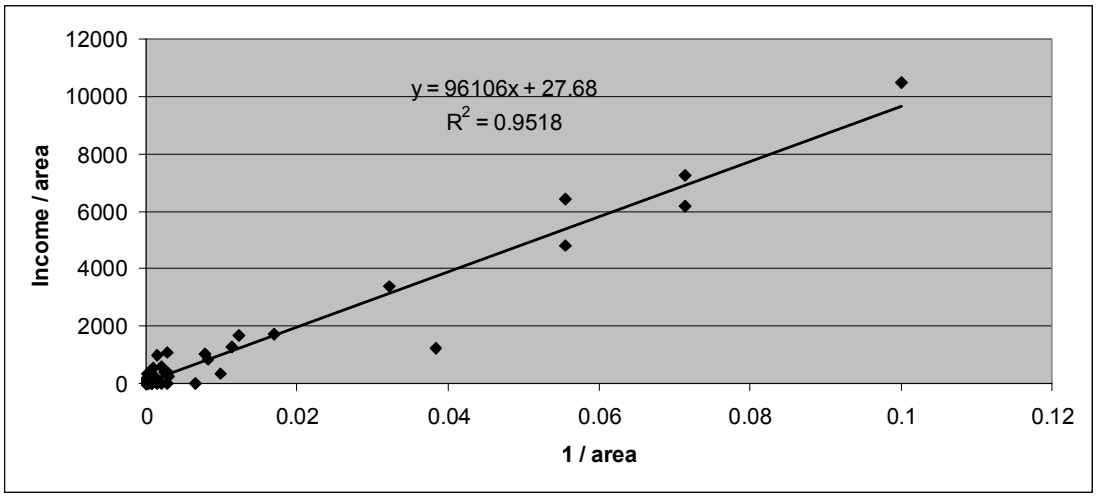
Exhibit 5.3.B illustrates the equivalent data for minimum income per visitor. The majority of the MPAs (those with visitor numbers ranging from 6,500 to six million per annum) would be satisfied with an annual income of USD 75 per visitor or less. For MPAs with visitor numbers below about 4,000 per annum, the per visitor income requirements shoot up to more than USD 350. An initial appraisal of this pattern might suggest that for MPAs with very low visitor numbers, other factors such as MPA size, become more important in determining income requirements.

As a separate point, the minimum income per visitor data covers a very broad range with some parks able to manage on less than USD 1/visitor and others estimating a minimum income need equivalent to more than USD 1,000/visitor.

In the following charts (Exhibit 5.3.C and Exhibit 5.3.D), we show the results of the linear regression tests. The relationships being tested are in the form of minimum income per unit area against the reciprocal of area and minimum income per visitor against the reciprocal of visitor numbers. It might be noted that where the reciprocal of area and visitors is used the overhead cost becomes the gradient term. In interpreting the graphs the clustering of the points around the origin needs to be emphasised. The following section covers this in further detail.

**Exhibit 5.3.C: Income per unit area versus the reciprocal of area**

*(USD per hectare)*




Results for area analysis:

Theoretical model: $C_T/A = O/A + u_a$

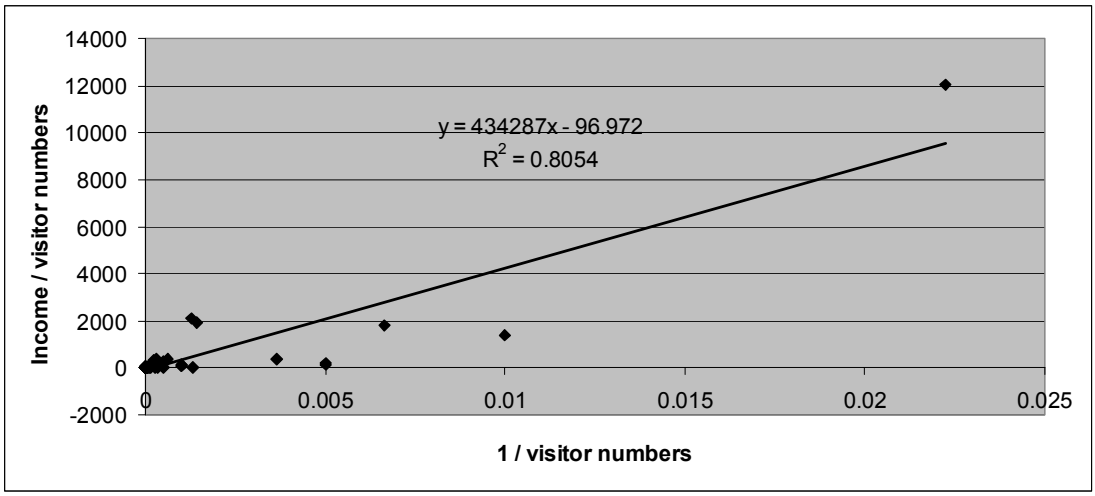
Best fit by regression: $y = 96{,}106x + 27.7$ $R^2 = 0.952$

In other words, based on the sample of 50 MPAs, each protected area requires a mean overhead of USD 96,000 plus USD 28 per hectare on an annual basis

Source: MPA survey

**Exhibit 5.3.D: Income per visitor versus the reciprocal of visitor numbers**

*(USD per visitor)*




Results for visitor number analysis:

Theoretical model: $C_T/V = O/A + u_a$

Best fit by regression: $y = 434{,}287x - 97.0$ $R^2 = 0.805$

In other words, based on the sample of 50 MPAs, each protected area requires a mean overhead of USD 435,000 plus a negative USD 97 per visitor on an annual basis

Source: MPA survey

Practical limitations of the bottom-up approach

On the face of it, the results of the regression exercise appear encouraging, with $R^2$ of 0.95 and 0.81 for the area and visitor models respectively. However, a closer examination of the data reveals a serious flaw with this approach, which means the apparent strength of the regression needs to be treated with scepticism.

The fundamental problem is the distribution of the data inputs. Since the data for area and visitor numbers cover many orders of magnitude, the density of data points across the sample is not uniform when analysed on a linear scale. In practice, the density of data points increases rapidly approaching the origin.

This clustering will tend to generate falsely high correlations in regression tests because the greatest weight will be given to the few outermost points while all of the points clustered near the origin will appear to be in close proximity — as far as the regression mathematics is concerned — to the line of best fit.

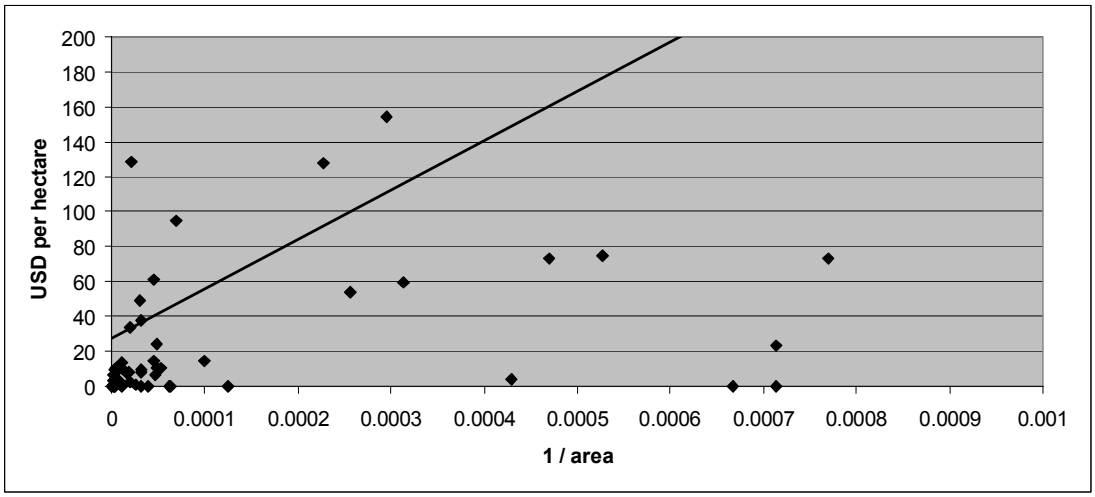
Exhibit 5.3.E illustrates this point by showing a magnified view of Exhibit 5.3.C in the vicinity of the origin (where most of the data points reside). Despite the $R^2$ of 0.95, the model does not usefully apply to the vast majority of the MPAs. In order to capture a reasonable proportion of the sample within an envelope of error, the variable cost per unit area would have to range from less than zero to over USD 100/ha. More

explicitly, the variable cost per unit area has been measured to be USD 28 (±70)/ha, a range so wide as to have little practical value.

A version of Exhibit 5.3.D magnified around the origin shows a similar pattern.

**Exhibit 5.3.E: Income per unit area versus reciprocal area (near origin)**

*(USD per hectare)*




Source: MPA survey

A practical alternative based on log regression

What began as an attempt to build a bottom-up model for MPA funding requirements must be abandoned, for now, in the absence of an evenly distributed sample. In fact, if the data is distributed on a log basis, the obvious conclusion to draw is that any regression-based approach will only be meaningful if applied to log data. This is the approach that will be adopted for the remainder of this chapter.

Moving from a model based on absolute data to a model based on log data is not without an analytical cost. In practice, it will be difficult to relate regressions based on log data easily to any bottom-up model because the intervening mathematics become complex. In effect, any relationships found in the log data will have to be seen as largely statistical in nature (rather than as grounded in a detailed understanding of the cost of pursuing various activities).

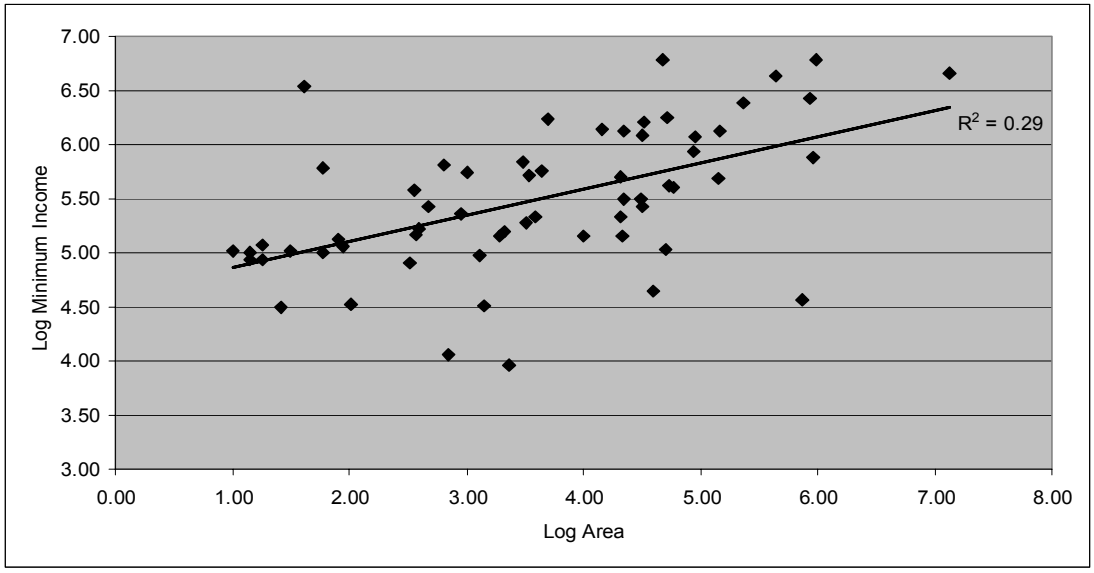
On a practical point, the analysis of the log data uses a log base of 10. This was to facilitate interpretation of the results.

## 5.4 Bivariate Patterns in the Log Data

Exhibit 5.4.A illustrates the relationship between the log of minimum income and the log of area, with a line of best fit. There appears to be a positive correlation, with larger incomes associated with larger areas. The $R^2$ of the regression is 0.29 (which would improve to 0.50 with the exclusion of four outliers). The corresponding regression for the log of minimum income against the log of visitor numbers is illustrated in Exhibit 5.4.B. The quality of correlation is almost the same as for area, with an $R^2$ of only 0.25 and a higher dispersion of the data points around the line of best fit.

**Exhibit 5.4.A: Log of minimum income versus log of area**

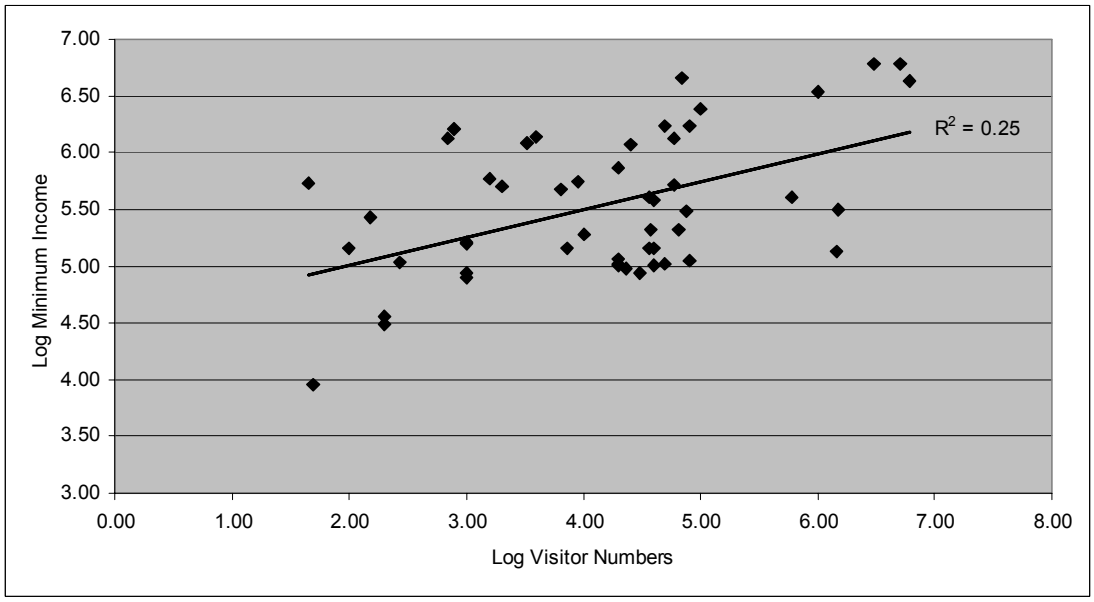
*(Minimum income in USD; area in hectares; $log_{10}$ )*




Source: MPA survey

**Exhibit 5.4.B: Log of minimum income versus log of visitor numbers**

*(Minimum income in USD; $log_{10}$ )*

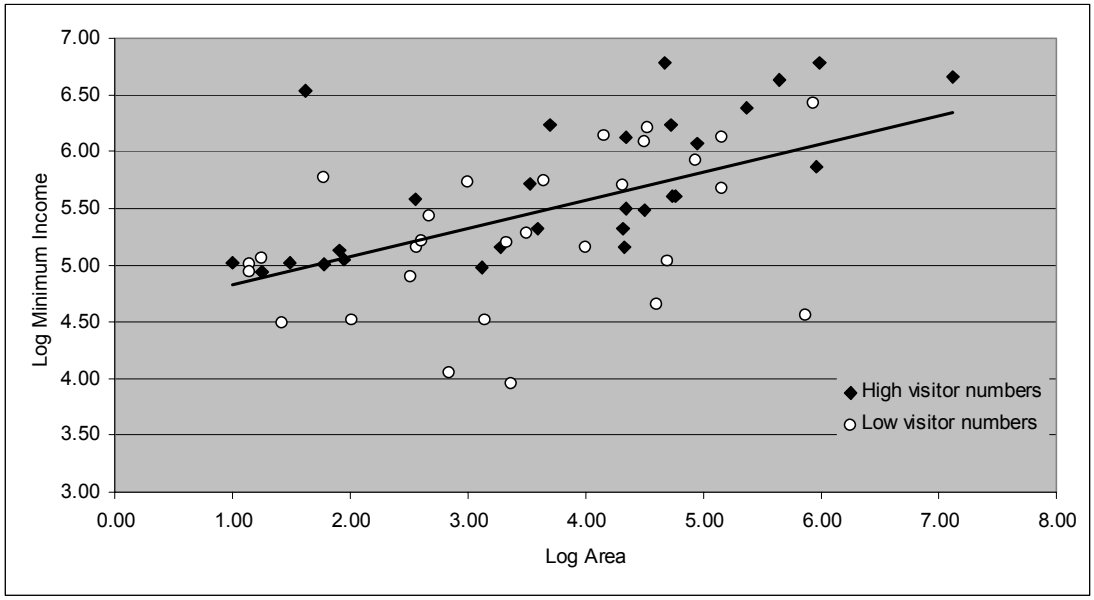



Source: MPA survey

In Exhibit 5.4.C, the income-against-area chart has been reproduced, but this time the MPAs have been divided into two groups — those with visitors numbers greater than the median and those with visitor numbers less than the median. As can be seen from the chart, MPAs with higher visitor numbers have a greater tendency to be positioned above the line of best fit, while those with lower visitor numbers tend to be distributed below the line. This implies that MPAs with high visitor numbers typically have a higher MFR than MPAs of an equivalent size with lower visitor numbers.

**Exhibit 5.4.C: Subdivision of log income-log area chart**

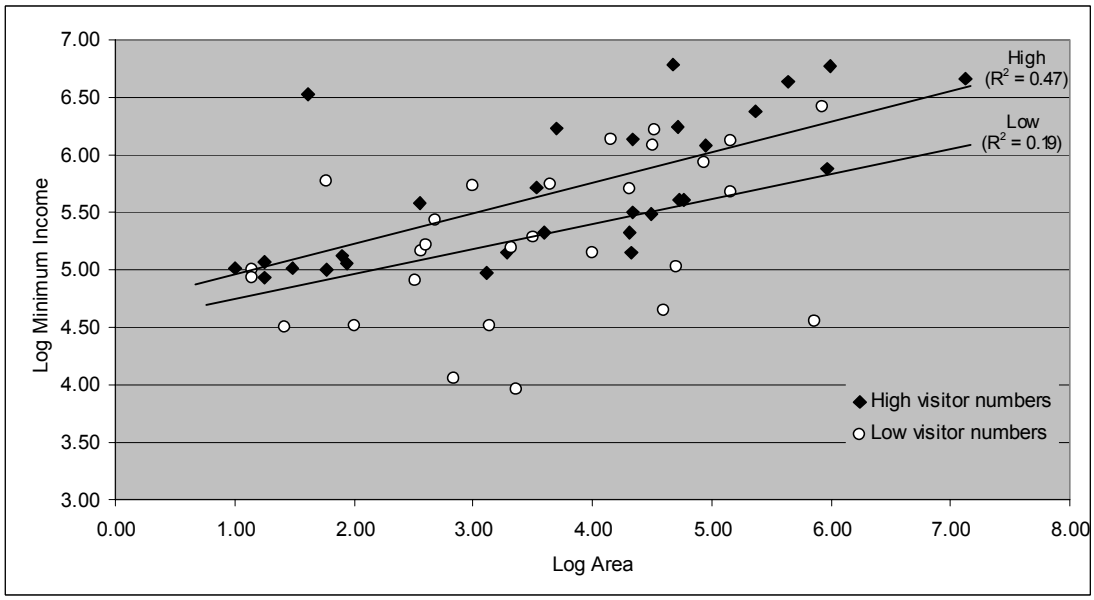
*(Minimum income in USD; area in hectares; sample divided between high- and low-visitor MPAs)*




Source: MPA survey

**Exhibit 5.4.D: Trendlines for log income-log area chart**

*(Minimum income in USD; area in hectares; trendlines for high- and low-visitor MPAs)*




Source: MPA survey

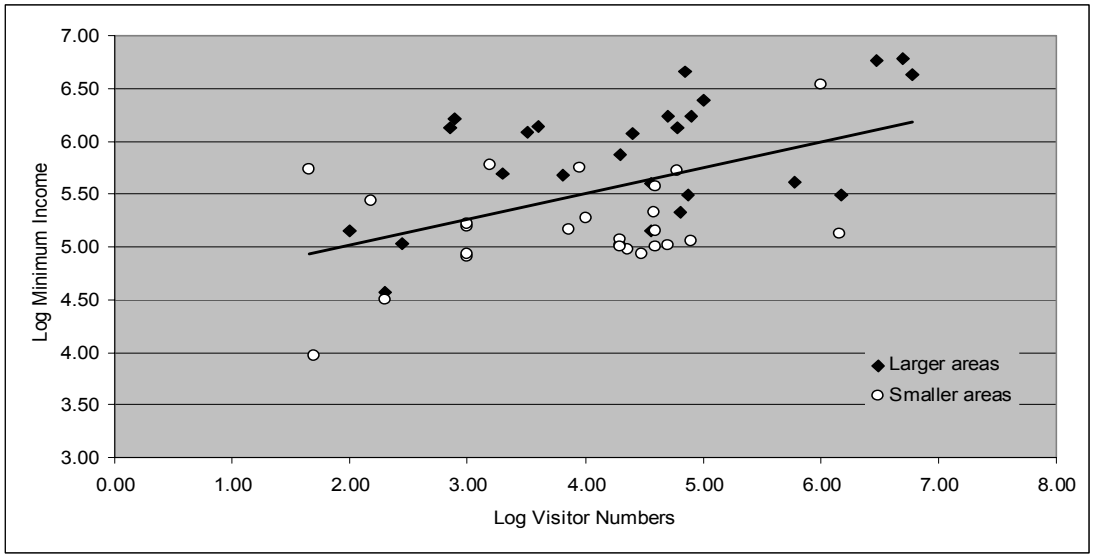
Exhibit 5.4.D, is essentially the same as Exhibit 5.4.C except, for this chart, separate trendlines are shown for the high and low visitor sub-groups. The trendlines serve to confirm the fact that the relationship between minimum income and area is much closer for the group with high visitor numbers than for the group with fewer visitors. This finding will be discussed in further detail in a later section.

Exhibit 5.4.E show the equivalent analysis for visitor numbers with respect to the MFR, but here the data points have been divided on the basis of area (larger and

smaller). In this case, the fact that the larger MPAs tend to have an MFR greater than that which would be expected on the basis of visitor numbers alone demonstrates the importance of area as a factor determining income requirements.

**Exhibit 5.4.E: Subdivision of log income-log visitor numbers chart**

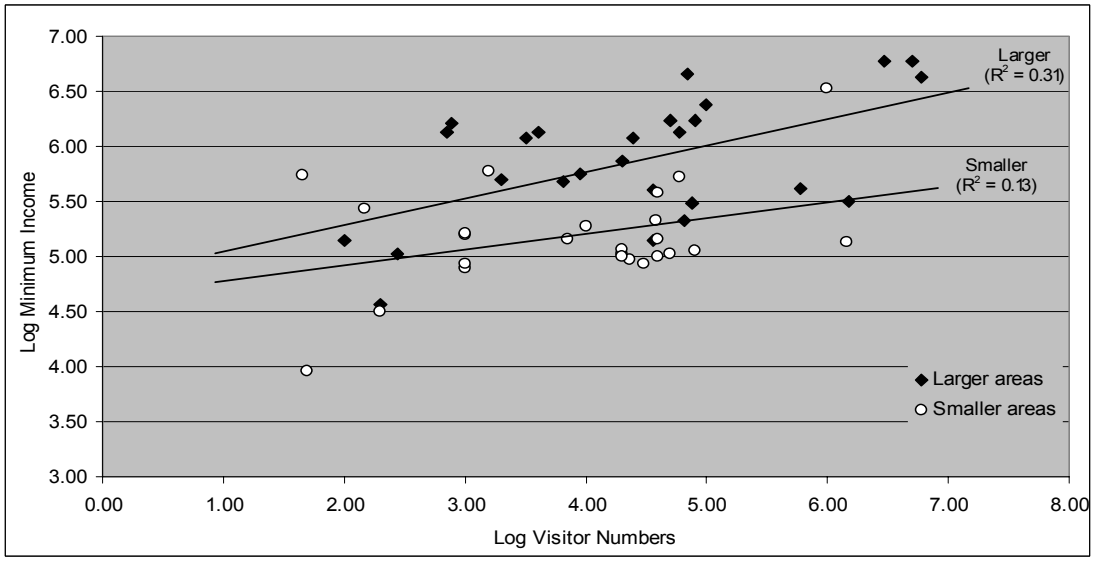
*(Minimum income in USD; sample divided between larger and smaller MPAs)*




Source: MPA survey

**Exhibit 5.4.F: Trendlines for income-visitor numbers chart**

*(Minimum income in USD; trendlines for larger and smaller MPAs)*




Source: MPA survey

It is notable that the separation between the two sub-groups is somewhat clearer in this case (where division is on the basis of area) than in the previous example where the sub-groups were divided on the basis of visitor numbers.

Exhibit 5.4.F shows the trendlines for the two sub-groups. For the smaller MPAs, the correlation between minimum income and visitor numbers is poor, with an r of only 0.13.

## 5.5 A Multivariate Log Model

The two preceding analyses suggest that minimum income is positively correlated with both area and visitor numbers, with area playing a somewhat more important role. This finding suggests that there might be benefits in examining the data further with a multivariate model. In this section, the relationships discovered in the preceding section will be explored using a two-variable model assuming the following form:

| | |
|---|---|
| Multivariate model: | MI = Minimum income |
| | A = Area |
| Log MI = a Log A + b Log V + c | V = Visitor numbers |
| | a,b = Regression coefficients |
| | c = Regression constant |

Within the total survey sample, 51 MPAs provided sufficient data to allow the model to be tested. A standard multiple regression in SPSS, based on this model, produced the following results:

**Exhibit 5.5.A: Results of multiple regression model**

| R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|
| 0.693 | 0.48 | 0.458 | 0.4611 |

| | Unstandardised coefficients | | Standardised coefficents | | |
|---|---|---|---|---|---|
| | B | Std. Error | Beta | t | Sig |
| Constant | 3.959 | 0.254 | | 15.608 | .000 |
| Area | .202 | .043 | .491 | 4.663 | .000 |
| Visitor numbers | .206 | .052 | .418 | 3.965 | .000 |

Source: SPSS multivariate analysis of MPA survey

The adjusted $R^2$ from this analysis was close to 0.46, with the standardised coefficients suggesting that area made a slightly greater contribution to the result than visitor numbers.

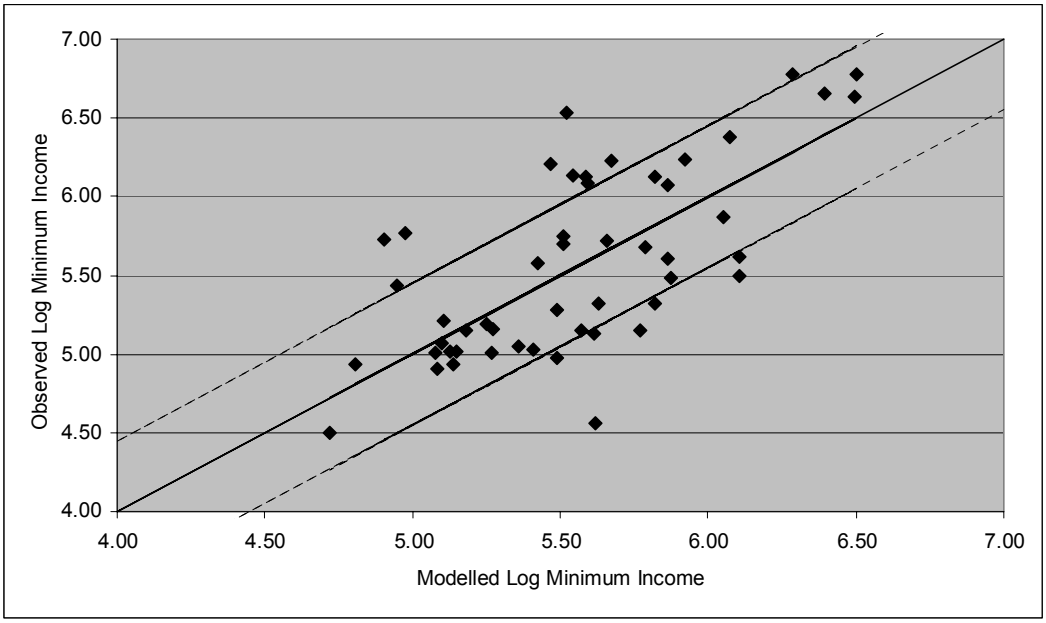
Quality of fit

Exhibit 5.5.B presents the results of the model as a chart of observed values against predicted values. The $R^2$ of 0.46 is apparent from this chart, with a broad distribution of the observed values around the modelled line. The standard deviation of the residual amounts (the difference between the observed and expected values) is approximately 0.45. This range is illustrated in the chart by two guidelines, separated on either side of the modelled line by one standard deviation. It is clear that the two-variable model provides an interesting but incomplete description of MPA funding

requirements. Furthermore, there seem to be no obvious patterns in the residuals, a subject to be discussed in further detail shortly.

**Exhibit 5.5.B: Minimum income compared with modeled income**

*(Guidelines show ± one standard deviation)*




Source: SPSS multivariate analysis of MPA survey

In order to demonstrate the predictive range of the model, the equation of best fit is presented below, with an estimated error of plus (or minus) one standard deviation.

$$\text{Log MI} = 0.202 \text{ Log A} + 0.206 \text{ Log V} + 3.959 \pm 0.45$$

It should be noted that the additive error of ±0.45 in the predicted log data of corresponds to a multiplicative error of $10^{\pm 0.45}$ in the predicted underlying data (i.e. approximately 2.8x).

In practice, this means that if a hypothetical MPA had a predicted value for minimum income of USD 1.0 million (based on area and visitor numbers); the actual figure could range from USD 350,000 up to USD 2.8 million within one standard deviation of the log model. Such a broad range is not entirely unexpected. The complexity of circumstances in which MPAs operate make it very unlikely that a simple model could explain with any precision the specific income requirements that would apply in a particular context. This broad point is the theme of the next section.

## 5.6 Explaining the Residuals

The purpose behind developing the multivariate model presented in the previous section was to propose a theory of how the variables of area and visitor numbers might determine income requirements. The analysis showed that area and visitor numbers between them explained 46% of MPA income requirements within the sample. In this section, the theoretical reasons as to why various factors might determine funding requirements will be analysed in more detail – paying particular consideration to the unexplained 54%.

It should be made clear from the start that, notwithstanding the analysis of the previous section, it is possible that the relationship linking visitor numbers and area with income requirements is largely illusory. The fact that the current (and desired) income requirements of MPAs correspond to a diminishing income per hectare as area increases might reflect economies of scale but might equally result from a funding approach in which funds are allocated on the basis of factors unrelated to scale (and possibly unidentified) or in which protected areas receive a flat rate independent of most of the more obvious variables.

The idea that MPA income requirements might be unrelated to visitor numbers or area seems improbable. However, it was interesting to note in Exhibit 5.4.D and Exhibit 5.4.F that the quality of fit was substantially reduced for those MPAs falling below the median for visitor numbers and area respectively.

These findings, coupled with the overall scope of the residuals from the two-variable model presented above, suggests that at least one, and probably many other factors, are at play in determining MPA funding needs.

As already discussed, a range of non-parametric tests have been used to mine the available data for possible relationships. These tests suggest that there is no relationship — at least not a statistically significant one — between any of the other variables assessed in this survey and MPA funding needs. Habitat, purpose, zonation, the benefit to fisheries and the geographical location of MPA appear to have no bearing on the minimum amount of income an MPA requires to fulfil its objectives. Non-parametric tests are, of course, inherently limited in what they can reveal in terms of the analysis, although they have been very successful throughout the study in indicating both the strength and direction of a number of relationships described in Chapter 4.

It is very probable that these other factors do have some impact of income requirements, but it has not been possible to test the extent of these possible relationships in this analysis. In the first instance, it is very likely that most of these various factors will have a small incremental impact on determining the income requirements, which although insignificant in their own right, when combined would explain a reasonable but indeterminate amount of the residual.

The decision was made not to undertake a stepwise multiple regression analysis in order to explore this proposition for a number of reasons. Firstly, most of the factors were nominal making the output of questionable analytical value, and secondly, the data set was insufficiently large. According to Pallant (2001), approximately forty

additional samples are necessary for each variable in order to produce reliable findings from a stepwise multivariate analysis.

The second reason why it has not been possible comprehensively to assess the influence of the remaining variables on funding requirements, is that it is very likely that the study failed to reveal sufficient texture and detail as to the exact nature of many if not all of these factors. Taking the example of zonation. Although the survey requested information on zonation, it did not solicit a detailed breakdown of zonation patterns on the basis of size and activity. It is very likely that the minimum funding requirement will be heavily dependent on the nature and scale of zonation-related activities.

This question of the limitations of the survey leads on to the issue of other potential factors that were not addressed by the questionnaire. Given the length of the survey, it was judged unwise to extend it further through the inclusion of questions pertaining to a range of alternative possibilities such as the condition of the MPA or the extent of the threats it was facing. Both of these issues may potentially have a tremendous impact on funding requirements.

Comparing the model with the clusters

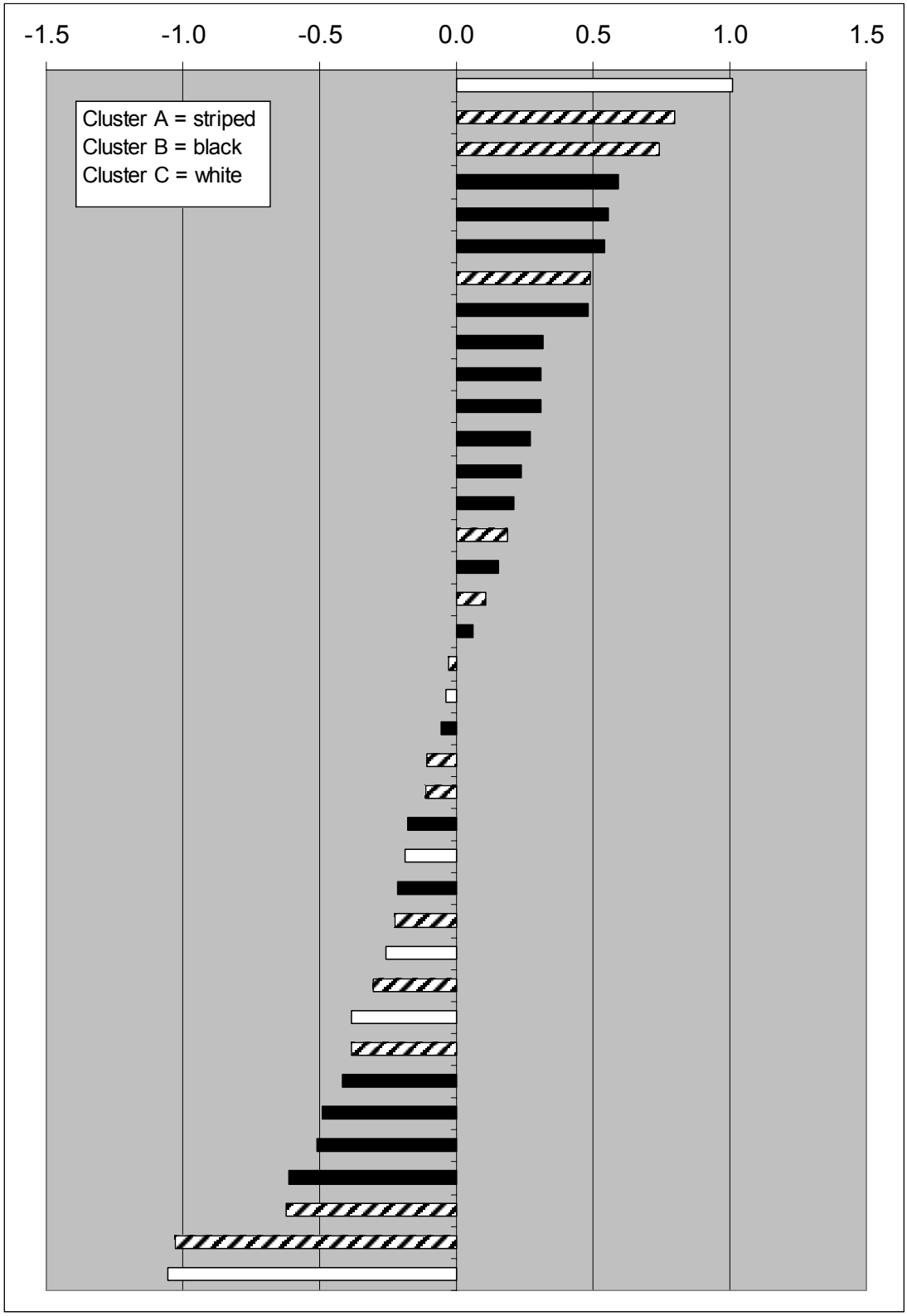
Having established the overall relationship between area and visitor numbers and the minimum funding requirement, it was of particular interest to compare the model with the actual requirements of the three main clusters identified in Chapter 4. It was anticipated that applying the model to the requirements of the different "types" of MPAs would have the potential to explain some of the residual differences between the actual MFR and the modelled requirement. For example, if Cluster A had showed very different requirements to Clusters B and C, it might have been surmised that the benefit to fisheries was a determinant of the MFR. In reality, no such difference was apparent.

Exhibit 5.6.A shows the results of this analysis. Interestingly, the clusters showed no variation in their requirements despite the differences in visitor numbers and area between the clusters. There are two possible reasons for this observation. Firstly, it is the case that the clusters have more in common than they have differences. Most of the clusters have an extensive range of purposes and there are only a couple of characteristics found in one particular cluster and not in the others. The benefit to fisheries found in Cluster A or the absence of fishing as a purpose in Cluster B are cases in point.

The second reason might be related to the sample sizes. Not all of the inputs required for the multivariate analysis were available for all of the cluster members. Because of this, the sample sizes of the clusters were reduced to very low levels – ranging from 6 to 19.

**Exhibit 5.6.A: Distribution of residuals from multivariate analysis**

*(Difference between observed log of minimum income and predicted value)*




Source: MPA survey

Some conclusions: appreciating complexity and context

The analytical work of this chapter has highlighted the many challenges associated with understanding the distribution of current and desired incomes across the sample of protected areas in this study and, probably, the global population of MPAs.

An important conclusion to be drawn from this work is that the specific context in which each MPA operates — embracing physical characteristics such as area and location, demands on resources such as visitors and enforcement, elective activities such as community relations and education and, finally, the ultimate aims and objectives of the MPA such as preservation of economic resources or environmentally motivated conservation — results in considerable complexity. This complexity makes it difficult to distinguish between coincidence and causality in the data and also makes it unlikely that any simple model could explain why a given MPA chooses a particular figure as the income it believes it needs to meet its objectives.

This is not to suggest that any further analysis of these relationships would be futile. Rather, it demonstrates that the study of MPA economics is still embryonic and that a much greater body of empirical information will have to be collected before a comprehensive picture of MPA funding requirements emerges.

## 5.7 How Additional Income Would be Spent

The information provided by the survey on ideal spending requirements was more comprehensive than the data on current spending although once again the results should only be taken as indicative. In addition, the findings on ideal spending by activity should not be directly compared to those for current spend, as a number of respondents to this section had no current income and had therefore not answered the current spending questions.

The suggestions provided by the respondents on how they would like to spend an additional increment to their income, represent a combination of discretionary items for the fully funded MPAs and necessities (and maybe some discretionary items) for their under-funded peers. Having said this, the ideal spending patterns of the MPAs currently functioning with sufficient income appear no different from their under-funded counterparts – with one exception. Only a handful of the fully funded MPAs would spend an extra increment on Research & Monitoring. This is clearly seen as a basic requirement.

Research and Monitoring is top of the list of activities upon which upon which the respondent would spend the ideal increment, with enforcement not far behind – the same pattern as for current spending. Spending by "type" such as for staff (i.e. wages and salaries) also features highly in the list of ideal spend preferences. Spending on staff, operating activities, boats and vehicles and other infrastructure and equipment could of course all be dedicated in practice to a variety of activities. Once again, a surprising omission to the list of activities MPAs wanted to increase their spending on, was conservation or habitat management. Only three MPAs made any explicit reference to habitat management of any type.

Exhibit 5.7.A shows the aggregated ideal spending patterns of all respondents in terms of both mentions and percentage spend.

As with current spending, the priorities vary amongst the MPAs. However, the trends in ideal spend show some far more clearly defined - albeit similar preferences - to those apparent for actual spend.

The strongest geographic trend was the clear preference in the North both in terms of responses and percentage to spend their additional increment on research and monitoring. This applied to all three of the Northern areas. A significantly greater number of MPAs from the South mentioned community activities, although there was no difference between the South and the North in terms of what percentage of their increased income they would spend on them.

These broad regional trends disguised some significant area-based differences. On every measure, the USA[12] and Indo-Pacific regard increasing their spending on enforcement as a clear priority. None of the European MPAs responding to this question mentioned enforcement. Community related activities[13] are a priority of the USA, Indo-Pacific and Caribbean. In addition, the USA also stands out as being particularly keen to spend more on visitor facilities and more staff.

As well as geographical location, visitor numbers also had a strong influence on how MPAs would spend their additional increment. MPAs with higher visitor numbers are strongly focused on increasing their income on visitor facilities and staff. Educational spend also receives a high number of mentions in this group. These trends are almost identical for host countries with a high per capita GNI. The higher a country's per capita GNI – the more it wanted to spend on both visitor facilities and increased staffing.

Most of these ideal spending priorities can be identified in terms of the preceding bivariate and cluster analyses – in particular the focus of the Indo-Pacific on enforcement and the relationship between GNI per capita and visitor spend. What is interesting however, is the across-the-board emphasis on Research & Monitoring in the North. Whatever percentage increase in income an MPA proposed, Research & Monitoring featured more widely in the Northern responses than in those from the South. It is possible that other activities are currently pressuring out Research & Monitoring from these Northern MPAs, or it may be that they are subject to greater accountability. This greater accountability might in itself be a function of a regional cultural difference or possibly a requirement of Government sponsors which are more prevalent in the North than in the South.

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[12] The MPAs in the USA who proposed to spend a significant amount of their additional funding increment on enforcement were part of a group of MPAs in the area currently receiving no income.

[13] Little information was provided on what these community related activities are, although a couple of MPAs mentioned a requirement for funds for community compensation purposes.

**Exhibit 5.7.A: Ideal MPA spending by activity**

*(average % spend and number of mentions)*

| Activity | Average % spend | Number of mentions |
|---|---|---|
| Staff | 26 | 31 |
| Enforcement | 21 | 28 |
| Research & Monitoring | 17 | 35 |
| Visitor related | 8 | 22 |
| Other | 7 | 2 |
| Other operating equipment | 4 | 14 |
| Other operating activities | 4 | 12 |
| Community activities | 2 | 10 |
| Infrastructure | 2 | 9 |
| Administration | 2 | 7 |
| Education | 1 | 11 |
| Boats/ other vehicles | 0 | 11 |
| Habitat management | 0 | 3 |

Source: MPA survey

## 5.8 Conclusion

In this chapter, the structure of the data set has been reviewed with respect to income requirements and several attempts have been made to construct explanatory mathematical models that can be tested against the empirical data. These models have reflected a bottom-up approach based on estimating the cost structures that might be required to pursue various activities. They have also approached the analytical challenge "top down" using purely statistical tests to uncover patterns and relationships.

The analysis has revealed two important challenges in modeling — the range of magnitudes covered by most of the empirical data and the complexity of the context in which each MPA operates. The range of values of the nominal data (such as incomes, area and visitor numbers) meant that regressions could be satisfactorily performed only on the basis of log data with the result that any linkage to a subsequent bottom-up model would be mathematically complex. Meanwhile, the complexity of the individual circumstances of the various MPAs means that it is most unlikely, in any event, that a model could explain the data on the basis of just a few variables. This is reflected in the prevalence of large residuals even in the multivariate model.

In the final chapter, we shall pull together these different themes in terms of some overall conclusions and recommendations for further research.

# CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS

## 6.1 Conclusions

The nature and extent of this survey of 79 MPAs from 34 countries produced a considerable amount of data and some very interesting findings. The protected areas surveyed showed an enormous range in a number of key characteristics – most notably in area, visitor numbers and income. In each of these cases the data spanned several orders of magnitude. It was also interesting to note the extensive range of purposes adopted by the majority of MPAs – very few showed any tendency towards single use. About 40% of the respondents, mostly from the Indo-Pacific, stated the benefit to fisheries as a purpose of their MPA.

Amongst the most striking of the findings was the fact that it was possible to cluster the MPAs into three main groupings according to a range of their characteristics. The first, most well-defined group was comprised largely of Indo-Pacific MPAs for whom the benefit to fisheries was a purpose. The second major cluster was formed out of an equal number of MPAs from both the North and South, and appeared to resemble the multiple-use MPA typology discussed throughout the literature. The final cluster was the least well-defined, but had a smaller range of purposes than the other two sets and had a greater proportion of no-take areas, giving the impression that conservation "for its own sake" might be more of a priority for this group.

In terms of the objectives the information gathered on the financial profile of the MPAs was both extensive and revealing. In the first instance a comprehensive data set was obtained on the annual level of income an MPA receives (covered in more detail below) and from what sources. The results showed that governments are the primary source of MPA funds – particularly in developed countries. In developing countries both visitors and NGOs play a far greater role in MPA funding.

Data on spending was less comprehensive – seemingly due to the difficulty respondents faced in categorising their spending patterns in relation to the questions asked. Notwithstanding some considerable regional differences, the results showed quite clearly that research and monitoring, enforcement and administration were the most important spending priorities across the sample set.

The main focus of the study was to develop an understanding of MPA funding based upon a set of key characteristics which might potentially have a bearing on the protected area funding requirements. The results showed that many MPAs thought their current income was inadequate minimally to achieve their objectives. The desired minimum increase in funding over current incomes in order to reach this threshold had a median of 15% with a mean of 104% across the data set. Based on the average requirement of the sample of fifty MPAs responding to this question, this implied a total annual income requirement of approximately USD 50 million compared with a total current income of roughly USD 25 million.

One of the most interesting findings with respect to income was that there were no geographical distinctions between the relative requirements of the protected areas: the MPAs from developing countries regarded themselves as just as well-funded as their developed country counterparts. Similarly, there were no evident distinctions in the funding requirements of the three main clusters. This was not entirely surprising for two reasons. Firstly, the clusters had a great deal of commonality — especially in

terms of MPA purpose. Secondly, the data set of clusters analysed using the two-factor multivariate model was very small, making trends difficult to distinguish.

Although it was not possible to define the specific income requirements of the primary subsets of MPAs, there were some evident relationships between funding needs of the entire data set and two of the key variables analysed in the study. A standard multivariate regression analysis showed that MPA size and visitor numbers together accounted for 46 % of MPA minimum income requirements, with area being the somewhat more influential factor. The significance of these factors was of little surprise given their profile in the literature. It was unclear from the analysis what factors lay behind the 54% unexplained residual component of income requirements but it is evident that any future explanatory model would have to address the complexity and variation in MPA profiles.

## 6.2 Recommendations

This unexplained residual component of income requirements is one topic amongst a number of associated issues about which a greater understanding is necessary if a comprehensive picture of MPA funding requirements is to be developed. In order to achieve this goal, it is recommended that further research is done to:

- Develop an understanding of the full range of contextual characteristics that could potentially determine MPA funding requirements. This would include further analysis of both the factors covered by this study and those excluded.

  It is recommended that the Hockings' (2000) list is used as the basis for further study. Hockings's selection of variables comprehensively embraces all factors both external and internal to protected areas that may impact on protected area resource requirements. Some elaboration of these factors to cater for the differences between the marine and terrestrial environments will of course be necessary.

  Overall, the potential complexity of assessing the contextual characteristics for reporting purposes should not be under-estimated. Unraveling a full set of characteristics pertinent to determining funding requirements presents an enormous challenge to the analyst – and indeed to the MPAs providing the data.

- Consider ways in which MPAs could be classified in terms of their objectives in order to facilitate analysis. A useful tool to achieve this might be to frame the study using the IUCN categories of protected areas detailed in Chapter 2. MPA funding requirements might then be compared directly to these pre-determined categories.

- Reduce the element of subjectivity in how a desired level of funding is estimated. It might be useful to present the respondent with a list of activities which would equate to the "minimum" or "ideal" level of management of the MPA. These activities would of course have to be framed within the context of the objectives of the MPA.

- Establish how income is distributed to MPAs by the donor organizations. This would help illuminate the broader picture of MPA funding. Similarly, an increased understanding of MPAs' internal budgeting process and how funds are allocated would give a clearer picture of their income requirements. A case study approach involving one or a number of MPAs might be the most effective means of achieving these objectives.

- Develop a model of funding requirements that fully accounts for the complexities of the scale effects which are likely to exist for most of the contributing variables. The cost model presented in this study assumes costs move on a linear basis in relation to the variable factor. An example of where this might not be the case is in MPA enforcement. If the size of a protected area doubles, the distance a ranger would have to travel in order to reach the perimeter would not automatically double.

- Assess the funding requirements of an MPA network. The area of sea covered by MPAs is expected to increase many-fold over the next ten years from its current level of less than 1% of the marine environment. Given that much of this expansion is expected to be in the form of networks, it would therefore be of great value to extend this analysis to cover their specific income requirements. It would be expected that the funding requirements might vary from those of individual MPAs – on the basis of the very different scales they will operate at and, possibly, a greater focus on open-ocean as opposed to coastal habitat.

- Consider ways in which some distinction can be made between whether an MPA's objectives are being achieved in an efficient as well as an effective manner. More funds might not necessarily be the solution to the fulfillment of objectives – changed management practices might have a similar effect.

- Obtain a broader sample of MPAs for study, including all geographical areas and all types of protected areas including voluntary, community and open-ocean MPAs. A more extensive sample might help to produce a more evenly distributed data set, making findings easier to model mathematically and the resulting analysis more productive.

- Determine the relevance of funding to the achievement of MPA objectives. As was discussed in Chapter 2, MPA funding is one of over fifty variables associated (in the literature) with MPA success. It would be of great interest to establish where in that hierarchy of factors funding was placed, and whether its significance varied between different types of MPA. More than one protected area in this study made it clear that income was not as important for MPA success as for example, political and or community support.

- Understand the nature and extent of all of the costs associated with starting up and running an MPA. Some of the respondents indicated that their ongoing revenue was satisfactory but that they needed further capital investment. In practice, however, borrowing to fund investments is not an option for many MPAs — particularly the Government-funded ones.

Potentially the most significant of all of the costs associated with an effective MPA are the opportunity costs. The day-to-day expenses of running an office and visitor centre might in many cases be dwarfed by the economic returns forgone in order to ensure that an MPA's objectives are met. These returns might include development profits forgone to avoid pollution and siltation of the site or fishing revenues forsaken by displaced communities. All too often in the MPA literature, the broader context of the MPA itself — beyond that of the local community — is ignored or only referred to in passing. The full implications of changing the development plans for a wide area must be considered in any MPA-based conservation strategy.

Many of the points listed above are focused on clarifying and thereby classifying the nature and objectives of MPAs in order better to understand their income requirements. The vast range of objectives, nomenclatures and circumstances currently characterizing MPAs around the world might well mean that until a consensus is reached in categorizing them in a uniform manner, the prospect of gaining a proper understanding of their funding needs will remain illusive.

As a final point, a focus on costs does not provide the full picture. What has been analysed in this survey — in conjunction with all of the proposals for further study — are gross costs. As important, if not more important than understanding the cost structure of MPAs, is an understanding of their economic benefits both existing and potential. As many studies have already indicated, the apparent costs of running an effective MPA might in many cases be more than offset by their attendant economic benefits.

## REFERENCES

AGARDY T S (1997) Marine Protected Areas and Ocean Conservation. R.G.Landes Company and Academic Press

AGARDY T S (2000) Information needs for marine protected areas: scientific and social. Bulletin of Marine Science, 66(3), 875-888

ALDER J, SLOAN N, UKTOLSEYA H (1994) A comparison of management planning and implementation of three Indonesian marine protected areas. Ocean & Coastal Management, 24, 179-198

ALDER J (1996) Have Tropical Marine Protected Areas Worked? An Initial Analysis of Their Success. Coastal Management, 24, 97-114

ALLISON G W (1998) Marine reserves are necessary but not sufficient for marine conservation. Ecological Applications, 8(1), Supplement S79-S92

ATTWOOD C G, MANN B Q, BEAUMONT J, HARRIS J M (1997) Review of the State of Marine Protected Areas in South Africa. South African Journal of Marine Science, 18, 341-367

BALLANTINE W J (1995) The New Zealand experience with "no-take" marine reserves. Presented to a symposium at the American Fisheries Society Conference, Florida, "Predicting the value of marine reserves for managing reef fisheries of the south-eastern United States"

BALLANTINE W J (1999) Marine reserves in New Zealand: The development of the concept and the principles. Paper for workshop on MPAs. Kordi, Korea

BALMFORD A, GASTON K J, BLYTH S, JAMES A, KAPOS V (2002) Global variation in conservation costs, conservation benefits, and unmet conservation needs. Paper presented to the Society for Conservation Biology 16th Annual Meeting July14-19. Canterbury, UK

BARR W B, THORNTON S R (1997) Marine protected areas, ecosystem management and ocean governance: making pieces of different puzzles fit together (without a hammer). In McARDLE, D. Management of MPAs in California. A Summary of a Conference Session. California and World Ocean'97 Conference March

BRAILOVSKAYA T (1998) Obstacles in protecting marine biodiversity through marine wilderness preservation: an example from the New England Region. Conservation Biology, 12, 1236-1240

BRYMAN A, CRAMER D (2001) Quantitative data analysis with SPSS release 10 for Windows: a guide for social scientists. Routledge

DAYTON P K, SALA E, TEGNER M J, THRUSH S (2000) Marine reserves: Baselines and fishery enhancement. Bulletin of Marine Science, 66(3), 617-634

De FONTAUBERT A C, DOWNES D R AND AGARDY T S (1996) Biodiversity in the Seas: Implementing the Convention in Marine and Coastal Habitats. IUCN. Gland, Switzerland and Cambridge, UK

DYTHAM C (1999) Choosing and using statistics: a biologist's guide. Blackwell Science. Oxford, UK

EAKIN C M, MCMANUS J W, SPALDING M D JAMESON S C (1997) Coral reef status around the world: where are we and where do we go from here? Proceedings of the 8th International Coral Reef Symposium 1, 277-282 and BRYANT D, BURKE L, MCMANUS J, SPALDING M (1998) Reefs at Risk: A Map-based Indicator of Threat's to the World's Coral Reefs. World Resources Institute. Washington D.C, USA. In WELLS S (Editor) (1998) Creating a Sea Change: The WWF/IUCN Marine Policy. WWF/IUCN. Gland, Switzerland

FAO (2000) The state of world fisheries and aquaculture. FAO. Rome

GEOHEGAN T, SMITH A H, THACKER K (2001) Characteristics of marine protected areas: an analysis of ecological, organisational and socio-economic factors. CANARI Technical Report N1 287

GLADSTONE (2000) The ecological and social basis for management of a Red Sea marine protected areas. Ocean & Coastal Management, 43, 1015-1032

GRAY J (1997) Marine Biodiversity: patterns, threats and conservation needs. Biodiversity and Conservation, 6, 153-175

GUBBAY S (Editor) (1995) Marine Protected Areas: principles and techniques for management. Chapman & Hall. London

HOCKEY P A R, BRANCH G M (1997) Criteria, objectives and methodology for evaluating marine protected areas in South Africa. South African Journal of Marine Science, 18, 369-383

HOCKINGS M, PHILLIPS A (1999) How well are we doing? – some thoughts on the effectiveness of protected areas. Parks, 9(2), 5-14

HOCKINGS M, STOLTON S, DUDLEY N (2000) Evaluating effectiveness: A Framework for Assessing the Management of Protected Areas. IUCN. Gland, Switzerland and Cambridge, UK

HOCKINGS M (2001) Paper Parks: Why They Happen and What Can Be Done to Change Them. MPA News, 2(11)

IUCN: FINANCING PROTECTED AREAS TASK FORCE OF THE WORLD COMMISSION OF PROTECTED AREAS (WCPA) OF IUCN, in collaboration with the ECONOMICS UNIT OF THE IUCN (2000) Financing Protected Areas. IUCN. Gland, Switzerland and Cambridge, UK

JAMES A, GREEN M J B, PAINE J R (1999) A Global Review of Protected Area Budgets and Staffing. WCMC - World Conservation Press. Cambridge, UK

JONES P J S (1994) A review and analysis of the objectives of marine nature reserves. Ocean & Coastal Management, 24, 149-178

KELLEHER, G, BLEAKLEY C, WELLS S (Principal Editors) (1995) A Global Representative System of Marine Protected Areas. World Bank. Washington D.C., USA

KELLEHER, G (Editor) (1999) Guidelines for Marine Protected Areas. IUCN. Gland, Switzerland and Cambridge, UK

KELLEHER, G (2001) MPA Perspective: The Development and Establishment of Coral Reef Marine Protected Areas. MPA News, 2(7)

MACHLIS G E, TICHNELL D L (Editors) (1985) The State of the World's Parks: An Assessment of Resource Management, Policy and Research. In GUBBAY S (Editor) (1995) Marine Protected Areas: principles and techniques for management. Chapman & Hall. London

MASCIA M B (1999) Governance of marine protected areas in the Wider Caribbean: Preliminary results of an international mail survey. Coastal Management, 27, 391-402

McCLANAHAN T R (1999) Is there a future for coral reef parks in poor tropical countries. Coral Reefs, 18, 321-325

McNEELY J A, GADGIL M, LEVELQUE C, PADOCH C, REDFORD K (1995) Human Influences on Biodiversity. In HEYWOOD V H (Executive Editor) Global Biodiversity Assessment. Cambridge University Press. Cambridge, UK

NATIONAL RESEARCH COUNCIL (1998) Improving Fish Stock Assessments. In NATIONAL RESEARCH COUNCIL (2001) Marine Protected Areas: tools for sustaining ocean ecosystems. National Academy of Sciences. USA

NATIONAL RESEARCH COUNCIL (1999) Sharing the Fish. In NATIONAL RESEARCH COUNCIL (2001) Marine Protected Areas: tools for sustaining ocean ecosystems. National Academy of Sciences. USA

NATIONAL RESEARCH COUNCIL (2001) Marine Protected Areas: tools for sustaining ocean ecosystems. National Academy of Sciences. USA

NORSE, E A (Editor) (1993) Global marine biological diversity. Island Press. Washington D.C., USA

OECD (2002) Purchasing Power Parities – Comparative Price Levels. OECD. Paris, France

PALUMBI S R (2000) The ecology of marine protected areas in BERTNESS M, GAINES S, HIXON M (Editors) Marine Community Ecology. Sinauer Press. In press

PET-SOEDE L (2001) Paper Parks: Why They Happen and What Can Be Done to Change Them. MPA News, 2(11)

POLLNAC R B, CRAWFORD, B R AND GOROSPE M L G (2001) Discovering factors that influence the success of marine protected areas in the Visayas, Philippines. Ocean and Coastal Management, 44, 683-710

ROBERTS C, BRANCH G, SAFINA C, BUSTAMANTE R (2000) Working paper from Defying Nature's End Conference. 22-26th August 2000. Pasadena, California, USA

ROGERS C, BEETS J (2001) Degradation of marine ecosystems and decline of fishery resources in marine protected areas in the US Virgin Islands. Environmental Conservation, 28(4), 312-322

RUSS G R , ALCALA A C (1996) Do marine reserves export adult fish biomass? Evidence from Apo Island, central Philippines. Marine Ecology Programme Series, 132, 1-9

SALM R V, CLARK, J AND SIIRILA E (2000) Marine and Coastal Protected Areas: A guide for planners and managers. IUCN. Washington D.C., USA

STOLTON S, DUDLEY N (1999) A preliminary survey of management status and threats in forest protected areas. Parks, 9(2), 5-14

SUCHANEK T H (1994) Temperate Coastal Marine Communities: biodiversity and threats in GRAY J (1997) Marine Biodiversity: patterns, threats and conservation needs. Biodiversity and Conservation, 6, 153-175

TICCO P (1995) The use of marine protected areas to preserve and enhance marine biological diversity: A case study approach. Coastal Management, 23, 309-314

THORNE-MILLER B (1999) The living ocean: understanding and protecting marine biodiversity. Island Press. Washington D.C.. USA

WELLS S (Editor) (1998a) Marine Protected Areas: WWF's Role in their Future Development. WWF. Gland, Switzerland

WELLS S (Editor) (1998b) Creating a Sea Change: The WWF/IUCN Marine Policy. WWF/IUCN. Gland, Switzerland

WHITE A T (2001) Paper Parks: Why They Happen and What Can Be Done to Change Them. MPA News, 2(11)

WHITE A T, COURTNEY C A, SALAMANCA A (2002) Experience with marine protected area planning and management in the Philippines. Coastal Management, 30, 1-26

WILKIE D S, CARPENTER J F, ZHANG Q (2001) The under-financing of protected areas in the Congo Basin: so many parks and so little willingness-to-pay. Biodiversity and Conservation, 10, 691-701

# BIBLIOGRAPHY

AGARDY T S (1994) Advances in marine conservation: the role of marine protected areas. Trends in Ecology and Evolution, 9, 267-270

ALDER J, ZELLER D, PITCHER T, SUMAILA R (2002) A method for evaluating marine protected area management. Coastal Management, 30, 121-131

ATTWOOD C G, HARRIS J M , WILLIAMS A J (1997) International experience of marine protected areas and their relevance to South Africa. South African Journal Science, 18, 311-332

BALLANTINE W J (1994) The Practicality and Benefits of a Marine Reserve Network. In Limiting Access to Marine Fisheries: Keeping the focus on conservation published. Center for Marine Conservation. Washington D.C

CARR M H (2000) Marine protected areas: challenges and opportunities for understanding and conserving coastal marine ecosystems. Environmental Conservation, 27(2), 106-109

DAY J C, ROFF J C (2000) Planning for Representative Marine Protected Areas. A Framework for Canada's Oceans. Report prepared for World Wildlife Fund Canada, Toronto

HOAGLAND P, SUMAILA U R, FARROW S (2001) Marine Protected Areas. In STEELE J, TUREKIAN K K , THORPE S A. Encyclopedia of Ocean Sciences. Academic Press

JAMES A N (1999) Institutional constraints to protected area funding. Parks, 9(2), 15-26

JAMES A N, GASTON K J, BALMFORD A (2001) Can we Afford to Conserve Biodiversity? Bioscience, 51(1) 43-52

KELLEHER G (1994) Coastal Marine Protected Areas. In McNEELY, HARRISON J, DINGWALL P (Editors) Protecting Nature – Regional Reviews of Protected Areas. IUCN – The World Conservation Union. Gland, Switzerland

KINNEAR P R, GRAY C D (2001) SPSS for Windows Made Simple: Release 10. Psychology Press Limited. Hove, UK

McKINNEY M L (2002) Affects of national conservation spending and amount of protected area on species threat rates. Conservation Biology, 16(2), 539-543

PALLANT J (2001) SPSS Survival Manual: A step by step guide to data analysis using SPSS for Windows (Versions 10 and 11). Open University Press. Buckingham, UK

POLUNIN N V C (In Press) Marine Protected Areas, Fish and Fisheries. In Handbook of Fish and Fisheries, Volume II, Chapter 14

ROBERTS C (1998) No-take marine reserves: unlocking the potential for fisheries. Marine Environmental Management Review of 1997 and Future Trends 5, Paper No.17, 127-132

SOBEL J (1996) Marine Reserves: Necessary tools for biodiversity conservation? Global Biodiversity. Special Marine Issue, 6(1), 8-18

WORBOYS G (2001) Protected area management: principles and practice. Oxford University Press. Oxford, UK

WWF/IUCN/WCPA (2001) The status of natural resources on the high-seas. WWF/IUCN. Gland, Switzerland

# APPENDIX 1: MPA OBJECTIVES

SCIENTIFIC

- Maintain genetic / species diversity
- Promote research
- Education / training areas
- Conserve habitats and biota
- Baseline monitoring areas
- Protect rare / important species

ECONOMIC

- Promote / control tourism / recreation
- Promote sustainable development
- Recolonise exploited areas
- Coastal protection
- Alternative environmental economic arguments

CULTURAL

- Aesthetic value
- Protect historical / cultural sites
- Political reasons

ETHICAL

- Intrinsic absolute value

Source: Jones 1994

# APPENDIX 2: SAMPLE QUESTIONNAIRE

**BIRDLIFE INTERNATIONAL AND PIPPA GRAVESTOCK AT CRANFIELD UNIVERSITY (UK) IN CONJUNCTION WITH CALLUM ROBERTS AT YORK UNIVERSITY (UK) AND ANDREW BALMFORD AT CAMBRIDGE UNIVERSITY (UK), ARE GATHERING INFORMATION AS PART OF A STUDY ON THE COSTS OF MANAGING MARINE PROTECTED AREAS**

Marine resources are increasingly threatened by human activities and there is urgent need for effective marine protected areas around the world. At present there is no good information available on how much it will cost to provide effective protected area management for the world's seas. We aim to make such an estimate and seek your help. We would be very grateful if you would help us in this project by completing this questionnaire and emailing us your reply.

Please reply by [21st **December 2001]** to: pippagravestock@compuserve.com

We are interested in obtaining information for individual protected areas. If you have information on more than one, please complete a questionnaire for EACH protected area. In all cases, please provide the most up-to-date information and state the financial year to which it applies. We would appreciate as much detail as you can give us. Please type your answers directly into this Word document in the blue sections.

If the area concerned is both a marine and land protected area, please limit your answers to the marine component where possible.

**THANK YOU FOR YOUR HELP**

## 1. RESPONDENT DETAILS

| | |
|---|---|
| Name | |
| Position | |
| Institution | |
| Address | |
| | |
| | |
| Tel | |
| Fax | |
| E-mail | |
| Web-site address of protected area | |

## 2. MARINE PROTECTED AREA DETAILS

| | |
|---|---|
| Name of protected area | |
| Main habitats / key species protected | |
| Legal designation (if any) | |
| Total area protected (include units) | |
| Zonation (if appropriate) including total area protected from all fishing | |
| Estimated number of annual visitors | |
| Number of staff | |
| → field employees (including rangers) | |
| → administrative employees | |
| → other employees (please specify) | |
| | |
| Purposes of protected area: | Reply YES to purposes which apply to your protected area and list them according to management priority e.g. 1 = most important 5 = least important |
| Habitat protection | |
| Species protection | |
| Archaeological / historical protection | |
| Protection of unique or unusual geological features | |
| Research and monitoring | |
| Fishing: | |
| → commercial | |
| → recreational | |
| Other recreational uses (specify) | |
| Other commercial uses (specify) | |
| Subsistence uses | |
| Other (please state) | |
| Is the area designed to protect habitats and species to benefit commercial fisheries outside of the protected area e.g. as a refuge nursery? | |

**3. INCOME**

| | |
|---|---|
| TOTAL INCOME FOR THE LATEST FINANCIAL YEAR = | |
| Financial year ending (month and year) | |
| Reporting currency | |
| | |
| Sources of income (approximate amounts): | |
| → state or national government funding | |
| → carried over from prior years | |
| → domestically generated donations | |
| → foreign sources of funding | |
| → visitor fees<br>(if visitor fees are charged please give details of the amounts charged to each category of visitor) | |
| → any other sources (please specify) | |
| | |
| Any comments on funding sources | |

## 4. SPENDING

| | |
|---|---|
| TOTAL SPENDING FOR THE LATEST FINANCIAL YEAR = | |
| Financial year ending (month and year) | |
| Reporting currency | |
| | |
| Approximate breakdown of spending: | |
| → wages and salaries | |
| → regular operational costs e.g. fuel, maintenance, rental of buildings, spare parts | |
| → replacement of worn-out equipment e.g. boats, vehicles | |
| → investments in new facilities e.g. buildings and equipment | |
| Over the last 5 years what has been the total capital spent on new facilities? | |
| What types of activity is money being spent on? For example protection, research, visitor facilities<br><br>Please describe giving a breakdown of spending in either currency or as a % of total expenditure | |

| | |
|---|---|
| If there is a difference between income and the amount of money spent, please explain | |

## 5. FUTURE FUNDING REQUIREMENTS

| | |
|---|---|
| This question refers to a MINIMUM standard of management<br><br>Is there a shortfall between actual spending and the amount you estimate would be required to bring management of the protected area up to the minimum level necessary to achieve the aims or objectives of the area?<br><br>If so, by how much? | |
| This question refers to an IDEAL standard of management<br><br>How much more money would be needed to bring management up to an ideal standard of protection and management? | |
| How would any increase in funding be spent? | |

## 6. OTHER RESEARCH

| | |
|---|---|
| Has any other research been done on the protected area? This might include work on, for example, the biological or economic values of the protected area | |
| Please give details (e.g. author, title, publication date, source). If possible please supply copies of the reports | |

All the information given in response to this questionnaire will be treated in the STRICTEST CONFIDENCE. We will produce an aggregated summary of the findings available for general distribution and will send you a copy when the report is complete.

Please send any supplementary information to:

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Email: pippagravestock@compuserve.com

If there is any additional information you think will be of benefit to this study, please add relevant details below:

# APPENDIX 3: CURRENCY CONVERSION DATA

| | Currency | Inflation Rate | | Exchange Rate | PPP Multiplier | Conversion Rate | NOTES on Conversion |
|---|---|---|---|---|---|---|---|
| Australia | AUD | 4.3% | ‡ | 1.34 | 0 | 1.34 | OECD PPP 2001 |
| Bermuda | USD | 2.8% | † | 1.00 | 0 | 1.00 | No PPP rate available therefore assumes same price level as USA |
| Bonaire | ANG | 2.8% | † | 1.78 | 0 | 1.78 | No PPP rate available therefore assumes same price level as USA |
| Colombia | COP | 8% | ‡ | 219 | 3.3 | 649 | 2001 spot average / 2000 PPP multiplier x 2001 inflation |
| Croatia | HRK | 6% | • | 8.34 | 1.9 | 4.50 | 2001 spot average / 2000 PPP multiplier x 2001 inflation |
| Ecuador | USD | 2.8% | † | 1.00 | 3 | 0.33 | 2001 spot average / 2000 PPP multiplier x 2001 inflation |
| Estonia | EEK | 4% | • | 17.1 | 2.8 | 6.20 | 2001 spot average / 2000 PPP multiplier x 2001 inflation |
| Fiji | USD | 2.8% | † | 1.00 | 2.5 | 0.40 | USD / 2000 PPP multiplier x 2001 inflation |
| France | FFR | 1.7% | ‡ | 6.271 | 0 | 6.27 | OECD PPP 2001 x FFR lock-in rate |
| Germany | EUR | 2.5% | ‡ | .946 | 0 | 0.95 | OECD PPP 2001 |
| Indonesia | IDR | 11.6% | ‡ | 8523 | 4 | 2029 | 2001 spot average / 2000 PPP multiplier x 2001 inflation |
| Kenya | KSH | 7% | • | 76.84 | 3 | 25.60 | 2001 spot average / 2000 PPP multiplier x 2001 inflation |
| Lithuania | LTL | 1% | • | 4.00 | 2.3 | 1.70 | 2001 spot average / 2000 PPP multiplier x 2001 inflation |
| Madagascar | USD | 2.8% | † | 1.00 | 3.4 | 0.29 | USD / 2000 PPP multiplier x 2001 inflation |
| Mexico | MXN | 6.4% | ‡ | 9.48 | 1.5 | 6.30 | 2001 spot average / 2000 PPP multiplier x 2001 inflation |
| Mozambique | USD | 2.8% | † | 1.00 | 4 | 0.25 | USD / 2000 PPP multiplier x 2001 inflation |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| New Caledonia | XFP | 1.7% | ◊ | 134 | 1.5 | 89.00 | 2001 spot average / 2000 PPP multiplier x 2001 inflation |
| New Zealand | NZD | 2.6% | ‡ | 1.48 | 0 | 1.48 | OECD PPP 2001 |
| Palau | USD | 2.8% | † | 1.00 | 0 | 1.00 | No PPP rate available therefore assumes same price level as USA |
| Philippines | PHP | 6.1% | ‡ | 44.88 | 4 | 11.20 | 2001 spot average / 2000 PPP multiplier x 2001 inflation |
| Saba | USD | 2.8% | † | 1.00 | 0 | 1.00 | No PPP rate available therefore assumes same price level as USA |
| Solomon Islands | USD | 1% | ◊ | 1.00 | 2.7 | 0.37 | USD / 2000 PPP multiplier x 2001 inflation |
| South Africa | XAR | 5.7% | ‡ | 7.00 | 3.2 | 2.20 | 2001 spot average / 2000 PPP multiplier x 2001 inflation |
| Spain | EUR | 3.7% | ‡ | 0.77 | 0 | 0.77 | OECD PPP 2001 |
| Sri Lanka | NLG | 2.6% | • | 2.40 | 4.2 | 0.57 | 2001 spot average / 2000 PPP multiplier x 2001 inflation |
| St Lucia | XCD | 2.8% | † | 2.67 | 1.3 | 2.10 | 2001 spot average / 2000 PPP multiplier x 2001 inflation |
| Sweden | SEK | 2.7% | ‡ | 9.48 | 0 | 9.48 | OECD PPP 2001 |
| Tanzania | USD | 6% | • | 1.00 | 2 | 0.50 | USD / 2000 PPP multiplier x 2001 inflation |
| Turks & Caicos | USD | 2.8% | † | 1.00 | 0 | 1.00 | No PPP rate available therefore assumes same price level as USA |
| USA | USD | 2.8% | ‡ | 1.00 | 0 | 1.00 | |
| USA Virgin Isl | USD | 2.8% | † | 1.00 | 0 | 1.00 | No PPP rate available therefore assumes same price level as USA |
| Vietnam | VND | -.6% | • | 15119 | 5 | 3023 | 2001 spot average / 2000 PPP multiplier x 2001 inflation |

‡ JP Morgan estimate, † JP Morgan estimate – USA rate, • CIA World Factbook 2001 – 2000 estimate, ◊ CIA World Factbook 2001 – 1999 estimate

# APPENDIX 4: STATISTICAL TESTS USED IN THE ANALYSIS

The table below details a list of statistical tests used in the study, in conjunction with the variables with which they were used. The left hand column shows the eight independent variables upon which the analysis of the survey was based (refer to Section 4.2 for further details). The middle column gives the test used and the final column lists the dependent variable.

In order to maximise the quality of the statistical output, parametric tests have been used where possible i.e. on interval or ratio data that has a normal distribution and equal variances. To facilitate the use of these parametric tests, some of the data was re-calculated using natural logs. In Chapter 5, logs to base 10 were used instead of natural logs, chiefly for ease on interpretation. Further comments on this point are covered in the analysis in the main text. To establish whether the data had equal variances it was tested using Levene's test for variances and to establish whether it has a normal distribution it was tested using the Kolmogorov-Smirnov test.

As a final point, Chi-square and correlation are classified as tests for relationships, while the independent t-test, ANOVA, Mann-Whitney and Kruskal-Wallis are more usually referred to as tests for differences (Dytham 1999). Throughout the analysis, these tests for differences are used as a proxy for tests for relationships. As Bryman et al (2001) conclude, "there is no hard-and-fast distinction between the exploration of differences and relationships".

**MPA size**

| STATISTICAL TEST | DEPENDENT VARIABLE |
|---|---|
| Chi-square | location – region and area<br>habitat<br>zonation<br>purpose<br>source of funds<br>current spending by activity – responses<br>ideal spending by activity – responses |
| Spearman's ranked correlation test | annual visitor numbers<br>staff numbers<br>current income<br>current spending by type<br>5 year capital spend<br>current spending by activity - % breakdown<br>ideal spending by activity - % breakdown<br>% increase in minimum and total income over current income<br>total minimum and ideal income |

**Purpose**

| STATISTICAL TEST | DEPENDENT VARIABLE |
|---|---|
| Chi-square | location – region and area<br>habitat<br>zonation<br>current spending by activity – responses<br>ideal spending by activity – responses |
| Anova (logged data) | annual visitor numbers<br>staff numbers<br>current income<br>5 year capital spend<br>total minimum and ideal income |
| Kruskal-Wallis | area<br>staff numbers<br>current spending by type<br>current spending by activity - % breakdown<br>ideal spending by activity - % breakdown<br>% increase in minimum and total income over current income |

**Habitat**

| STATISTICAL TEST | DEPENDENT VARIABLE |
|---|---|
| Chi-square | location – region and area<br>zonation<br>purpose<br>source of funds<br>current spending by activity – responses<br>ideal spending by activity – responses |
| Anova (logged data) | annual visitor numbers<br>staff numbers<br>current income<br>5 year capital spend<br>total minimum and ideal income |
| Kruskal-Wallis | mpa size<br>current spending by type<br>current spending by activity - % breakdown<br>ideal spending by activity - % breakdown<br>% increase in minimum and total income over current income |

**Annual visitor numbers**

| STATISTICAL TEST | DEPENDENT VARIABLE |
|---|---|
| Chi-square | location – region and area<br>habitat<br>zonation<br>purpose<br>source of funds<br>current spending by activity – responses<br>ideal spending by activity – responses |
| Spearman's ranked correlation test | area<br>staff numbers<br>current income<br>current spending by activity - % breakdown<br>ideal spending by activity - % breakdown<br>% increase in minimum and total income over current income<br>total minimum and ideal income |

**Geographical location**

| STATISTICAL TEST | DEPENDENT VARIABLE |
|---|---|
| Chi-square<br>(both region and area) | habitat<br>zonation<br>purpose<br>source of funds<br>current spending by activity – responses<br>ideal spending by activity – responses |
| Independent t-test (region) logged data | annual visitor numbers |
| Anova (area) logged data | staff numbers<br>current income<br>5 year capital spend<br>total minimum and ideal income |
| Mann-Whitney (region) | area |
| Kruskal-Wallis (area) | staff numbers<br>current spending by type<br>current spending by activity - % breakdown<br>ideal spending by activity - % breakdown<br>% increase in minimum and total income over current income |

**GNI per capita**

| STATISTICAL TEST | DEPENDENT VARIABLE |
|---|---|
| Chi-square | location – region and area<br>habitat<br>zonation<br>purpose<br>source of funds<br>current spending by activity – responses<br>ideal spending by activity – responses |
| Pearson's Product Moment Correlation test | annual visitor numbers<br>staff numbers<br>current income<br>5 year capital spend |
| Spearman's ranked correlation test | area<br>current spending by type<br>current spending by activity - % breakdown<br>ideal spending by activity - % breakdown<br>% increase in minimum and total income over current income<br>total minimum and ideal income |

**Zonation**

| STATISTICAL TEST | DEPENDENT VARIABLE |
|---|---|
| Chi-square | location – region and area<br>habitat<br>purpose<br>source of funds<br>current spending by activity – responses<br>ideal spending by activity – responses |
| Independent t-test (logged data) | annual visitor numbers<br>staff numbers<br>current income<br>5 year capital spend<br>total minimum and ideal income |
| Mann-Whitney | area<br>current spending by type<br>current spending by activity - % breakdown<br>ideal spending by activity - % breakdown<br>% increase in minimum and total income over current income |

**Source of funds**

| STATISTICAL TEST | DEPENDENT VARIABLE |
|---|---|
| Chi-square | location – region and area<br>habitat<br>zonation<br>purpose<br>current spending by activity – responses<br>ideal spending by activity – responses |
| Anova (logged data) | annual visitor numbers<br>staff numbers<br>current income<br>5 year capital spend<br>total minimum and ideal income |
| Kruskal-Wallis | area<br>current spending by type<br>current spending by activity - % breakdown<br>ideal spending by activity - % breakdown<br>% increase in minimum and total income over current income |

# APPENDIX 5: CLUSTER ANALYSIS METHODOLOGY

The aim of the hierarchical cluster analysis was to identify any homogenous groups within the data.

The data were clustered using six of the eight key MPA characteristic variables used throughout the study. GNI per capita was not included as it was felt to be giving too much weight to the geographical distribution of the MPAs. Zonation was also not included as the relatively low response rate to this question reduced the sample size to an unacceptably low level. Both of these variables were "added back" to the results following the analysis to assess their patterns of distribution on the clustered results. The only habitat type clustered on was coral, given its pronounced overlap with most of the other "tropical" options such as sea grass.

The first step was to re-categorise the nominal variables. The answers to a yes/no question (e.g. to a question on MPA purpose) were assigned the values yes = 1, no = 0. All of the variables were then re-scaled from 0-1 to ensure they were given an equal weighting.

The squared Euclidian distance index was used as the measurement of distribution between the clusters before being combined using between-groups linkages.

# APPENDIX 6: CLUSTER ANALYSIS FINDINGS

KEY TO COLUMNS FROM LEFT TO RIGHT:

| | |
|---|---|
| C | CLUSTER (Subsidiary clusters D to I) |
| REGION | NORTH , SOUTH |
| AREA | 1 = US. 2 = EUROPE, 3 = CARIBBEAN AND BERMUDA EX USA, 4 = INDO-PACIFIC EX USA, 5 = AUSTRALIA / NEW ZEALAND |
| FUNDS | PRIMARY SOURCE OF MPA FUNDS: 1 = GOVERNMENT OR OTHER STATE BODIES, 2 = FOREIGN ENTITIES, 3 = VISITORS |
| GNI PER CAP | GNI PER CAPITA OF HOST COUNTRY |
| SIZE | MPA SIZE IN HECTARES |
| VISIT NO | ANNUAL MPA VISITOR NUMBERS |
| C | PROTECTION OF CORAL: 1 = YES, 0 = NO |
| 1 | HABITAT PROTECTION: 1 = YES, 0 = NO |
| 2 | SPECIES PROTECTION: 1 = YES, 0 = NO |
| 3 | ARCHAEOLOGICAL / HISTORICAL PROTECTION: 1 = YES, 0 = NO |
| 4 | PROTECTION OF GEOLOGICAL FEATURES: 1 = YES, 0 = NO |
| 5 | RESEARCH & MONITORING: 1 = YES, 0 = NO |
| 6 | RECREATIONAL FISHING: 1 = YES, 0 = NO |
| 7 | COMMERCIAL FISHING: 1 = YES, 0 = NO |
| 8 | OTHER RECREATIONAL USES: 1 = YES, 0 = NO |
| 9 | OTHER COMMERICAL USES: 1 = YES, 0 = NO |
| 10 | SUBSISTENCE USES: 1 = YES, 0 = NO |
| 11 | OTHER USES: 1 = YES, 0 = NO |
| Benefit to Fisheries | Purpose of MPA is a benefit to fisheries |

| C | REGION | AREA | FUNDS | GNI PER CAP | SIZE (HA) | VISIT NO. | C | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | Benefit to Fisheries | NO-TAKE >5% | CURRENT INCOME | CURRENT INCOME PER HA | CURRENT INCOME PER VIS | MINIMUM REQUIRED FUNDING | MINIMUM REQUIRED FUNDING PER HA | MINIMUM REQUIRED FUNDING PER VIS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A | South | 4 | | 4220 | 26 | 200 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | | | | | 31250 | 1201.9 | 156.25 |
| | South | 4 | 2 | 800 | 143000 | 6500 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | | 398380 | 2.786 | 61.289 | 478056 | 3.343 | 73.547 |
| | South | 4 | 3 | 520 | 60 | 1574 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 594919† | 9915.317† | 377.966† | 594919† | 9915.317† | 377.966† |
| | South | 4 | 1 | 1950 | 20500 | 2000 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | | 248098 | 12.102 | 124.029 | 498164 | 24.301 | 249.082 |
| | South | 4 | 2 | 1710 | 400 | 1000 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 112341 | 280.853 | 112.341 | 163074 | 407.685 | 163.074 |
| | South | 4 | 1 | 1010 | 3900 | 38000 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | | 105057 | 26.938 | 2.765 | 210114 | 53.875 | 5.529 |
| | South | 4 | 1 | 1010 | 21300 | 36000 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 36976 | 4.553 | 2.694 | 141423 | 6.640 | 3.928 |
| | South | 4 | 2 | 820 | 10000 | 100 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 141597 | 14.160 | 1415.97 | 141597 | 14.16 | 1415.97 |
| | South | 4 | 2 | 3460 | 8000 | 2000 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 161786 | 20.223 | 80.893 | | | |
| | South | 4 | 1 | 7100 | 2331 | 50 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | | 9120 | 3.912 | 182.4 | 9120 | 3.912 | 182.45 |
| | South | 3 | 2 | 6060 | 366 | 7200 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 102840 | 290.984 | 14.283 | 143997 | 393.38 | 19.997 |
| | South | 4 | 1 | 4220 | 32000 | 3250 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 323661 | 10.114 | 99.588 | 1216518 | 38.016 | 374.313 |
| | South | 1 | | 820 | 32183 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | | | |
| | South | 4 | 2 | 4220 | 33200 | 780 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 1620180 | 48.801 | 2077.154 | 1620180 | 48.801 | 2077.154 |
| | South | 4 | 1 | 2830 | 50000 | 274 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 64663 | 1.293 | 235.996 | 106556 | 2.131 | 388.891 |
| | South | 4 | 2 | 4480 | 700 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | | 11250 | 16.071 | N/A | 11250 | 16.071 | N/A |
| | South | 4 | | 4480 | 1500 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | | 0 | 0 | 0 | | | |
| | North | 1 | 1 | 34100 | 188000 | 800000 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 121389 | 6.457 | 0.152 | 195089 | 1.037 | 0.244 |
| Av/S | | | | 4656 | 21015 | 49940 | 94 | 100 | 100 | 50 | 22 | 100 | 44 | 56 | 83 | 33 | 72 | 33 | 89 | 64 | 241897 | 626 | 299 | 370752 | 758 | 366 |
| | | | | | | | | | | | | | | | | | | | | Exc† | 219834 | 46 | 294 | 354741 | 148 | 365 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | |
| B | South | 3 | 3 | 11400 | 3390 | 60000 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 522482 | 154.124 | 8.708 | 522482 | 154.124 | 8.708 |
| | South | 3 | 1 | 15000 | 356 | 40000 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 25763 | 72.368 | 0.644 | 378188 | 1062.326 | 9.455 |
| | South | 4 | 1 | 2830 | 89000 | 25000 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | | 988000 | 11.101 | 39.52 | 1188000 | 13.348 | 47.52 |
| | North | 1 | 1 | 34100 | 231870 | 100000 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1921988 | 8.289 | 19.22 | 2417633 | 10.427 | 24.176 |
| | South | 3 | 1 | 8790 | 144360 | 700 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 291030 | 2.016 | 415.757 | 1339807 | 9.281 | 1914.01 |
| | North | 2 | 2 | 19260 | 4400 | 9000 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 560249 | 127.329 | 62.25 | 560249 | 127.329 | 62.25 |
| | North | 1 | 1 | 34100 | 25900 | 90000 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 1604289 | 61.942 | 17.825 | | | |
| | North | 1 | 1 | 34100 | 984500 | 3000000 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 4445586 | 4.516 | 1.482 | 5955977 | 6.05 | 1.985 |
| | North | 1 | 1 | 34100 | 14504 | 4000 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 892326 | 61.523 | 223.082 | 1371411 | 94.554 | 342.853 |
| | South | 4 | | 9160 | 3200 | 10000 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 189537 | 59.23 | 18.954 |
| | North | 2 | 1 | 9340 | 2128 | 1000 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 139844 | 65.716 | 139.844 | 155973 | 73.296 | 155.973 |
| | South | 4 | 2 | 4220 | 476 | 150 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 269883 | 566.981 | 1799.22 | 269883 | 566.981 | 1799.220 |
| | North | 5 | 1 | 24970 | 22000 | 1500000 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 312479 | 14.204 | 0.208 | 312479 | 14.204 | 0.208 |
| | North | 2 | 1 | 7960 | 22000 | 60000 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1125933 | 51.179 | 18.766 | 1348155 | 61.28 | 22.469 |
| | North | 2 | 1 | 7960 | 5000 | 50000 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | | 1260133 | 252.027 | 25.203 | 1704578 | 340.916 | 34.092 |
| | North | 1 | 1 | 34100 | 857287 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1221403 | 1.425 | N/A | 2631102 | 3.069 | N/A |
| | North | 1 | 1 | 34100 | 53824 | 600000 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 410826 | 7.633 | 0.685 | 410826 | 7.633 | 0.685 |
| | South | 4 | | 9160 | 1898 | 40000 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 142153 | 74.896 | 3.554 |
| | South | 3 | 3 | 4220 | 1300 | 23000 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 94576 | 72.751 | 4.112 | 94576 | 72.751 | 4.112 |
| | South | 3 | 1 | 7300 | 86799 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 844152 | 9.725 | N/A | 844152 | 9.725 | N/A |
| | South | 3 | 1 | 8790 | 923000 | 20000 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | | 298507 | 0.323 | 14.925 | 746269 | 0.809 | 37.313 |
| | South | 3 | 1 | 8790 | 52238 | 80000 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 158730 | 3.039 | 1.984 | 1746032 | 33.425 | 21.825 |
| Av/S | | | | 16534 | 160429 | 259675 | 50 | 100 | 100 | 100 | 86 | 100 | 86 | 100 | 100 | 91 | 32 | 23 | 41 | 21 | 790372 | 70 | 140 | 1158546 | 127 | 225 |

| C | REGION | AREA | FUNDS | GNI PER CAP | SIZE (HA) | VISIT NO. | C | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | Benefit to Fisheries | NO-TAKE >5% | CURRENT INCOME | CURRENT INCOME PER HA | CURRENT INCOME PER VIS | MINIMUM REQUIRED FUNDING | MINIMUM REQUIRED FUNDING PER HA | MINIMUM REQUIRED FUNDING PER VIS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | | | | | | | | | | | |
| C | North | 1 | 1 | 34100 | 327 | 1000 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 50579 | 154.676 | 503579 | 79481 | 243.061 | 79.481 |
| | North | 5 | 1 | 24970 | 58300 | 36000 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 401898 | 6.894 | 11.164 | 401898 | 6.894 | 11.164 |
| | South | 3 | 1 | 33000 | 31323 | 75000 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 308860 | 9.86 | 4.118 | 308860 | 9.86 | 4.118 |
| | South | 4 | | 19660 | 155 | 500000 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | | | | | | |
| | North | 2 | 1 | 23970 | 40000 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 22740 | 0.569 | N/A | 44398 | 1.11 | N/A |
| | South | 4 | 3 | 4220 | 15 | 3600 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | | 80705 | 5380.333 | 22.418 | | | |
| | North | 2 | 1 | 23970 | 14000 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 16243 | 11.602 | N/A | 32486 | 23.204 | N/A |
| | North | 1 | 3 | 34100 | 41 | 1000000 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 3400000† | 82926.83† | 3.4† | 3400000† | 82926.83† | 3.4† |
| | North | 1 | | 34100 | 18 | 20000 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1156008 | 6422.667 | 5.78 |
| | North | 1 | | 34100 | 127 | 250000 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 130059 | 1024.87 | 0.52 |
| | North | 5 | | 18530 | 735000 | 200 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 36319 | 0.049 | 181.595 |
| | North | 2 | 1 | 23970 | 102 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 16785 | 164.559 | N/A | 33028 | 323.804 | N/A |
| | North | 5 | | 24970 | 16000 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | |
| Av/S | | | | 25641 | 67908 | 145062 | 54 | 100 | 85 | 69 | 100 | 77 | 0 | 0 | 77 | 54 | 8 | 8 | 15 | 58 | 390710 | 8060 | 11 | 458214 | 8271 | 41 |
| | | | | | | | | | | | | | | | | | | | | Exc† | 89781 | 573 | 13 | 131349 | 805 | 47 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | |
| D | North | 1 | | 34100 | 14 | 1000 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 86706 | 6193.386 | 86.706 |
| | North | 2 | | 29630 | 99300 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| | North | 1 | 1 | 34100 | 31 | 20000 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 25289 | 815.774 | 1.264 | 104770 | 3379.677 | 5.239 |
| Av/S | | | | 32610 | 33115 | 7000 | | | | | | | | | | | | | | | 8430 | 272 | 0 | 95738 | 4786 | 46 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | |
| E | South | 4 | | 2910 | 13300000 | 7000 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 4545455 | 0.342 | 64.935 | 4545455 | 0.342 | 64.935 |
| | North | 2 | 1 | 23970 | 1400 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 3249 | 2.321 | N/A | | | |
| | South | 4 | 2 | 820 | 1000 | 45 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 196552 | 196.552 | 4367.822 | 541379 | 541.379 | 12030.644 |
| Av/S | | | | 9233 | 4434133 | 233348 | | | | | | | | | | | | | | | 1581752 | 66 | 2216 | 2543417 | 271 | 6048 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | |
| F | North | 1 | 1 | 34100 | 47091 | 5000000 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 5538102 | 117.604 | 1.108 | 6041566 | 128.296 | 1.208 |
| | North | 1 | | 34100 | 121 | 15000 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 101157 | 836.008 | 6.744 |
| Av/S | | | | 34100 | 23606 | 2507500 | | | | | | | | | | | | | | | 2769051 | 59 | 1 | 3071362 | 482 | 4 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | |
| G | North | 1 | | 34100 | 19 | 30000 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 86706 | 4817 | 2.89 |
| | North | 1 | | 34100 | 59 | 40000 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 101157 | 1714.525 | 2.529 |
| | North | 1 | | 34100 | 88 | 80000 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 111996 | 1272.682 | 1.4 |
| | North | 1 | 1 | 34100 | 10 | 50000 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 25289 | 2528.9 | 0.506 | 104770 | 10477 | 2.095 |
| | North | 1 | | 34100 | 14 | 20000 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 101157 | 7225 | 5.058 |
| Av/S | | | | 34100 | 38 | 44000 | | | | | | | | | | | | | | | 5058 | 506 | 0 | 101157 | 5101 | 3 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | |
| H | North | 1 | | 34100 | 81 | 1456000 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 133672 | 1650.272 | 0.092 |
| | South | 4 | 1 | 15000 | 20559 | 65000 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 210599 | 10.244 | 3.239 | 210599 | 10.244 | 3.24 |
| | North | 2 | | 24570 | 16160 | 3000 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| Av/S | | | | 24557 | 12267 | 508000 | | | | | | | | | | | | | | | 70200 | 3 | 1 | 172136 | 830 | 2 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | |
| I | North | 2 | 1 | 24920 | 441000 | 6000000 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 4334038 | 9.828 | 0.722 | 4334038 | 9.828 | 0.415 |

# APPENDIX 7: RESPONDENT DETAILS

| REGION | AREA | COUNTRY | CNPPA‡ ZONE | Number |
|---|---|---|---|---|
| NORTH | USA | USA | Northeast Pacific | 3 |
| | | | South Pacific | 15 |
| | | | Wider Caribbean | 5 |
| NORTH | EUROPE | Croatia | Mediterranean | 2 |
| | | Estonia | Baltic | 1 |
| | | Finland | Baltic | 1 |
| | | France | Mediterranean | 2 |
| | | Germany | Northeast Atlantic | 1 |
| | | Lithuania | Baltic | 1 |
| | | Norway | Baltic | 1 |
| | | Spain | Mediterranean | 1 |
| | | Sweden | Baltic | 4 |
| SOUTH | CARIBBEAN Plus Bermuda Ex USA | Bermuda | Northwest Atlantic | 1 |
| | | Colombia | Wider Caribbean | 1 |
| | | Mexico | Wider Caribbean | 3 |
| | | Netherlands Antilles | Wider Caribbean | 2 |
| | | St. Lucia | Wider Caribbean | 1 |
| | | Turks and Caicos Islands, British West Indies | Wider Caribbean | 1 |
| | | Virgin Islands | Wider Caribbean | 1 |
| SOUTH | INDO-PACIFIC Ex USA | Ecuador | Southeast Pacific | 1 |
| | | Fiji | South Pacific | 2 |
| | | Indonesia | East Asian Seas | 2 |
| | | Israel | Arabian Seas | 1 |
| | | Kenya | East Africa | 2 |
| | | Madagascar | East Africa | 3 |
| | | Mauritius | East Africa | 2 |
| | | Mozambique | East Africa | 1 |
| | | New Caledonia | South Pacific | 1 |
| | | Palau | South Pacific | 1 |
| | | Philippines | East Asian Seas | 5 |
| | | Solomon Islands | South Pacific | 1 |
| | | South Africa | West Africa | 2 |
| | | Sri Lanka | Central Indian Ocean | 1 |
| | | Tanzania | East Africa | 1 |
| | | Vietnam | East Asian Seas | 1 |
| NORTH | AUSTRALIA / NEW ZEALAND | Australia | Australia / N. Zealand | 4 |
| | | New Zealand | Australia / N. Zealand | 1 |

MLCD: Marine Life Conservation District, ‡ Commission for Natural Parks and Protected Areas

# APPENDIX 8: MINIMUM FUNDING REQUIREMENT

*(Geographical breakdown, 2001USD and % uplift)*

| GEOGRAPHIC AREA | CURRENT INCOME | MINIMUM REQUIRED | % UPLIFT |
|---|---|---|---|
| USA | 3400000 | 3400000 | 0 |
| | 264761 | 264761 | 0 |
| | 410826 | 410826 | 0 |
| | 5538102 | 6041566 | 9 |
| | 1921988 | 2417633 | 26 |
| | 4445586 | 5955977 | 34 |
| | 892326 | 1371411 | 54 |
| | 50579 | 79481 | 57 |
| | 1221403 | 2631102 | 115 |
| | 25289 | 104770 | 314 |
| | 25289 | 104770 | 314 |
| Average | 1654195 | 2071118 | 84 |
| Median | 892326 | 1371411 | 34 |
| | | | |
| EUROPE | 646203 | 646203 | 0 |
| | 560249 | 560249 | 0 |
| | 4334038 | 4334038 | 0 |
| | 139844 | 155973 | 12 |
| | 198020 | 227723 | 15 |
| | 1125933 | 1348155 | 20 |
| | 1260133 | 1704578 | 35 |
| | 22740 | 44398 | 95 |
| | 16785 | 33028 | 97 |
| | 16243 | 32486 | 100 |
| | 85294 | 674759 | 691 |
| Average | 764135 | 887417 | 97 |
| Median | 198020 | 560249 | 20 |
| | | | |
| CARIBBEAN | 522482 | 522482 | 0 |
| | 15780 | 15780 | 0 |
| | 94576 | 94576 | 0 |
| | 844152 | 844152 | 0 |
| | 102840 | 143977 | 40 |
| | 298507 | 746269 | 150 |
| | 291030 | 1339807 | 360 |
| | 158730 | 1746032 | 1000 |
| | 25763 | 378188 | 1368 |

| | | | |
|---|---|---|---|
| Average | 261540 | 647918 | 324 |
| Median | 158730 | 522482 | 40 |
| | | | |
| INDO-PACIFIC | 594919 | 594919 | 0 |
| | 4545455 | 4545455 | 0 |
| | 269883 | 269883 | 0 |
| | 141597 | 141597 | 0 |
| | 210599 | 210599 | 0 |
| | 9120 | 9120 | 0 |
| | 1620180 | 1620180 | 0 |
| | 11250 | 11250 | 0 |
| | 398380 | 478056 | 20 |
| | 988000 | 1188000 | 20 |
| | 112341 | 163074 | 45 |
| | 96976 | 141423 | 46 |
| | 64663 | 106556 | 65 |
| | 105057 | 210114 | 100 |
| | 248098 | 498164 | 101 |
| | 196552 | 541379 | 175 |
| | 323661 | 1216518 | 276 |
| Average | 584514 | 702723 | 50 |
| Median | 210599 | 269883 | 20 |
| | | | |
| AUSTRALIA / NZ | 401898 | 401898 | 0 |
| | 312479 | 312479 | 0 |
| Average | 357189 | 357189 | 0 |
| Median | 357189 | 357189 | 0 |