A strategic 'way forward' for research and monitoring in the Department of Conservation and Land Management's marine conservation program

Nick D'Adamo[1], Chris Simpson[1] and Neil Burrows[2]

[1] Marine Conservation Branch, [2] CALMScience,
Department of Conservation and Land Management
Perth, Western Australia, 6000

February 2003

https://dpaw.sharepoint.com/teams/BCSConfluenceArchive/Shared Documents/General/WAMSI 1 Node 3 Administration/R&M_WayForward_NDA_Latest160203.doc 5/26/2022

CONTENTS

SUMMARY

General

The establishment of a consolidated centralised research and monitoring (R&M) group is recommended, to work closely with external groups, for research, and internal Departmental groups (eg Districts, PVS, SDCA, CALMScience, NCD), for monitoring.

With respect to marine research, it is recommended that the Department's requirements be serviced via a model based principally on the facilitation of research by external research providers (through strategic alliances and seed funding). The basis for this as the preferred model (rather than one where the Department undertakes research) is that experience to date shows that the external research community (local and national) has the scientific capacity, interest and strategic alignments to undertake the nature and level of marine research pertinent to DCLM's requirements for management. The Department can therefore limit its internal marine research capacity to that of a relatively small but specialised group that acts as a driver of marine research through funding and strategic alliances with the external research community.

With respect to marine monitoring, on the other hand, it is recommended that the Department's requirements be coordinated and largely implemented through a dedicated internal monitoring capacity. The task of monitoring the State's marine values, as required by DCLM to support its management objectives is generally of minimal scientific interest to external marine research groups. Furthermore, the time frames required to establish management-related time series through monitoring (generally of order 10 years or more) are inconsistent with the usual temporal spans of marine research/monitoring studies undertaken by external groups. The monitoring group should have specialist experience in marine monitoring for natural resource management and work closely with the Department's District offices in the establishment and ongoing servicing of monitoring networks both in MCRs (ie on reserve)and in State waters (ie off reserve).

Resources

The R&M group should comprise 17 personnel (involving a salary budget of approximately $1.5M) and recurrent annual operational budgets of $4M for research and $2.5M for monitoring, respectively.

The recommended sum total budget for the R&M functions is therefore $8M per year.

This compares to CALMScience's current annual budget of $13M for terrestrial R&M.

1 INTRODUCTION

General

This paper reviews the Department of Conservation and Land Management's (DCLM) current marine research and monitoring framework in terms of its capacity to deliver the information that is required for conserving, through management, the State's natural marine resources. Recommendations are made in relation to a strategic 'way forward' for the DCLM to address identified needs for improving the current framework.

A critical issue addressed is that relating to the limiting factor of resources for the management of existing reserves. Planning processes relating to proposed marine conservation reserves (MCR) also require information derived from research and, to a lesser degree, monitoring. To that end, this paper's recommendations are also relevant to the DCLM's respective MCR management and implementation functions.

The DCLM's current reliance on externally generated marine research and its own under-resourced internal marine monitoring capacity places the Department's marine program in a tenuous position with respect to its capacity to deliver the current and future requirements for marine R&M.

An assessment is made in respect of the degree to which DCLM's current and future research and monitoring requirements, respectively, should be serviced either through internal or external means or through some combination of both. Cost implications of the various options are provided.

Background

The State's marine conservation reserves (MCRs) are vested in the Marine Parks and Reserves Authority (MPRA), which was established in 1997 through amendments to the *Conservation and Land Management Act 1984* (CALM Act). Day to day management of waters vested in the MPRA is carried out by the DCLM.

In relation to the conservation of the state's natural marine and estuarine resources, Section 26B(1)b of the CALM act prescribes the functions of the MPRA to include:

- the development of policies to preserve those resources;
- submitting proposed management plans for MCRs to the Minister for the Environment;
- with the approval of the Minister for the Environment, to cause study or research to be undertaken to assist in policy development; and
- in relation to management plans for MCRs, to develop guidelines for monitoring the implementation of the plans by the DCLM, to set performance criteria for evaluating the carrying out of the management plans and to conduct periodic assessments of the implementation of the management plans.

The MPRA therefore has an overseeing role to assess the effectiveness of management in meeting the objectives of MCR management plans. This is achieved

through regular MPRA audits of DCLM's management performance, in respect of the implementation of management strategies expressed in MCR management plans. The working relationship between the MPRA and DCLM is detailed in an annually updated Memorandum of Understanding between the two parties.

The DCLM's core statutory functions, in terms of the conservation, through management, of Western Australia's natural resources are defined in the CALM Act and *Wildlife Conservation Act 1950* (WC Act). Through these Acts, the Department plays a primary role in contributing to the goal of conserving the state's natural resources (CALM, 2002) and, to that end, its core functions in relation to the management of those resources are expressed via the following major outputs:

- effectively managed comprehensive, adequate and representative (CAR) systems of terrestrial and marine protected areas programs;
- threatened species and communities recovery programs; and
- sustainable use of wildlife programs.

With respect to the marine environment, DCLM's management responsibilities cover areas that are in many cases vast, remote, and operationally complex and challenging for management. For example, the DCLM currently manages seven existing MCRs between the northwest and southwest of the State, covering a total reserve area of approximately 1.2M ha. One reserve (Rowley Shoals Marine Park) is situated some 150 nm offshore. Within the same coastal span, a further three proposed MCRs, having a combined area of about 0.45M ha, are currently in advanced stages of planning by DCLM. In addition to these, the Report of the Marine Parks and Reserves Selection Working Group (DCLM 1994) recommends that about 65 more areas, comprising nearly 30% of the State's Territorial Waters, be considered as a basis for the establishment of a representative marine reserve system for the State. The establishment of such a system is consistent with the Government's environment policy relating to *'protecting biological diversity'* and creating *'marine parks'*. Strategies for the conservation of the ecological and social values of MCRs are expressed in *MCR management plans*.

In addition to its MCR functions, the DCLM also has primary responsibility for the conservation of the state's native marine flora and flora throughout State Territorial Waters, as defined in the WC Act. The Department's principle management strategies to service this responsibility are expressed via *threatened species recovery plans* and *wildlife management plans*.

The various activities undertaken to achieve the Department's three major outputs can, in general, be allocated to one of the following seven generic management strategies:

- development and maintenance of appropriate administrative frameworks;
- education and interpretation;
- public participation;
- intervention;
- surveillance and enforcement;
- research; and
- monitoring.

Research and monitoring have critical roles in enabling the MPRA and DCLM to meet their respective statutory obligations in relation to conservation of the State's marine environment.

Research is categorised into 'fundamental' (also called 'strategic') and 'tactical'. Monitoring is categorised into 'surveillance' or 'compliance' monitoring. These are described as follows (Simpson *et al*, 2002).

Fundamental research is important primarily for the following reasons.

- *To develop an effective inventory and characterisation of an area's key ecological and social values, to establish the natural spatial and temporal variability (i.e. baselines) of the values, to characterise an area's key ecological and social processes, and to characterise the cause-effect relationships defining the influence of natural pressures on the health of the values.*
- *To enable a predictive capacity for the forecasting of responses of natural systems to existing and potential pressures from natural or human sources.* In so doing, this provides managers with the flexibility to react to unforeseen pressures on values and associated threats to the values.

Applied research is important primarily for the following reasons.

- *To understand the cause-effect relationships defining the influence of human pressures on the health of the values.* This is management-related research, the results of which can generally be described as 'functional or applied knowledge'. Examples of applied research include studies that investigate human usage patterns and attitudes, human pressure-value pathways and synergistic relationships between pressures and values. Applied research typically addresses existing or foreseeable specific management concerns and is often spatially focussed in response to site-specific pressures or threats to an area's values.

Both forms of research inform the monitoring process through the identification and development of appropriate and cost-effective performance measures (ie monitoring parameters) and through the specification of the temporal frequency and spatial resolution of monitoring.

'Surveillance' monitoring is important primarily for the following reasons.

- *To keep a check on the 'condition' of the system, as it responds to natural or human pressures.*
- *To provide a 'safety net' to detect the system's response to unpredictable or poorly understood pressures and processes.*
- *To provide an understanding of the natural variation in key attributes of values at sites that are undisturbed and representative of the key values of the area.* This enables changes in the attributes of values at sites of human activity (monitored, for example, through compliance monitoring) to be assessed in the context of natural variation.

'Compliance' monitoring is important primarily for the following reason.

- *To assess user compliance with agreed environmental management targets for specific approved activities.* This type of monitoring is generally spatially and temporally constrained in accordance with the associated characteristics of the activities.

2 REVIEW OF CURRENT MARINE RESEARCH AND MONITORING AND THE CASE FOR CHANGE

Current research and monitoring effort

Most of DCLM's marine research and monitoring (R&M) is coordinated and conducted by the MCB with the operational support of relevant District offices. The MCB works closely with DCLM's Strategic Development and Corporate Affairs Division, along with Parks, Policy and Tourism Branch and CALMScience. The main guiding frameworks for integration of R&M amongst DCLM's various marine-related groups are via annual marine work plans, with an individual plan produced for each respective MCR. These plans are updated annually and presented to the MPRA for consideration. With respect to prioritising R&M strategies for each MCR, a value-threat methodology is employed based on that recently developed for the Shark Bay World Heritage Area (Simpson *et al*, 2002, see Attachment 1). With respect to the implementation of management strategies, the MPRA audits DCLM's management performance via the MPRA/DCLM Memorandum of Understanding.

The current sum total value of R&M conducted by DCLM is of the order of $1M, delineated as follows.

The proportion of CALMScience's total R&M budget currently assigned to marine management strategies is approximately 1.5% or approximately $200K (see Attachment 2). By way of comparison, the value of R&M conducted by CALMScience for terrestrial reserve conservation is approximately $13M annually, most of which (approximately 75%) is supported through DCLM's central funding and the remainder through external grants

Nature Protection Branch and the Parks & Visitor Services Division assign approximately $40K to marine R&M. Regional Services Division (through the District offices) contribute to marine R&M to the value of approximately $150K.

The Marine Conservation Branch (MCB) has established a number of marine R&M programs for management (existing reserves) and planning (proposed reserves), summarised in Attachment 3. Attachment 3 lists exemplifies the generic approach, supported by specifically related initiatives, that has thus far been adopted by the MCB in attempting to establish an effective framework for the Department's current and future marine R&M needs. The lessons learnt and achievements made through this current approach have been used to evaluate and recommend on a way forward (next chapter) for DCLM's future marine R&M framework.

For fundamental management related research, the MCB has generally relied heavily on external research providers. Where possible, for applied research, resources have been derived mainly through short-term external grants, with associated studies undertaken through collaborative initiatives with academic institutions. For monitoring, the MCB has coordinated and conducted this internally, in collaboration with relevant District offices. The MCB's Marine Management Support section budget (comprising research, monitoring, biological inventory and education

functions) is approximately $275K (comprising internally and externally funded salary and operating costs). In respect of the marine reserve planning process, the MCB has attracted approximately $300 pa in external funds over the past five years, however this source has now effectively dried up. A significant proportion of the MCB's staffing and operational funds for planning-related R&M is derived from external grants. Despite these mechanisms, the R&M components of the marine program within DCLM remain critically under-resourced. Much of DCLM's current capacity for the delivery of required R&M relies upon external grants and on the goodwill of external research providers, which places DCLM in a tenuous position in respect of ensuring the provision of future R&M requirements.

Future pressures

As the current set of planned MCRs are transformed into gazetted reserves, the R&M requirements for their management will rise commensurately. In addition, the DCLM and MPRA have commenced scoping the possibility of adopting a bioregional planning approach to complete the establishment of a representative Statewide marine conservation reserve system. This approach would be consistent with the Government's recent election environment policy statements relating to *'protecting biological diversity'* and creating *'marine parks'*. For example, through its policy on marine parks, the Government states that it will *"...commence Bioregional Marine Planning to ensure the conservation of the marine biodiversity..."*. Such an approach will place significant additional resource requirements on the DCLM in respect of R&M, initially for planning and then for management. Also intricately linked to this issue, will be the growing demand on the DCLM to supply appropriate information, through monitoring, for the MPRA's auditing of management performance in existing MCRs.

The case for change

The case for changing the way DCLM approaches the task of providing information for effective marine management, with respect to R&M, is therefore compelling.

At the broadest level, the options for DCLM's respective research and monitoring frameworks range from full internal capacities to full or partial outsourcing.

The following section provides (i) a broad quantification of current and future R&M requirements for management of the State's marine ecological and social values under DCLM's jurisdiction and (ii) an examination of various options to service these requirements. A recommended 'way forward' is then presented in respect of a R&M framework for the DCLM.

3 A PROPOSED FRAMEWORK FOR MARINE RESEARCH AND MONITORING

3.1 Research

General

There is no distinction made here between 'on' and 'off' reserve marine research requirements, since the motivation for research is derived from the need to develop inventories, baselines and predictive models, to understand ecological and social processes for the State's marine ecological and social values, and to inform the monitoring process in the development of appropriate and cost-effective monitoring strategies and methods, both within and outside of MCRs, as required through the WC and CALM acts.

The relationship between research and monitoring was pointed out in Simpson *et al* (2002) as follows: *"A high priority should be given to clearly expressing operational management objectives in scientifically measurable terms so that performance measures (i.e. indicators) and management targets can be developed and applied spatially…". "Research programs can then focus on developing appropriate performance measures (i.e. monitoring parameters) and sufficient predictive capacity so that management 'triggers' and targets can be identified. Monitoring methodologies and monitoring programs can then be formulated to specifically address management targets as an indication of management effectiveness."*

The four broad generic research areas that are required to facilitate effective management are described as follows.

<u>Inventory</u>
- Key ecological (biological and physical) values.
- Key social values.
- Human usage and associated pressures on ecological and social values.

<u>Baseline</u>
Variability (in time and space) of ecological and social values

<u>Process</u>
- Natural cause-effect relationships defining the influence of natural environmental forcings/pressures on values. This requires an appropriate understanding of key biological and physical processes.
- Anthropogenic cause-effect relationships defining the influence of human-induced forcings/pressures on values.

<u>Prediction (modelling)</u>
- Developing a predictive capacity of future responses of natural systems to existing and potential pressures from human or natural sources. This requires an

understanding of patterns and ability to predict (model) future trends in social behaviour, as relevant to conserving marine ecological and social values.

Internal versus external research?

The marine research capacity that currently exists outside of the DCLM (see Attachment 3) demonstrates that there is a well-developed, comprehensive multi-disciplinary marine research capacity within Western Australia, mainly through the agents of AIMS, CSIRO, academia and some Government departments (eg WA Museum).

Apart from the need to have a limited capacity to respond quickly (either solely or in collaboration with external researchers) to serious short term applied research requirements, there appears to be no need to duplicate or replace the State's external marine research capacity by one within a Government agency such as DCLM.

The Department's recent history and experiences in collaborative research (Attachment 3) programs demonstrate clearly that the Department's marine research requirements are closely aligned with the scientific interests and technical capabilities of external groups. Hence, what is critically important for DCLM's internal marine research capacity is:

(i) that there are sufficient financial resources allocated to support external marine research,
(ii) that there are sufficient numbers of departmental marine scientific staff with the appropriate level and range of scientific expertise to enable an appropriate level of scientific dialogue and interaction between DCLM and its external collaborators, and
(iii) that there is an effective coordinating framework within the Department to ensure that marine funding, strategic directions and Departmental resources are effectively prioritised, adequately integrated and administered so as to allow for flexibility and change in respect of research, as required.

The Department's ability to influence the research directions and research quality of external research providers will be strongly related to both the amount of research money available to fund and/or 'lever' external research and to the Department's own level of scientific marine research expertise. DCLM marine research staff must have sufficient technical expertise, scientific credibility and up-to-date knowledge to enable Departmentally funded marine research initiatives to be effectively managed from a quality assurance perspective.

Recommendation for an internal research group in DCLM to drive 'external' research

The most effective option for delivering the State's marine research-based informational requirements is therefore one where the DCLM supports externally conducted research through direct funding, strategic alliances and collaborative participation. The collaborative participation should be limited in a tactical sense (i.e.

in the conduct of the research) and fully developed in a strategic sense (i.e. in assisting to establish the research programs and research directions of external research providers).

A minimum complement of marine staff with sufficient scientific experience is required in the Department to enable it to achieve a capability that can:

(i) respond quickly to serious unforeseen research requirements, through the sole or collaborative conduct of research and/or through the provision of internal advice,
(ii) support marine policy development (MPRA and DCLM), and
(iii) engage with external research providers, at a level of expertise and credibility that facilitates effective strategic research alliances relevant to DCLM's research requirements.

In order to achieve this capability, biological, physical and socio-economic research scientific expertise will be required, the categories of which can be guided by a consideration of the ecological and social values that characterise the marine ecosystems of the State.

The key ecological values (ie the State's indigenous marine flora and fauna) are identified according to their biodiversity significance and their importance in maintaining the structure and function of the State's marine ecosystems. Generally, these values can be categorised as: globally endangered species, key species endemic to an area, key structural components, exploited species or communities, and key physico-chemical characteristics. More specifically, the State's marine ecological values may be listed as follows:

- Water quality (microbial, chemical, biological)
- Sediment quality (microbial, chemical, biological)
- Benthic habitas (sub-tidal)
- Benthic habitats (inter-tidal)
- Mangroves
- Coral reef communities
- Seagrasses
- Microbial communities (stromatolites)
- Microbial communities (algal mats)
- Invertebrate communities (excluding corals)
- Mammals
- Birds
- Reptiles
- Finfish
- Geomorphology

The State's marine social values derive from the major cultural, aesthetic, recreational and economic uses of the marine environment These values may be either 'passive' (eg wilderness or seascape values) or 'active' (eg fishing, tourism). 'Passive' uses are those that are not considered primarily as threatening processes, whilst 'active' uses are those considered primarily as potential threatening processes. 'Passive' social values are treated, for conservation and planning purposes, as quasi-ecological values

because these 'uses' do not impact on the natural environment in the same way as the 'active' social values do. By contrast, the 'active' social values are those that are considered, primarily, as potential threatening processes and, secondarily, as legitimate uses. More specifically, the State's marine social values may be listed as follows:

- Indigenous heritage
- Maritime heritage
- Coastal use
- Seascape
- Wilderness
- Water sports
- Nature-based tourism
- Commercial fishing (extractive and aquaculture)
- Recreational fishing
- Science
- Education
- Extraction (eg petroleum, minerals)

A broad assessment has been made, through Table 1, in relation to the adequacy of existing research in the areas of inventory, baseline, process and prediction for the State's MCRs (ie on reserve) and also on a statewide spatial scale (ie on and off reserve).

Table 1Adequacy of current research (for management). H=high, M=medium, L=low.

Area	Inventories		Baselines (n.v.)	Processes		Prediction	
	Ecol	Social (pressures)		Ecol	Phys	Ecol	Phys
RSMP	L/M	M/H	L	L	L	L	L
NMP	L/M	M/H	L	L/M	L/M	L	L
SBMP	M	M	L	M	L/M	L	L
HPMNR	M	M/H	L	M	L/M	L	L
MMP	M/H	M/H	L/M	M/H	M/H	M	M/H
SIMP	M/H	M/H	L/M	M/H	M/H	M	M/H
SEMP	M	M	L/M	L/M	M/H	M	M/H
DACPMP	L/M	M	L	L/M	L/M	L	L
MBBIMP	L/M	M	L	L/M	L/M	L	L
GBCHIMP	L/M	M	L	L/M	L/M	L	L
JBMP	L/M	L/M	L	L	L/M	L	L/M
STATEWIDE	L	L		L	L/M	L	L/M

The suite of scientific expertise required to adequately underpin an internal research capacity (aimed primarily at coordinating externally funded research) must therefore derive from all of the disciplines of marine environmental engineering, marine biology, marine zoology and marine social science. These four respective research areas will require dedicated senior staff. In addition, scientific support in terms of say one physical and one biological marine scientist, along with administrative assistance (say 1 person), is appropriate to assist the senior 'research' group. Finally, the size,

multi-disciplinary nature and roles of such a group necessitates the role of an overall scientific research manager. On this basis, the following Departmental marine research staffing complement is recommended. The ranges in 'levels' and costings assigned to the positions reflect the upper salary limits (with overheads) of each range. The structure also provides for career progression and flexibility in staffing as the Department's research requirements evolve and/or change. The managerial position for research is set at 0.5FTE on the basis that both research and monitoring (next Section) will require equal managerial coordination, resulting in a consolidated full time position to oversee both functions.

Marine Research Manager (0.5FTE)L7/8/9	(salary x 1.4)	$65K
Senior Marine Physical/Biological Scientist L5/6/7	"	$100K
Senior Marine Benthic/Pelagic Ecologist L5/6/7	"	$100K
Senior Marine Zoologist L5/6/7	"	$100K
Senior Marine Social Scientist L5/6/7	"	$100K
Marine Physical Scientist L4/5	"	$80K
Marine Biological Scientist L4/5	"	$80K
Administrative Officer L3/4	"	$65K
Net salary cost	**"**	**$690K**

The research group will work in close collaboration with respective DCLM marine District offices. Where possible, District offices may contribute through assisting in undertaking risk assessments for the setting of research priorities, providing marine operational and personnel resources, and funds for research. There will be relevance in forming strong alliances between external researchers and the relevant District offices for marine studies undertaken in District jurisdictions. This model already works well and hence a continuation and strengthening of District alliances with external researchers is recommended.

Operational funding

In consideration of the level of annual seed funding that will be required to effect the marine research needs of the DCLM, two of the key factors that need to be considered are:

- That high priority be initially given to the areas of inventories, human usage and key physical processes.
- That research priorities are assigned according to a risk assessment approach in conjunction with the need to identify appropriate performance measures (ie indicators) and develop appropriate monitoring regimes in response to priorities set by the MPRA in relation to Key Performance Indicators of key values.

It is difficult to specify precisely the level of annual seed funding required for the marine reserve management program because, as Table 1 shows, all areas of research are critically under-represented at present and a formalised Statewide risk assessment has yet to be undertaken due to the lack of fundamental inventories and baselines. A first order calculation is therefore undertaken here.

Attachment 3 indicates that the multiplier effect in relation to DCLM's externally funded research has been of order 10:1 or more. On that basis (taking 10:1 as a conservative measure), every $1M of DCLM seed funding will likely generate external research valued in the order of $10M or more per year. The issue therefore reduces to one of calculating the desired annual value of external research.

As an indicative yardstick, the multi-disciplinary Strategic Research Fund for the Marine Environment (CSIRO/State Government) aims to expend $20M over 5 years, employing a balanced complement of 20 scientific, technical and administrative personnel to undertake fundamental research in the areas of inventories, baselines (to a limited extent), processes and prediction in WA's State marine waters (CSIRO, 2001). The funds available to SRFME limit its geographic focus (Perth metropolitan and Recherche) to lie within two bioregions of the State and also limit its thematic focus to deal mainly with inventories, processes and prediction, thereby largely excluding the area of natural variability. In view of the assessment contained in Table 1, it is necessary to address, as an immediate priority for the next 5 years, at least the seven existing marine reserves, the four being planned and, at first estimate, a limited amount of 'off' reserve area, say equivalent to the effort required to address three bioregions. If, for the sake of the calculation, this net area is amalgamated and compared to the area of SRFME coverage, an approximate effort equivalent to about 7 X SRFME (ie approximately $30M), factored by 1.33 to allow research into baselines (ie natural variability) could be argued as being appropriate. This amounts to research valued in the order of $40M per year. To generate annual research of this value (through a 10:1 multiplier) would require of the order of $4M per year in operational funds.

Hence, in addition to the $0.75M salary budget, a recurrent operational fund of $4M per year is recommended for the DCLM's marine research program.

3.2 Monitoring

General

In contrast to marine research, the task of monitoring the State's marine values, as required by DCLM to support its management objectives, is generally of minimal scientific interest to external marine research groups. Furthermore, the time frames required to establish management-related time series through monitoring (generally of order 10 years or more) are inconsistent with the usual temporal spans of marine research/monitoring studies undertaken by external groups. For example, external groups set their strategic research directions at time scales generally less than 5 years, consistent with the scales of post-graduate student programs, research grant periods, and political funding cycles ($\leq$4 years). The exception to this general rule can sometimes be found in the area of long-term monitoring of natural variability. The national research institutions in particular (ie AIMS and CSIRO) do have a capacity and scientific interest to undertake this type of fundamentally orientated monitoring in terms of answering questions related to the natural spatial and temporal variation of key marine ecological and social processes. Hence, although external mechanisms

cannot be fully relied upon for baseline monitoring, DCLM should have the capacity to fund or form collaborative arrangements for such in the event of opportunities arising with external groups.

Internal versus external monitoring

As discussed in Chapter 1, DCLM is obliged under the CALM Act to undertake monitoring of indicators because it is required to report (to the MPRA) on the effectiveness of its management performance. This is in relation to 'on' reserve management targets set through the MCR management plans and also in relation to conserving the State's native flora and fauna under the WC Act for both 'on' and 'off' reserve values. Hence, apart from deriving information from a limited amount of externally-based monitoring of baselines, DCLM will require a fully internalised and resourced monitoring capacity. That capacity will include the role of coordinating and facilitating community monitoring (DCLM, 2000) for those ecological and social values that do not fall under the auditing requirements of the MPRA and for which monitoring methods are sufficiently straightforward. Details of methods for monitoring the State's marine ecological and social values are given in Grubba *et al* (in preparation).

Recommendation for a centralised internal monitoring group in DCLM to work in conjunction with District offices

It is recommended that an internal centralised monitoring capacity be established within MCB, with the model of operation for this group based around collaborative arrangements with respective marine District offices.

In terms of deciding on an appropriate internal monitoring structure for the Department, the issue arises in respect of the relative degree to which monitoring should be undertaken and coordinated by a centralised capacity (eg MCB) compared with a decentralised capacity (eg through the District offices). In respect of this question, significant experience has been gained through the recent (ie since 1996) establishment of monitoring networks in existing MCRs by the MCB in conjunction with the support of relevant District offices. It has been apparent that those offices have had, and will continue to have in the foreseeable future, a limited capacity to undertake the Department's marine monitoring requirements. This capacity varies from District to District, but overall it is clear that the Department is not currently positioned to move towards a model where the coastal Districts become self-sufficient (scientifically and operationally) in establishing and implementing programs for monitoring of the ecological and social values of their respective MCRs. This is exemplified by the current small budgetary allocations that the Districts are able to assign to marine monitoring. For example, in 2002/03 the combined marine management budget of the DCLM's Exmouth and Shark Bay district offices was of the order of $800K, and of this only about 4% was allocated to monitoring. The majority of these funds were assigned to administration, education, interpretation,

surveillance and enforcement. Some of the key factors which currently limit the Department's regional monitoring capability are:

- Insufficient personnel resources,
- Insufficient operational capacities (equipment, vessels),
- Insufficient funds for effective monitoring, and
- Insufficient scientific experience and expertise in marine monitoring for natural resource management.

These constraints are slowly being overcome (eg with the acquisition of vessels in the Districts, and increasing numbers of suitably trained marine staff etc). However, it is apparent that at present and until the Department's regional staffing policy and resourcing for monitoring match monitoring requirements, the preferred model will be one of a centralised capacity (ie within the MCB) that links and forms internal collaborative monitoring arrangements with the respective District offices.

Furthermore, a number of strategic initiatives, fundamental to DCLM's monitoring framework are still under preparation through the MCB. These include:

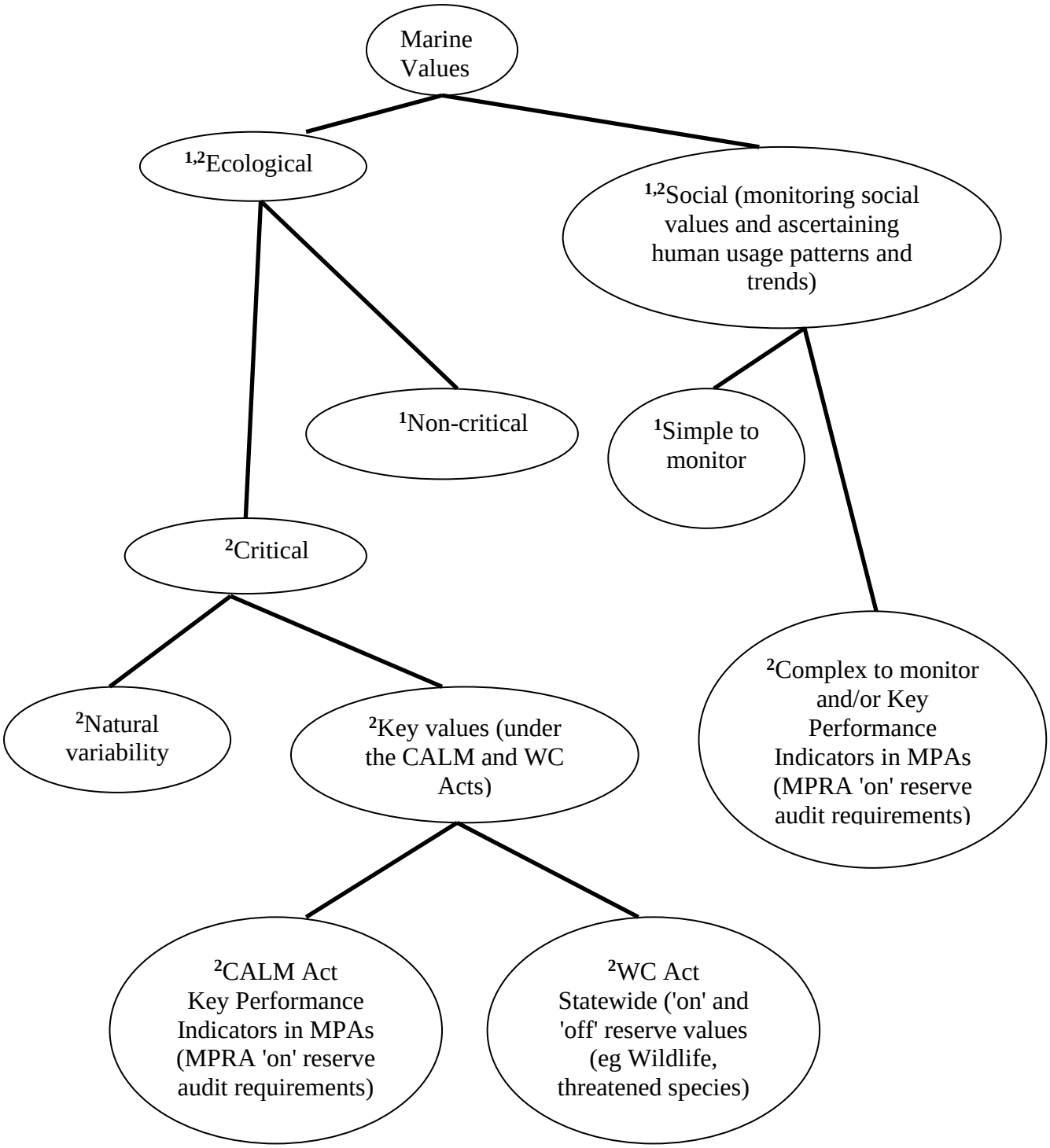
- evaluation and specification of monitoring methods for all of the State's marine ecological and social values,
- the development and implementation of the Statewide Marine Community Monitoring Program,
- reviews of DCLM's current research and monitoring arrangements for wildlife conservation,
- the establishment of baseline monitoring networks, and
- the pursuit of relevant research to inform the monitoring program.

The monitoring group will work in collaboration with the monitoring capacities of the respective DCLM marine District offices. Where possible, District offices will contribute, to the extent possible, marine operational and personnel resources, along with funds for monitoring.

However, one key informational requirement that requires the immediate and principle involvement of the Districts, will be that of establishing and maintaining human usage databases. An understanding of historical, current and projected human usage patterns and trends is fundamental to monitoring (Simpson *et al*, 2002; Simpson and Cary, 1998).

The required overall framework for DCLM's marine monitoring objectives can be conceptualised in the Schematic of Figure 1. The schematic indicates whether the values should be monitored either by the 'community' (ie via the Marine Community Monitoring Program (DCLM, 2000)) or by DCLM.

Figure 1. Schematic of 'on' and 'off' reserve monitoring framework (indicating both [1]community-based and [2]DCLM monitoring)



1 Monitoring performed by the community (coordinated by DCLM)
2 Monitoring coordinated and performed by DCLM

The complement of expertise that will be required in the monitoring group will reflect, to a large extent, the generic groupings of the MCB research group (above), but with the addition of a community monitoring function and complementary operational support.

The monitoring group will require sufficient expertise to:

- interact scientifically with the research group (in terms of setting and prioritising research directions relating to monitoring requirements and in interpreting research results),
- undertake monitoring of the State's floral, faunal and social values (as listed and discussed in the previous section), in collaboration with the Department's coastal District offices, and
- formulate and conduct field operational strategies for monitoring throughout the required range of environs and conditions.

Again, the ranges in 'levels' and costings assigned to the positions reflect the upper salary limits (with overheads) of each range. In addition, the structure provides for career progression and flexibility in staffing as the Department's monitoring requirements evolve and/or change. The managerial position for monitoring is set at 0.5FTE which, in conjunction with the similar 0.5 FTE position assigned to the research portfolio (previous Section) forms a consolidated full time position to oversee both functions. The following centralised monitoring group is therefore recommended.

Marine Monitoring Manager (0.5FTE) L7/8/9	(salary x 1.4)	$65K
Senior Marine Ecologist L5/6/7	"	$100K
Senior Marine Zoologist L5/6/7	"	$100K
Marine Social Scientist L4/5	"	$80K
Marine Physical/Biological Officer L4/5	"	$80K
Marine Community Monitoring Officer L4/5	"	$80K
Marine Ecologist L2/4/5	"	$80K
Marine Ecologist L2/4/5	"	$80K
Marine Operations Officer L2/4/5	"	$80K
Administrative Officer L3/4	"	$65K
Net salary cost	**"**	**$810K**

Operational funding

In consideration of the level of annual operational funding that will be required to support the marine monitoring needs of the DCLM, two of the key factors that need to be considered are:

- that high priority be given to monitoring values relating to DCLM's key reporting requirements (ie in relation to values which have Key Performance Indicators assigned to them, as set by the MPRA through area management plans), and
- that high priority be given to monitoring threatened, endangered or rare species, both 'on' and 'off' reserve.

Two relevant guides are available in estimating the level of operational funding needed for DCLM's monitoring function. These are first, the recent monitoring budget assigned for the proposed Jurien Bay Marine Park (JBMP) and second, recent costings associated with the establishment of 'benthic' monitoring programs in the State's existing MCRs.

For the proposed JBMP a recurrent operational monitoring budget of order $100K has been assigned.

The operational (ie excluding salary) cost of establishing benthic monitoring networks in MCRs has been about $50K and $100K per MCR. On this basis, a similar cost can be estimated for the establishment of baseline monitoring networks for values other than 'benthic'.

From an operational perspective, the re-visitation of monitoring networks will cost in the same order as it does to establish them since the scope and breadth of work required is similar. Hence, an operational budget in the order of $200K per MCR is recommended for ongoing monitoring. For the State's set of gazetted and imminent MCRs (totalling 11) this yields a recurrent operational budget in the order of $2.0M. Added to this is the need to provide operational funds for monitoring of wildlife in all State waters. Based on the operational costs associated with the Department's recent dugong monitoring program, an operational cost in the order of $100K per year per key species would seem appropriate. Hence, considering the range of mammals, reptiles and birds under the Department's management jurisdiction, a Statewide operational monitoring budget in the order of $500K would seem appropriate.

Hence, a total operational budget for DCLM's monitoring function of $2.5M is recommended. This figure should increase by $100K per year for every new MCR that is created.

4 RECOMMENDATIONS

Overall

The establishment of a consolidated centralised research and monitoring (R&M) group is recommended, to work closely with external groups, for research, and internal Departmental groups (eg Districts, PVS, SDCA, CALMScience, NCD), for monitoring.

The R&M group should comprise 17 personnel (involving a salary budget of approximately $1.5M) and recurrent annual operational budgets of $4M for research and $2.5M for monitoring, respectively.

The recommended sum total budget for the R&M functions is therefore $8M per year.

This compares to CALMScience's current annual budget of $13M for terrestrial R&M.

Personnel (details and salary budgets)

With respect to marine research, it is recommended that the Department's requirements be serviced via a model based principally on the facilitation of research by external research providers (through strategic alliances and seed funding). The basis for this as the preferred model (rather than one where the Department undertakes research) is that experience to date shows that the external research community (local and national) has the scientific capacity, interest and strategic alignments to undertake the nature and level of marine research pertinent to DCLM's requirements for management.

The research group's primary functions would be:

- to coordinate and faciltate external marine research, using research seed funds,
- to provide a focus for scientific dialogue and interaction between DCLM and its external collaborators, and
- to provide an effective coordinating framework within the Department to ensure that marine funding, strategic directions and Departmental resources are effectively prioritised, adequately integrated and administered so as to allow for flexibility and change in respect of research, as required.

With respect to marine monitoring, on the other hand, it is recommended that the Department's requirements be coordinated and largely implemented through a dedicated internal monitoring capacity. The task of monitoring the State's marine values, as required by DCLM to support its management objectives, is generally of minimal scientific interest to external marine research groups. Furthermore, the time frames required to establish management-related time series through monitoring (generally of order 10 years or more) are inconsistent with the usual temporal spans of marine research/monitoring studies undertaken by external groups. The monitoring group should work closely with the Department's District offices in the establishment and ongoing servicing of monitoring networks both in MCRs (ie on reserve)and in State waters (ie off reserve).

The monitoring group's primary functions would be to:

- interact scientifically with the research group (in terms of setting and prioritising research directions relating to monitoring requirements and in interpreting research results), and
- undertake monitoring of the State's floral, faunal and social values (as listed and discussed in the previous section), in collaboration with the Department's coastal District offices.

The R&M group should comprise the following staff complement.

Management		
Marine R&M Manager L7/8/9	(salary x 1.4)	$130K
Research sub-group		
Senior Marine Physical/Biological Scientist L5/6/7	"	$100K
Senior Marine Benthic/Pelagic Ecologist L5/6/7	"	$100K
Senior Marine Zoologist L5/6/7	"	$100K
Senior Marine Social Scientist L5/6/7	"	$100K
Marine Physical Scientist L4/5	"	$80K
Marine Biological Scientist L4/5	"	$80K
Administrative Officer L3/4	"	$65K
(Sub-total)		**$690K**
Monitoring sub-group		
Senior Marine Ecologist L5/6/7	"	$100K
Senior Marine Zoologist L5/6/7	"	$100K
Marine Social Scientist L4/5	"	$80K
Marine Physical/Biological Officer L4/5	"	$80K
Marine Community Monitoring Officer L4/5	"	$80K
Marine Ecologist L2/4/5	"	$80K
Marine Ecologist L2/4/5	"	$80K
Marine Operations Officer L2/4/5	"	$80K
Administrative Officer L3/4	"	$65K
(Sub-total)		**$810K**
GRAND SALARY TOTAL		**$1.5M**

REFERENCES

CSIRO (2001). *Strategic Research Fund for the Marine Environment. Report of the Joint Venture Management Committee on the Research Portfolio for the Strategic Research Fund for the Marine Environment 18 June 2001.* CSIRO Marine Research, Castray Esplanade, Hobart, Tasmania, Australia.

DCLM (2000). *Marine Community Monitoring Manual - an early warning system for detecting change in the marine environment.* Marine Conservation Branch, Department of Conservation and Land Management, 47 Henry Street, Fremantle, 6160, Western Australia and Australian Marine Conservation Society, Western Australian Branch, PO Box 8157, Perth Business Centre, Western Australia, 6849.

DCLM (2002). *Corporate Plan 2002-2005*. Department of Conservation and Land Management, Perth, Western Australia, 6000.

DCLM (1994). *A Representative Marine Reserve System for Western Australia.* Report of the Marine Parks and Reserves Selection Working Group. Department of Conservation and Land Management, Perth, Western Australia, 6000.

Grubba T, Bancroft K, Holley D, D'Adamo N and Simpson C (in preparation). *Ecological and Social Monitoring Methods for the Western Australian Marine Conservation Reserve Monitoring Program.* Marine Conservation Branch, Department of Conservation and Land Management, 47 Henry Street, Fremantle, 6160, Western Australia.

Simpson C J and Cary J L (1998). *Generic Information Requirements for the Management of Marine Conservation Reserves in Western Australia.* Marine Conservation Branch, Department of Conservation and Land Management, 47 Henry Street, Fremantle, 6160, Western Australia.

Simpson C J, Colman J G and Hill A K (2002). *A Strategic Framework for Marine Research and Monitoring in the Shark Bay World Heritage Property*. Marine Conservation Branch, Department of Conservation and Land Management, 47 Henry Street, Fremantle, 6160, Western Australia.

Attachment 1: A Strategic Framework for Marine Research and Monitoring in the Shark Bay World Heritage Property (Simpson et al, 2002)

Attachment 2: The Department of Conservation and Land Management CALMScience Division resources assigned to marine management in 2002/2003.

Attachment 3: Summary of marine research and monitoring programs established by the Marine Conservation Branch of the Department of Conservation and Land Management since 1996 for management (existing reserves) and planning (proposed reserves).

Progress since 1996 in internal marine R&M

- Since its inception in 1996, the MCB has almost completed the development of biological inventories for all existing MCRs, comprising habitat and wildlife distribution maps, species inventories, aerial photography, satellite imagery and bathymetry/topography databases.
- A standardised classification scheme for benthic habitats is currently under development.
- The establishment of a Statewide network of long term surveillance monitoring sites (to characterise the natural variability *of* and the impacts of human usage *on* the values of the State's MCRs) has almost been completed, with sites to be established for the Perth metropolitan MCRs during 2002/03. To date, surveillance baseline monitoring has been initialised at these sites with respect to indicators relating to the health of benthic communities. Surveillance baseline monitoring programs for other indicators (eg pelagic communites, water quality, wildlife, sediments) are yet to be initialised.
- A framework for the collection and management of human usage data has been developed and is being progressively applied to each MCR. This will document current and projected intensities and trends in human usage, as relevant for the management of threats to the values of the State's MCRs.
- The Marine Community Monitoring Program is now in its third phase, involving the testing and refinement of methods and the establishment of database frameworks to systematically manage the information that will flow from community monitoring.
- The oceanography of the Perth metropolitan MCRs is well studied, both in terms of process understanding and predictive modelling. However, significant work in this regard is still required for the Shark Bay, Ningaloo and Rowley Shoals marine reserves and the proposed Jurien Bay Marine Park. The MCB has undertaken a limited number of focussed tactical oceanographic studies for Monkey Mia, Ningaloo and Rowley Shoals and conducted oceanographic reviews of the Ningaloo, Capes, Recherche Archipelago and Pilbara areas. The DCLM's internal capacity to mount the desired range and depth of oceanographic R&M required for management of its existing and proposed MCRs is and will likely remain limited due resource contraints. The major avenue for achieving oceanographic R&M has and will continue to be through external collaborations (see below).
- The development of a generic GIS-based Marine Information System (MIS) is currently well advanced, with the first prototype now installed for Ningaloo Marine Park. The MIS is PC-based, and comprises an organised system of computer hardware, software and geographic data, which will be used by trained DCLM personnel to efficiently capture, store, update, manipulate, analyse, and display all forms of marine-related geographically referenced information.

Progress since 1996 in external/collaborative R&M

- DCLM's internal marine research capacity is limited due to resource constraints. Most research has been generated through external/collaborative initiatives with academic, State and Federal marine research groups. This has proven to be a successful model and MCB has continued to work towards establishing a framework for externally based marine research. To this end, the MCB has implemented the following initiatives.
  - MCB has established a seed fund for student-based research in MCRs. A student honours list is produced and disseminated annually. The research fund also supports post-graduate research, mainly through supplementary funding of masters and doctoral programs. During the past year, 7 honours and one PhD project received support. The MCB acts as a central focus for students wishing to engage in under- or post-graduate study relevant to management of the State's MCRs.
  - Alliances have been developed with external research providers in order to influence and encourage the research directions of these programs to be more closely aligned with the marine R&M requirements relevant to management of the State's MCRs. These alliances also generally facilitate and foster R&M relevant to DCLM's overall marine management objectives outside of MCRs. To this end, the MCB chairs or participates, at a strategic level, in groups which include the following:
    (i) Strategic Research Fund for the Marine Environment
    (ii) Western Australian Physical Oceanography Coordinating Group
    (iii) North West Shelf Joint Environmental Management Study
    (iv) Ord-Bonaparte Program
    (v) Shark Bay World Heritage Property Scientific Advisory Committee
    (vi) Intergovernmental Oceanographic Commission (WA Global Ocean Observation System)
    (vii) State Liaison Committee on Remote Sensing
    (viii) National Oceans Office (South East Regional Marine Planning initiative)
    (ix) Marine and Coastal Committee of the Natural Resource Management Ministerial Council
    (x) Nature Based Tourism Research Reference Group
  - Informal professional alliances have also been formed through the MCB's interactions with scientists at tertiary institutions and Federal research agencies (eg Australian Institute of Marine Science, Commonwealth Scientific and Industrial Research Organisation) leading to support of marine R&M funding applications and active participation in research stemming from joint grant applications through bodies such as:
    (i) Australian Research Council
    (ii) Fisheries Research and Development Corporation
    (iii) Cooperative Research Centres
    (iv) NOAA
    (v) Natural Heritage Trust