MARINE COMMUNITY MONITORING PROGRAM

DEVELOPMENT AND IMPLEMENTATION OF A DATABASE FOR THE *MARINE COMMUNITY MONITORING PROGRAM*: *MCMP BASE*

Database Report: MCB-4/2000

A collaborative project between CALM Marine Conservation Branch and Australian Marine Conservation Society WA Branch

A project funded by Coastwest/Coastcare

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January 2001

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ACKNOWLEDGEMENTS

The *Marine Community Monitoring Program* database, *MCMP Base* was designed and constructed by Ben Radford (Consultant). A special thanks to Anne Robertson and Mark Taylor, WALIS who assisted in establishing a link between the *Marine Community Monitoring Program* and the *WA Atlas* and provided comment on this report.

This report may be cited as:

Radford B and Grubba T (2000). Development and implementation of a database for the *Marine Community Monitoring Program*: *MCMP Base*. Data Report: MCB – 4/2000 (Marine Conservation Branch, Department of Conservation and Land Management, 47 Henry St., Fremantle, Western Australia, 6160).

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SUMMARY

The Department of Conservation and Land Management (CALM) and the Australian Marine Conservation Society WA (AMCS WA) with funding from Coastwest/Coastcare are developing a manual of methods entitled the *Marine Community Monitoring Manual* and a database entitled *MCMP Base*. The development of the manual and database is the second stage of a three-stage program known collectively as the *Marine Community Monitoring Program.*

This document summarises three reports produced by the consultant (Ben Radford) contracted to design and construct a database (*MCMP Base*) for the *Marine Community Monitoring Program.* This document summarises the design of *MCMP Base*, outlines future developments and provides a guide for the use of the working database and the *WA Atlas*.

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1 INTRODUCTION

The Department of Conservation and Land Management (CALM) and the Australian Marine Conservation Society WA (AMCS WA) are developing a package of monitoring tools to enable community groups to participate in the conservation and management of their local marine environments.

The *Marine Community Monitoring Program* will provide a framework to integrate the expertise and extensive local knowledge of community groups in Western Australia through the development of marine life identification tools, standardised monitoring methods, data management procedures, and community training programs.

The program is being developed in three stages:

STAGE 1:

1. the development of a CD-ROM-based marine identification guide entitled *Marine Life in Western Australia*. The CD-ROM identifies about 400 of the most common marine fauna and flora from Western Australia's coastal waters.

STAGE 2:

1. review of existing community monitoring programs in Australia and overseas;
2. workshop assessment of community concerns and interests;
3. production of a manual of user friendly monitoring methods entitled *Marine Community Monitoring Manual*;
4. field trials to trial and refine the manual and methods;
5. development of data-handling procedures to facilitate information flow to and from community groups through the establishment of a marine data page within CALM's internet site, NatureBase; and
6. identification of priority community monitoring projects throughout Western Australia.

STAGE 3:

The development and implementation of a community-based training program that will focus on training community groups to use the tools developed in stages one and two.

The program is currently in the second stage of development. This report summarises three documents produced by the database consultant (Ben Radford) contracted to design and implement a database (*MCMP Base*) for the storage and presentation of data collected by the community using methods from the *Marine Community Monitoring Manual.*

2 OBJECTIVES

One of the main objectives of the second stage of the *Marine Community Monitoring Program* is the design of a database that:

- stores data collected using monitoring methods from the *Marine Community Monitoring Manual*;
- stores data in a variety of formats including qualitative data, quantitative data, photographs and electronic data from loggers;
- has the capability to be upgraded as new methods are added to the *Marine Community Monitoring Manual* and as new technology becomes available;
- provides feedback to community, science and management using formats that are both useful and understandable;
- is widely accessible to the community (eg linked to the internet);
- is fast and easy to operate; and
- has low maintenance requirements.

The objectives of this report are to document the design, construction and use of *MCMP Base* including:

- a review of existing community monitoring programs and databases;
- identification and establishment of links to existing databases;
- documentation (reference guide) for *MCMP Base* and *WA Atlas*;
- estimated costs for the design and maintenance of *MCMP Base*; and
- details on the future development of *MCMP Base*.

3 REVIEW OF EXISTING COMMUNITY MONITORING DATABASES

3.1 THE REVIEW OF COMMUNITY MONITORING PROGRAMS IN AUSTRALIA AND OVERSEAS

An important step in the development of the *Marine Community Monitoring Program* (including a database) is a review of existing community monitoring programs in Australia and overseas. A review of 39 programs was conducted and is presented in the report, *Review of community monitoring programs in Australia and overseas* (Grubba 2000). The review examines the standard structural components of community monitoring programs and identifies which components, could be used in the *Marine Community Monitoring Program.* The review also identified existing programs that can be linked to the *Marine Community Monitoring Program.* This approach ensures that the *Marine Community Monitoring Program* doesn't "re-invent the wheel" in terms of replicating programs or developing mechanisms already developed and implemented.

3.1.1 Review recommendations

The report *Review of community monitoring programs in Australia and overseas* (Grubba 2000) recommend:

- link the database to the internet to increase accessibility for the community, science and management;
- incorporate mechanisms into the database design that allow the database to be queried via the internet;
- ensure that the database is fully up gradable;
- restrict data entry to trained CALM/AMCS WA staff and/or volunteers;
- provide data summaries on the internet using formats useful and easily understood by the community (eg maps);
- incorporate mechanisms in the database design that allow raw data to be down loaded from the internet;
- provide feedback on who is viewing and using the data; and
- identify existing programs with similar databases and establish links.

3.2 REVIEW OF DATABASES

The database consultant reviewed five programs in detail in order to assist in making recommendations on database design and mechanisms for data presentation. The five programs reviewed are run by Australian Institute of Marine Science (Long term monitoring team, Townsville), CSIRO (Centre for Research into Marine Pest Species, Hobart), CALM (Flora Base, Herbarium), WALIS (*WA Atlas*, Midland) and Department of Fisheries WA (Marmion Labs). The programs were selected on the basis of their linkage to the internet which is one of the most effective mechanisms for making data available, as the majority of West Australians have internet access at school, home, work, public libraries, etc.

The review identified two database systems (static and dynamic) and six data presentation formats (GIS maps, non-GIS maps, graphs, tables, text summaries and data downloads). Table 2 summarises the types of formats used by the five programs reviewed. The review also identified monitoring programs (eg WALIS, *WA Atlas*) with databases that could be linked to the *Marine Community Monitoring Program* and *MCMP Base*.

Table 1. The main methods used by each organisation to present and distribute data using the internet.

ORGANISATION	GIS MAP METHOD	DATA GRAPHS	DATA TABLES	DATA DOWNLOADS
AIMS	No	Yes	Yes	No
CSIRO**	Yes	Unknown	Unknown	Unknown
CALM	Yes	No	No	No
WALIS	Yes	No	No	Yes
Fisheries WA*	Yes	No	No	Yes

Note:
** Fisheries WA are collaborating with WALIS to present their data using the internet based system WA Atlas.*
*** CSIRO (CRIMPS) is in the process of developing a database*

3.2.1 Static and dynamic database systems

The AIMS internet site is a classic example of a static design where there is an organised system of pre-made pages displaying data summaries as non-GIS maps, tables, graphs and text. Static systems can best be described as an electronic book that has an index and pages. Users navigate through the system using the index and by moving from page to another. Users do not have direct access to the database and therefore cannot query the data in real time. This pre-determined content reduces the ability for users to modify outputs to meet their requirements. Any new data entered into the database requires the static pages to be updated before users can view the data. Static designs require extensive resources for the development and regular updates of pages.

The WALIS *WA Atlas* is the closest example of a dynamic design that was reviewed. Unlike static systems, dynamic systems work in real time allowing users to query the database directly using standard engines (programs). These engines search the database for the required data and then present the data using formats such as GIS maps, tables, graphs etc. Dynamic systems allow users to access new data as soon as it is entered into the database. The use of different engines provides users with a greater flexibility to query, view and extract data to meet their requirements. The disadvantages of dynamic systems lie in their complexity and use of engines which requires specialised knowledge in programming languages to develop and maintain dynamic systems. Complex dynamic systems used simultaneously by many users may have issues in relation to system speed and reliability.

3.2.2 GIS data maps

The programs reviewed have developed systems for the presentation of monitoring data spatially on maps. All the programs, except for AIMS, use GIS (Geographic Information Systems) based maps. GIS maps allow users to add selected data layers to a map and to view the map at different scales. GIS maps provide one of the most effective ways of presenting data in a meaningful form that can be understood by the community. For example when a data layer such as Crown of thorns starfish (COTS) abundance is added to a map, it provides a clear picture of COTS distribution and abundance. It provides users with the versatility to view maps and data at different spatial scales. For example users can look at the data on a state wide level or they can zoom into a local site scale. The WALIS program *WA Atlas* has a powerful internet based system that easily generates GIS maps.

3.2.3 Non-GIS maps, data graphs and data tables

The AIMS program uses a series of pre-made (static) non-GIS maps, which the user can navigate through. The map series decrease in spatial scale. This approach provides more detail for individual sites but can be overwhelming and require interpretation of data. The AIMS program is the only one that uses graphs and tables to present data for monitoring sites on the internet. Graphs are used to clearly display change over time for monitoring variables (eg fish abundance) at specific sites. However it is difficult to interpret data on a larger scale. When a user clicks on a monitoring site they are presented with graphs and tables that clearly show change over time for the variables being monitored.

3.2.4 WALIS *WA Atlas*

The *WA Atlas* is an online interactive atlas of the WA coastal and inland regions. Through the *WA Atlas* users can create their own maps from various layers of information from WA Government agencies (including water quality, climate, fisheries, shipwrecks, indigenous site sand land use). The *WA Atlas* also forms the WA component of the Australian Coastal Atlas (ACA) which is a national network of marine and coastal agencies working together to provide information to the public over the WWW. The *WA Atlas* uses the Australian Atlas online mapping software developed by the Environmental Resources Information Network (ERIN) within Environment Australia. Data are stored within ORACLE and accessed via ESRI's ArcSDE. The system is managed and funded by the WALIS Office and forms a key component of the WALIS Strategic services.

3.2.5 Review recommendations

The following recommendations were made:

- GIS maps are the most effective format for the presentation of monitoring data;
- the *Marine Community Monitoring Program* should establish a link to the *WA Atlas* which uses a powerful internet based GIS system to present data on maps;
- avoid the use of static maps, graphs and tables for the presentation of monitoring data as these formats:
  - require the development of an internet site,
  - can replicate the data presented using the *WA Atlas*;
  - require additional interpretation of monitoring data; and
  - require extensive resources to establish and maintain;
- use static maps at a latter stage (ie when an internet site as been designed and constructed) to summarise the data using screen shots from the *WA Atlas*.

4 COMPUTER HARDWARE AND SOFTWARE REQUIREMENTS

4.1 HARDWARE AND SOFTWARE; DEPLOYMENT PLATFORM CONSIDERATIONS

There are certain hardware requirements common to any database solution including:

- a powerful computer to act as a internet and database server;
- a backup system for all the data (eg high capacity DTL tape drive);
- a test platform computer which allows design and structural changes to be tested before their implementation in the database and performing other maintenance tasks on the database;
- networking peripherals will be required to tie the internet server into the existing CALM Intranet.

There are six types of software that common to any internet based database including:

- operating system (eg WinNT, Linux, Unix);
- database software (eg Access, FileMaker, VisualBasic, MySql, Oracle, SQL Server);
- mapping GIS software (eg AGIS, GRASS, ArcView);
- internet development software (eg FrontPage, Freehand, PageMill);
- graphing software (eg Excel, SigmaPlot); and
- internet server software (eg Apache, Ms InternetSever, FTP).

The following sections detail three options for hardware/software combinations that were considered for *MCMP Base*. The hardware/software option that will be used for *MCMP Base* is detailed in section 5.2)

4.2 SOLUTION ONE: PC COMPUTERS WITH MICROSOFT SOFTWARE

The following lists the advantages and disadvantages of using PC computers with Microsoft software. Table 2 presents a cost estimate for the establishment of this combination of hardware and software.

Advantages:

- Microsoft internet database solutions and expertise are very common, with many Microsoft products used in CALM;
- extensive product support and training is available at all levels;
- Microsoft product continuity is good;
- flexible development solutions for internet databases with the ability to present data in a number of different formats (Graphs, Charts tables, etc) without the use of Java; and
- scalable (for example an internet database written in Microsoft Access can be transferred to the more powerful SQL Server).

Disadvantages:

- compared to other options (eg Filemaker Pro) there is a large design and implementation effort. Although much of this can be completed using simple programming (eg Visual Basic or Visual Basic for Applications) compared to the more complex programming necessary to set up Unix databases (eg Perl and Java) it is still quite a substantial labour requirement;
- as databases get larger performance is likely to be affected; and
- Microsoft products work best with Microsoft products and there could be issues with incompatibility to user internet browsers such as Netscape.

Table 2 Option 1 Hardware and software costs

ITEM	NO. REQUIRED	COST PER UNIT (EX TAX)
Hardware		
PC Server	1	4000.00
Backup Unit (DLT tape)	1	2500.00
Testing PC	1	1500.00
Routers, Hubs	1	500.00
	Sub-Total	**8,500.00**
Software		
Microsoft NT4	1	300
Microsoft Back Officer Server	1	1,946.00
Ms Front Page 98	1	85.00
Ms Vstudio 6.0 Enterprise	1	1,585.00
Ms Access 97	7 (already purchased)	0.00
	Sub-Total	**3,916.00**
	Total	**$12,416.00**

4.3 SOLUTION TWO: UNIX

Unix in its various forms is one of the most popular internet database platforms. The following lists the advantages and disadvantages of using Unix. Table 3 presents a cost estimate for the establishment of this combination of hardware and software.

Advantages:

- superior speed compared to other common platforms in the same price range;
- once the Unix hardware is purchased virtually all of the best Unix software for internet and internet database development software is free;
- Unix internet databases are very scalable;
- able to power large and complex internet databases; and
- CALM's *NatureBase* internet site is predominantly run on Unix severs using the free Apache internet server software so there may be some expertise within CALM that could help with the set up of this type of system.

Disadvantages

- once you go beyond the basics, creating a useful searchable internet database is technically demanding. It requires significant amounts of programming in Perl and Java with all the added ongoing maintenance this entails. These costs may well out way any of the advantages of free software.

Table 3. Option 2: Hardware and software costs

ITEM	NO. REQUIRED	COST PER UNIT (EX TAX)
HARDWARE		
Linux Server	1	4,000.00
Backup Unit (DLT tape)	1	2,500.00
Testing PC	1	1,500.00
Routers, Hubs	1	500.00
	SUB-TOTAL	**8,500.00**
SOFTWARE		
Linux OS	1	0
Apache server	1	0
Ms Front Page 98	1	85.00
Burkly DB	1	0
Java Development Kit 1.2	1	0
Perl V 5.x	1	0
Ms Access 97	7 (already purchased)	0.00
	SUB-TOTAL	**85.00**
	TOTAL	**$8,585.00**

4.4 SOLUTION THREE: FILEMAKER PRO

Filemaker Pro has recently gained great popularity as an Enterprise database platform. The following lists the advantages and disadvantages of using Filemaker Pro. Table 4 presents a cost estimate for the establishment of this combination of hardware and software.

Advantages:

- technically simple and very easy to use and allows the generation of searchable internet databases with a minimum amount of coding (ie Perl, Java, and CGI) which significantly reduces database development and maintenance; and
- relatively scalable (eg a Filemaker Pro database server can have up to 100 concurrent logons).

Disadvantages:

- not as functional as other systems;
- Filemaker Pro database outputs by default are only tabular data. To create graphs requires passing the output to a pre written graphing Java Applet (small graphing program that runs in the internet browser) or purchasing add-ons for Filemaker to add this functionality (these are relatively cheap); and
- compared to more popular software (eg Microsoft) Filemaker Pro is less well known which could mean problems supporting it in the future.

Table 4. Option 3: Hardware and software costs

ITEM	NO. REQUIRED	COST PER UNIT (EX TAX)
HARDWARE		
PC Server	1	4,000.00
Backup Unit	1	2,500.00
Testing PC	1	1,500.00
Routers, Hubs	1	500.00
	SUB-TOTAL	**8,500.00**
SOFTWARE		
Filemaker Pro Server Kit	1	1,000.00
Filemaker Pro 4.0 Developer kit	1	800.00
Claris HomePage	1	135.00
Additional licences	5 x 70 per licence	450.00
	SUB-TOTAL	**2,385.00**
	TOTAL	**$10,885.00**

5 *MCMP Base*

5.1 DATABASE DESIGN

The following model (figure 1) demonstrates the common functionality that is being implemented in *MCMP Base*. The model has three basic components, which include inputs, process and outputs.

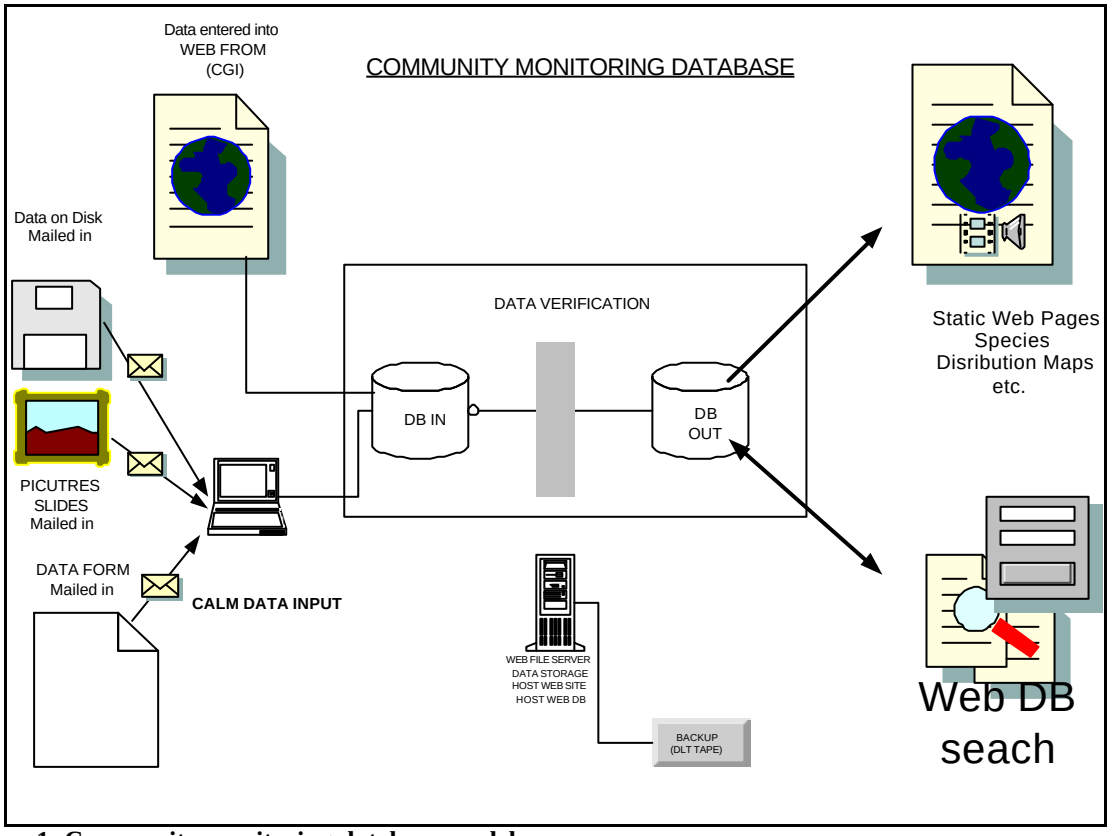

Figure 1. Community monitoring database model

5.2 *MCMP Base* (*VERSION 4.2*) A WORKING DATABASE

The first working model of *MCMP Base* (*version 4.2*) has been designed to run on PC computers using Microsoft software (NT and Access) (Option one). This option was selected as the hardware and software was provided in kind by CALM, which minimised establishment costs. *MCMP Base* is currently hosted by MCB, on CALM's intranet. *MCMP Base* currently accepts data for 21 methods from the *Marine Community Monitoring Manual*, as well as group registration and site registration data. As *MCMP Base* is currently located on the CALM intranet it can only be accessed by authorised people (trained CALM/AMCS WA staff/volunteers) for data entry, database management and queries. Appendix I provides documentation on the use of *MCMP Base* (*version 4.2*).

The first working model of *MCMP Base* incorporates standard queries for each method, which preform basic analysis such as averaging monitoring data for selected time periods. The queries produce outputs in the form of excel spreadsheets. The spreadsheets can be converted to shape files, which can be used in GIS software as data, layers that can be added to GIS maps.

5.2.1 Non-internet based data entry

The first working model of *MCMP Base* has been designed with a non-internet based interface that only allows trained and authorised CALM/AMCS WA staff/volunteers to manually enter data into *MCMP Base*. The interface has easy to use menus and *MCMP Base* data forms are consistent with the data sheets from the *Marine Community Monitoring Manual.* Participants submit their monitoring data in an electronic or hard copy (data sheet) format. The data entry person manually verifies the data as it is entered. *MCMP Base* also has in-built data verification where data fields accept only certain types of data (eg strings and numeric) within pre-defined ranges (eg 1 to 100). If there are questions about data validity contact is made with the participant/s that collected the data. Refer to Appendix I for further details on using *MCMP Base.*

5.2.2 WALIS internet site *WA Atlas*

The *Marine Community Monitoring Program* has liaised closely with WALIS and their *WA Atlas* during the design of *MCMP Base*. WALIS have agreed to host the data provided by the *Marine Community Monitoring Program* on the *WA Atlas* internet site. This removes the need for the *Marine Community Program* to design and construct it's only internet based data presentation system. In order for community monitoring data to be presented on the *WA Atlas* the data must be verified and provided in a format that can be loaded into ArcSDE (preferably shapefiles) with accompanying ANZLIC compliant metadata. WALIS also ask that data be provided in a GDA94 datum and be recorded in decimal degrees. . These requirements have been incorporated into the design of the *MCMP Base*.

Initially *MCMP Base* queries will produce Excel spread sheets which will be converted to shape files and e-mailed to WALIS, which will post them on the *WA Atlas* internet site. Shape files will be previewed using GIS software (eg CALM has Arcview) before being sent to the *WA Atlas*. Users (community, science and management) can access the *WA Atlas* online and select layers of data representing their monitoring data along with any other layers of data on the Atlas and create their own maps. Currently the *WA Atlas* is trialing data on the abundance and distribution of Crown of thorns starfish (COTS), which was supplied by the Marine Community Monitoring Program. Appendix II provides an extract from the *Marine Community Monitoring Manual*, which details the use of the *WA Atlas.*

The *WA Atlas* will present community monitoring data using three data layers representing the same data on different spatial scales:

- 60 NM grid- this gives an overall view of WA on a state scale (figure 2);
- 5 NM grid- gives a view of community monitoring information at a regional scale (figure 3); and
- point data (Lat/Longs produced by GPS or from maps) give monitoring information on a local scale (figures 4 and 5).

For the two layers of grid data, each grid cell is colour coded or shaded to represent a quantitative category of the method it represents (eg red – very abundant, green – common and blue – absent). For the point data, once a particular point is located it can be selected (with a mouse click) to view a table of the data it represents (including location information). The three scales are nested within each other and with each increase in scale the data are represented as an average value of the previous nested scale's data.

Monitoring data can be previewed using GIS software (eg CALM has Arc View) before being sent to the *WA Atlas*. This provides the opportunity to check the data before it is made accessible.

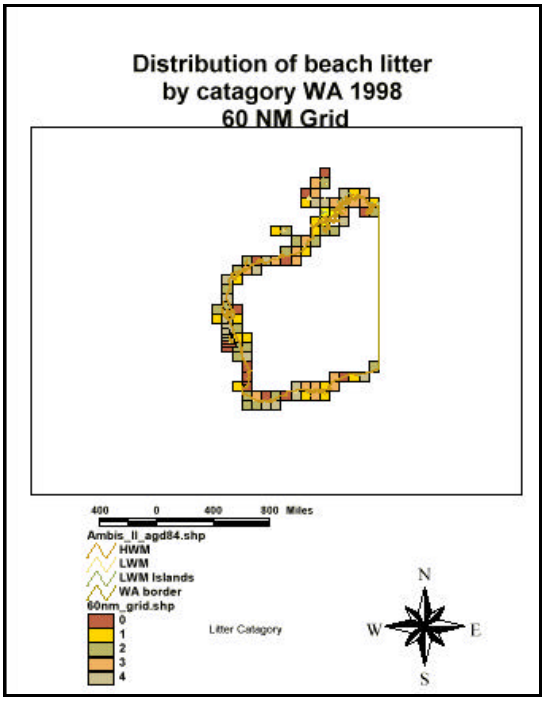

Figure 2. 60 NM grid provides a view of community monitoring data on a state level.

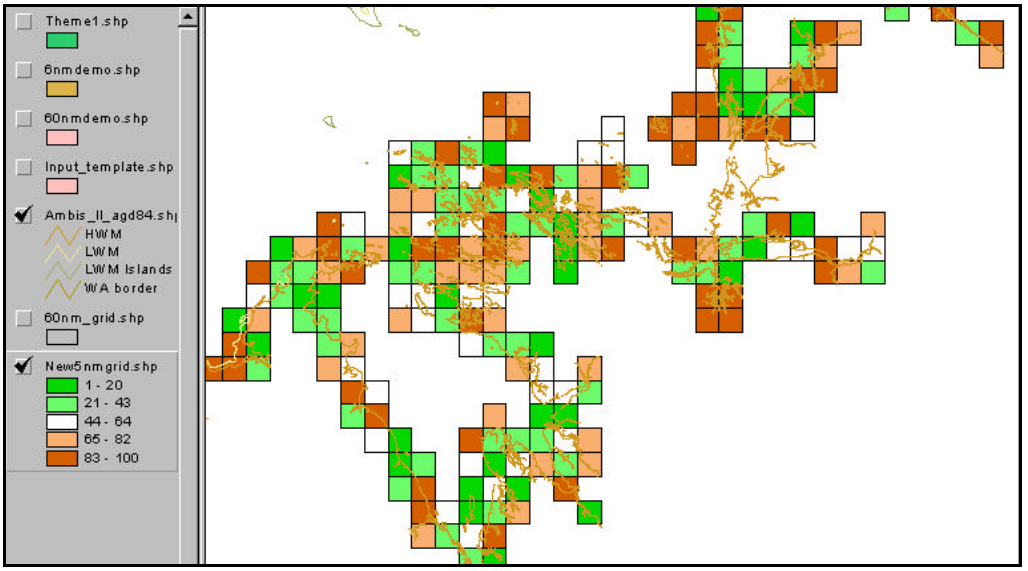

Figure 3. 5NM grid provides a view of community monitoring data at regional scale.

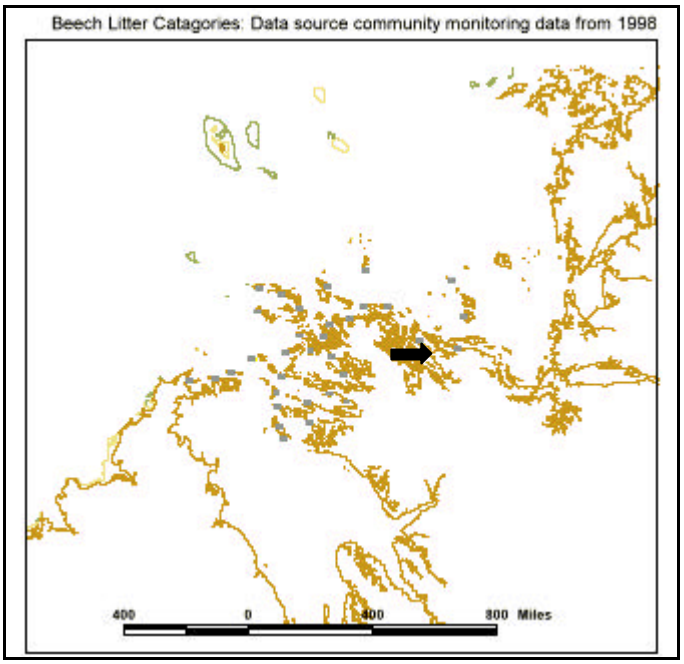

Figure 4. Clicking on point data (lat/long of monitoring sites) provides a data on a specific site (see figure 5 for an example of the data provided).

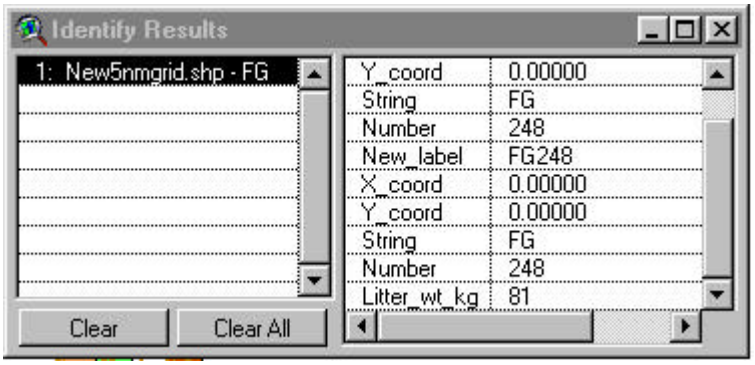

Figure 5. Example of the data provided after clicking on a specific monitoring site.

5.3 FUTURE DEVELOPMENT

MCMP Base will need to be upgraded during the next two to three years as it increases in size and complexity. The upgrade will probably involve the transfer of *MCMP Base* to more advanced hardware and software such as Microsoft SQL server. It is also expected that a *Marine Community Monitoring Program* internet site will be designed which will host both a dynamic system and static system which allows users to query the database and view data summaries presented as screen shots from the *WA Atlas*, graphs and tables. The system will be complimentary to the data presented on the *WA Atlas* with minimal replication of data. The following sections detail proposed systems that have been planned to be implemented in the future.

5.3.1 Internet-based data entry

When a *Marine Community Monitoring Program* internet site has been designed and constructed, an internet based data entry system for *MCMP Base* will be designed. This system will allow participants to input data via the internet by electronically filling in a data entry (forms will have the same layout as those in the *Marine Community Monitoring Manual*). The completed data entry form is sent via CGI (Common gateway Interface) scripts (small web based programs like automated e-mail) to a holding database. The data is validated prior to being electronically transferred to *MCMP Base* by a

suitably trained/qualified person. This system minimises the resources used by CALM/AMCS WA to manually enter data.

5.3.2 Data maps, data tables and graphs

When a *Marine Community Monitoring Program* internet site has been designed and constructed a static system that presents data using tables, graphs and static maps will be considered. The need to develop a complex system will not be required, as it would replicate the data presented on the *WA Atlas* system. Instead a system that presents summaries (screen shots from *WA Atlas*) of monitoring data would be developed that provides faster access. The system would have links to the *WA Atlas*.

In addition it is proposed that a dynamic internet database could be designed and constructed which will allow users to query the data in real time. Users could view and query data as soon as it is entered into the database. For example a user could query the internet database to find out the average density of plastic bags collected by beach litter surveys for a specified period and location. The query would produce results in tabular and graphical format that would be displayed on the internet (figure 6). This system would provide better opportunities for users to query and view data that meets their requirements. However this system will be costly to develop.

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RESULTS OF QUERY

Method: Beach Litter
Location: Site 1
Dates: 1/1/98 to 12/1/01
Collection method: Transect

DATA
Kg per m2

	YEAR			
SOURCE	**1998**	**1999**	**2000**	**2001**
Terrestrial	7	5	4	6
Marine	8	4	5	7

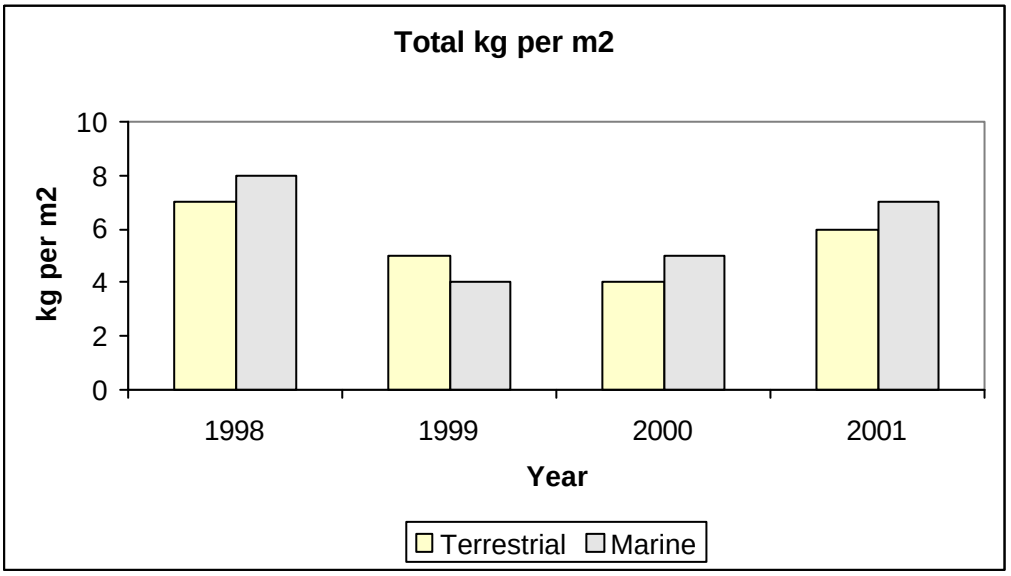


Figure 6. Example report output using tables and graphs.

5.3.3 FTP-Archive

In the future *MCMP Base* will house a large and diverse data set and it is not feasible to design a database that can analyse and report on all possible permutations of the data. Therefore it is proposed that in the future when the database is accessible through a *Marine Community Monitoring Program* internet site that a FTP (file transfer protocol) archive system will be designed. The FTP archive system will allow users (community, science and management) to select and down load raw data via the internet site. This provides users with the option of carrying out their own analysis of the data. The WALIS office have implemented a data Clearinghouse. This Clearinghouse replaces the ftp archive where WALIS agencies used to exchange data ex-government. Users of the Clearinghouse sign a licence agreement and obtain a login/password to the Clearinghouse server, which sits behind the government firewall. The Clearinghouse uses http and html, the benefit of this is that users can browse metadata via their browser (IE or Netscape) and search for records by key word or by agency name and gets away from users having to know ftp commands to navigate directories and down load files. Currently this Clearinghouse is for within government transfer of data only but could be rolled out beyond that. The WALIS office would certainly be able to assist the Group if they chose this option.

5.4 ESTIMATED RESOURCE REQUIREMENTS

The *Marine Community Monitoring Program* acts an "umbrella" for a number of different monitoring methods and *MCMP Base* will have separate but linked sub-databases for each method. Each sub-database and output needs to be individually designed and constructed. Table 5 presents an estimate of the resources required by a consultant to design and construct a sub-database for just one method.

"Environment Australia" has provided funding to assist the development of the *WA Atlas* and the *Marine Community Monitoring Program.* Table 6 presents an estimate of the resources required to set up a stand-alone system (including internet based data entry system and dynamic database) that links to the *WA Atlas.* Table 7 presents an estimate of the annual costs of using the *WA Atlas* to present monitoring data. Table 8 presents an estimate of the costs to present summary data on a *Marine Community Monitoring Program* internet site. The estimate cost of designing and constructing a *Marine Community Monitoring Program* internet site is estimated to be $40,000.

The maintenance costs associated with keeping *MCMP Base* operational have not been documented, however it is expected that a minium of one to two days per week would be required for data, non-technical data entry, data validation, technical development and maintenance. However the level of maintenance required will increase as participation of the *Marine Community Monitoring Program* increases. The regular maintenance of *MCMP Base* is essential as it ensures that the database remains easy to use and contains accurate, up to date and interesting data.

Table 5. Estimation of labour costs per community monitoring method(Hence if there are 10 methods its ten times the grand total below).

TASK DESCRIPTION	HOURS	HOURLY RATE($)*	CHARGE
Construct Database design	1	25	25.00
Design meeting to finalise look and feel of system	4	25	100.00
		SUB TOTAL	**125.00**
DEVELOP HTML SCREENS			
Data Entry	5	25	125.00
Data Validation	5	25	125.00
Coding (Perl, GGI and JAVA)	5	25	125.00
Data Query	5	25	125.00
		SUB TOTAL	**499.00**
GENERATING REPORTS			
Dynamic Cross tabular reports	5	25	125.00
Dynamic Graphical reports	5	25	125.00
Static Map reports	10	25	250.00
		SUB TOTAL	**500.00**
IMPLEMENTATION AND TRAINING			
Database design documentation	8	25	200.00
User Guide	8	25	200.00
System presentation prior to acceptance testing (Training in use)	4	25	100.00
Changes arising from user acceptance changing	4	25	100.00
Installation	4	25	100.00
User support (on site)	16	25	400.00
		SUB TOTAL	**1,100.00**
		GRAND TOTAL	**$2,225.00**

** Refers to the rate that the database consultant, Ben Radford.*

Table 6. Estimated costs for the design, implementation and hardware when using the *WA Atlas.*

ITEM	YEAR 1 (5 METHODS IMPLEMENTED)	YEAR 2 (10 METHODS IMPLEMENTED	YEAR 3 (15 METHODS IMPLEMENTED
Data verification by WALIS	$200	$400	$600
Implementation of database (includes CGI)	$4,000		$2,000
Hardware costs (eg data server, backup server and FTP server)*			$8,000
Software costs (eg SQL server license)			$2,200
TOTAL	**$4,200**	**$400**	**$11,000**

** It possible that these systems could be implemented in conjunction with CALM system development which will reduce costs.*

Table 7. Estimated annual costs for task associated with the presentation of data on the WA Atlas

ITEM	YEAR 1 (5 METHODS IMPLEMENTED)	YEAR 2 (10 METHODS IMPLEMENTED	YEAR 3 (15 METHODS IMPLEMENTED
Level 5 Senior GIS Officer (support role)	$1,000	$1,000	$2,000
Level 2 Data Management Officer	$4,000	$10,000	$16,000
TOTAL	**$5,000**	**$11,000**	**$18,000**

Table 8. Estimated annual costs for task associated with the additional presentation of data on a *Marine Community Monitoring Program* internet site

ITEM	YEAR 1 (5 METHODS IMPLEMENTED)	YEAR 2 (10 METHODS IMPLEMENTED	YEAR 3 (15 METHODS IMPLEMENTED
Level 2 Data Management Officer	$500	$1,000	$1,500
TOTAL	**$500**	**$1,000**	**$1,500**

6 REFERENCES

CALM and AMCS WA (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 St., Fremantle, Western Australia, 6160).

Grubba T (2000). Review of community monitoring programs in Australia and overseas. Report: MCB – 1/2000 (Marine Conservation Branch, Department of Conservation and Land Management, 47 Henry St., Fremantle, Western Australia, 6160).

APPENDIX I: MARINE COMMUNITY MONITORING DATABASE USER MANUAL

INTRODUCTION

MCMP Base has two functions

- it houses and collates all the data from the community monitoring data sheets; and
- it produces tabulated outputs that can be exported to ArcView (GIS Package) and linked to shape files (predetermined maps) to display the data collected for each community monitoring method as a map overlay.

WHAT USERS NEED TO KNOW TO USE *MCMP Base*

While the design of *MCMP Base* allows the easy production of maps, users will have to have a working knowledge of ArcView or a similar GIS Package (for example to be able to import and join tables) and similarly basic Microsoft Excel skills.

WHAT METHODS ARE CURRENTLY INCLUDED IN *MCMP Base*

The methods already included in *MCMP Base* are listed below, the method type refers to the data entry subheading under which that method is found in the database

Method implemented in the CMDB

Method ID	Method	Method Type
1	*Porites* bleaching	Biological Survey - FAUNA
2	Beach litter	Social Environment Survey
3	Fish length	Biological Survey - FAUNA
4	*Drupella* (coral predator)	Biological Survey - FAUNA
5	Crown of thorns starfish (coral predators)	Biological Survey - FAUNA
6	Seagrass health (meadow edge)	Biological Survey - FLORA
7	Black striped mussel	Introduced Pest Survey
8	Green crab	Introduced Pest Survey
9	Northern Pacific seastar	Introduced Pest Survey
10	Underwater litter	Social Environment Survey
11	Boat ramp usage	Social Environment Survey
12	Recreational boating sites	Social Environment Survey
13	Mangrove health	Biological Survey - FLORA
14	Beach width (measurement)	Physical Environment Survey
15	Water clarity	Physical Environment Survey
16	Water temperature (temperature logger)	Physical Environment Survey
17	Water temperature (thermometer)	Physical Environment Survey
18	Seagrass health (meadow health)	Biological Survey – FLORA
19	Beach structure (photograph method)	Physical Environment Survey
20	Potato cod relative abundance	Biological Survey – FAUNA
21	Coral bleaching	Biological Survey – FAUNA

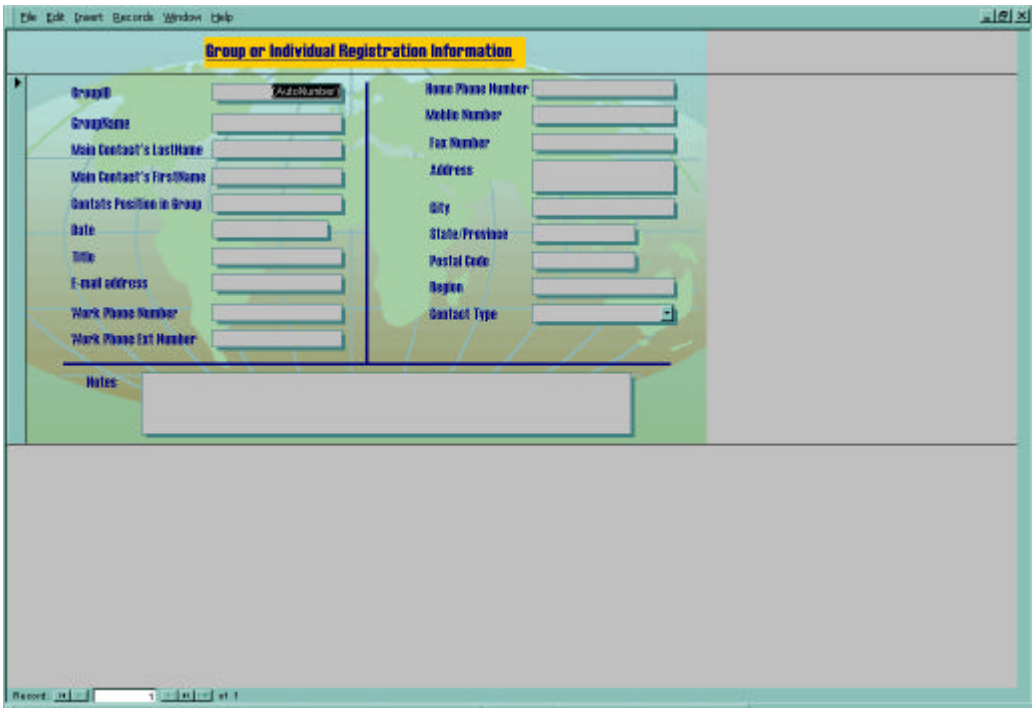
USING *MCMP BASE*

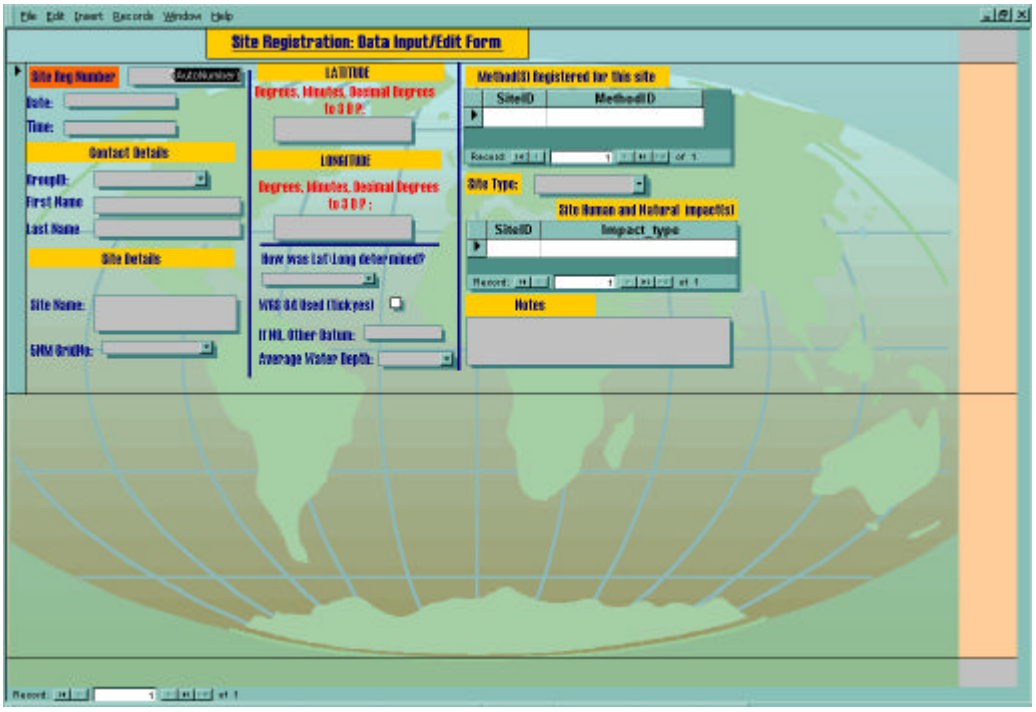
DATA INPUT

Group and Site Registration

From the main menu above select the group and site register button which links to sub menu below

The sub heading links to the data entry / edit page for group and site detail registration (see below).


Group or Individual Registration Information
GroupID
GroupName
Main Contact's LastName
Main Contact's FirstName
Contacts Position in Group
Date
Title
E-mail address
Work Phone Number
Work Phone Ext Number
Home Phone Number
Mobile Number
Fax Number
Address
City
State/Province
Postal Code
Region
Contact Type
Notes


Site Registration: Data Input/Edit Form
Site Reg Number
Date:
Time:
Contact Details
GroupID:
First Name
Last Name
Site Details
Site Name:
Notes

Data from methods

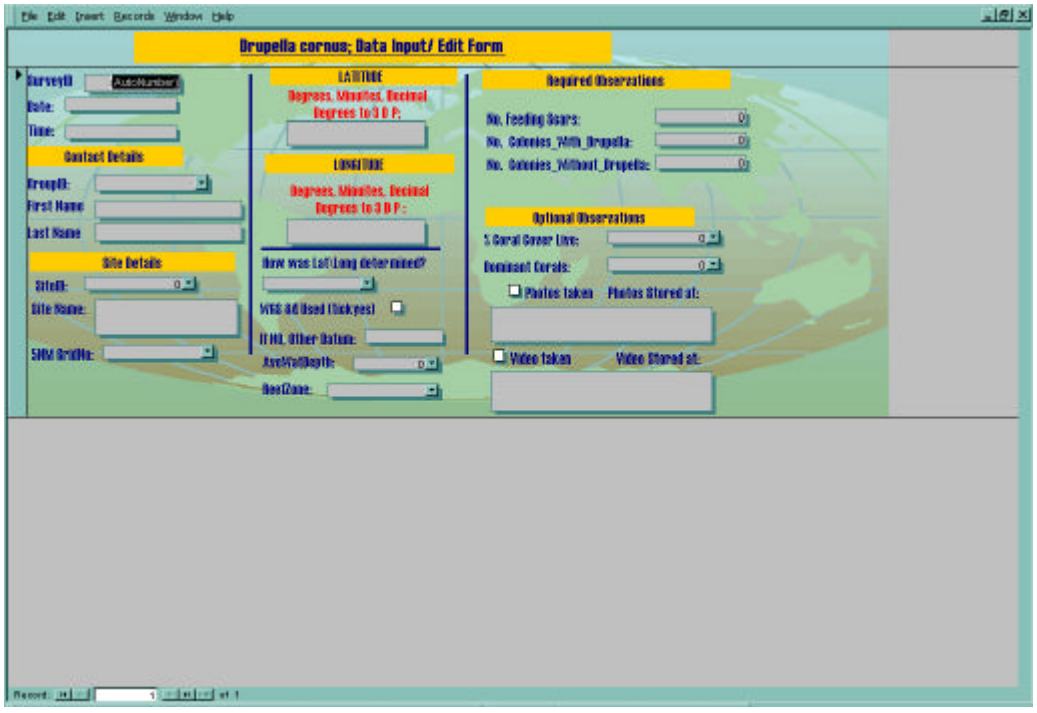
From the main menu the data input button takes links to the menu below

The survey type sub heading leads to the data entry / edit page for each of the methods as listed below

Method Type	Method
Biological Survey - FAUNA	*Porites* bleaching
Biological Survey - FAUNA	Fish length
Biological Survey - FAUNA	*Drupella* (coral predator)
Biological Survey - FAUNA	Crown of thorns starfish (coral predator)
Biological Survey - FAUNA	Potato cod relative abundance
Biological Survey - FAUNA	Coral bleaching
Biological Survey - FLORA	Seagrass health (meadow edge)
Biological Survey - FLORA	Mangrove health
Biological Survey - FLORA	Seagrass health (meadow health)
Introduced Pest Survey	Black striped mussel
Introduced Pest Survey	Green crab
Introduced Pest Survey	Northern Pacific Sea Star
Physical Environment Survey	Beach width (measurement)
Physical Environment Survey	Water clarity
Physical Environment Survey	Water temperature (temperature logger)
Physical Environment Survey	Water temperature (thermometer)
Physical Environment Survey	Beach structure (photographic method)
Social Environment Survey	Beach litter
Social Environment Survey	Underwater litter
Social Environment Survey	Boat ramp usage
Social Environment Survey	Recreational boating sites

For example to enter/edit data from the *Drupella* (coral predator) method select "Biological Survey-FAUNA to give the menu below

From this sub-menu click the second button down "Coral health: *Drupella* (coral predator)" to get to the data entry/edit form below.



The form above is the *Drupella* (coral predator) data entry/edit sheet, which is typical of most methods in the database. To enter new data first select the "Group Registration Number" and the "Site Registration Number" from the drop down menus (** Note if the appropriate group or site information is not available then see the section on add/editing group and site information above).

The other fields (name, date etc) are filled in directly from the completed data sheet apart from the data entry boxes that have a drop down button (they can be identified as they have a little box with down arrow in them) select the appropriate category from these boxes.

To enter another set of data either use the "New Record Button" on the tool bar or hit the little button with ">*" (right arrow and asterisk) in on your Record bar. The Record Bar displays the current record number and clicking the "Show all Data button" views all the data entered into the database for that particular method. Data can also be edited using this form and there are many other sort, filtering and export functions that can be used to look at the entered data. These functions are covered in the advanced tool section

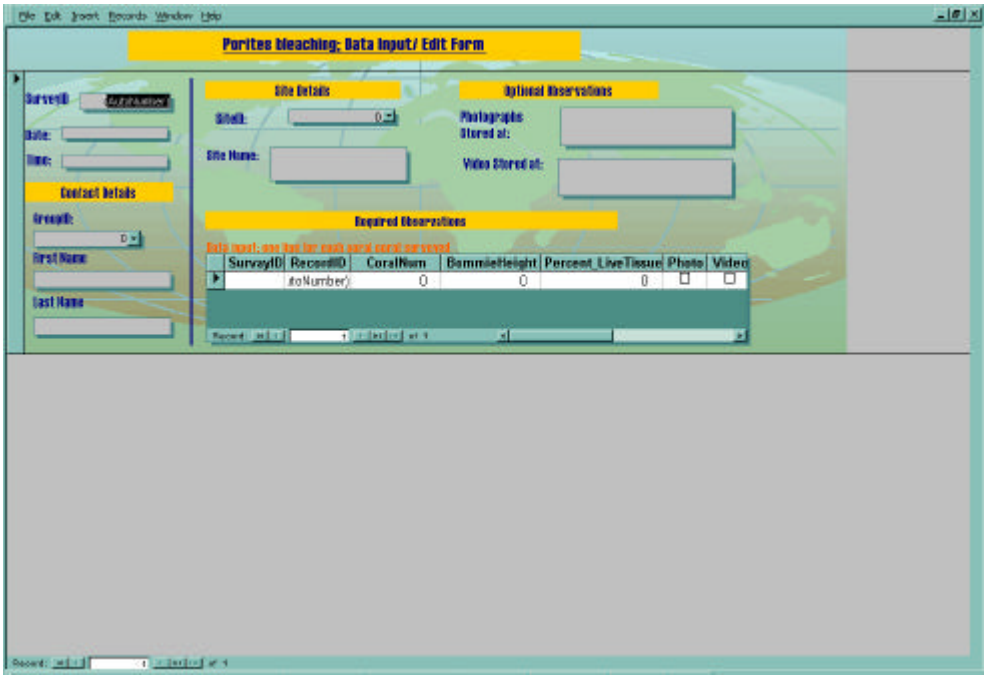
Although the data entry forms for most methods are very similar there are three exceptions which are the "*Porites* bleaching", "Beach litter" and "Underwater litter" methods. These are covered in the next section.

DATA INPUT: SPECIAL NOTES AND EXCEPTIONS

This section contains additional information for certain methods, which have different data entry forms (comprising of two sections). Although the differences are small they are important to be aware of when entering data.

PORITES BLEACHING METHOD

The *Porites* bleaching data sheet (below) has two data entry areas. In the first section enter the general site information and in the second section enter the *Porites* observations. The second section has a table that scrolls (or tab) along the table to get to all the fields. Like the main part of the form use the record navigation tools (|<, <,>,>|, >*) to navigate through the entered data. The Survey ID in the top right hand corner of the first section is the same as the survey ID in the second section.



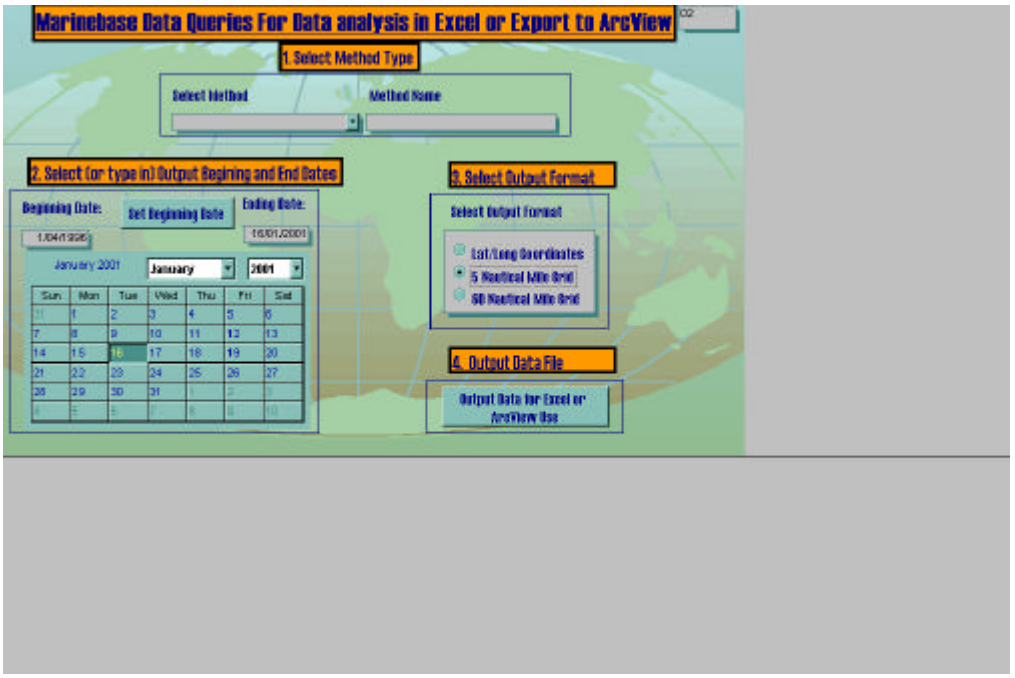
BEACH AND UNDERWATER LITTER SURVEYS

Like the *Porites* bleaching method, the beach litter method and the underwater litter method contain two data entry areas on the one sheet. In the first section enter the general site information and in the

second section enter the litter data for the site. The second section has a drop down menu to select litter type ("T" indicates terrestrial litter and "M" indicates litter from a marine source).

QUERYING METHOD AND GENERATING OUTPUT FOR USE WITH ARCVIEW

Select "Data querying and output" from the main menu



APPENDIX II: EXTRACT FROM THE MARINE COMMUNITY MONITORING MANUAL

SEEING YOUR DATA ON THE WEB

OVERVIEW OF THE *WA ATLAS*

The *Marine Community Monitoring Program* is using the *Australian Atlas* to make collected data publicly available via the Web. *The Australian Atlas* is a national network of State marine and coastal agencies working together to provide information to the public over the world-wide-web (WWW). The *WA Atlas* uses the *Australian Atlas* WWW application developed by Environment Australia to view marine and coastal data including data from the *Marine Community Monitoring Program.*

HOW TO USE THE *WA ATLAS* TO LOOK AT COMMUNITY MONITORING DATA

To use the *WA Atlas* you need to have access to a computer with internet access and a basic understanding of how to use an internet browser. If you don't have a suitable computer, internet access is now available through most public libraries.

The web address for the *WA Atlas* is http://www.walis.wa.gov.au/atlas. The Atlas works by adding different "data layers" of different information to a base layer of the WA coastline. Each community monitoring method is presented at three different resolutions with each having a separate "data layer". For an entire state view of your data, use the 60 nautical mile grid layer. For a regional scale perspective use the five nautical mile grid layer and to look at the results from individual monitoring sites, use the point data layer. Information on navigating around the *WA Atlas*, using its functionality and generating your own maps is covered in the following sections. It may help to have the *WA Atlas* up and running on your computer while you work through the various functions. If you want a quick overview you can run though the section " Using the *WA Atlas*; Example beach litter data"

USING THE *WA ATLAS*; EXAMPLE "BEACH LITTER DATA"

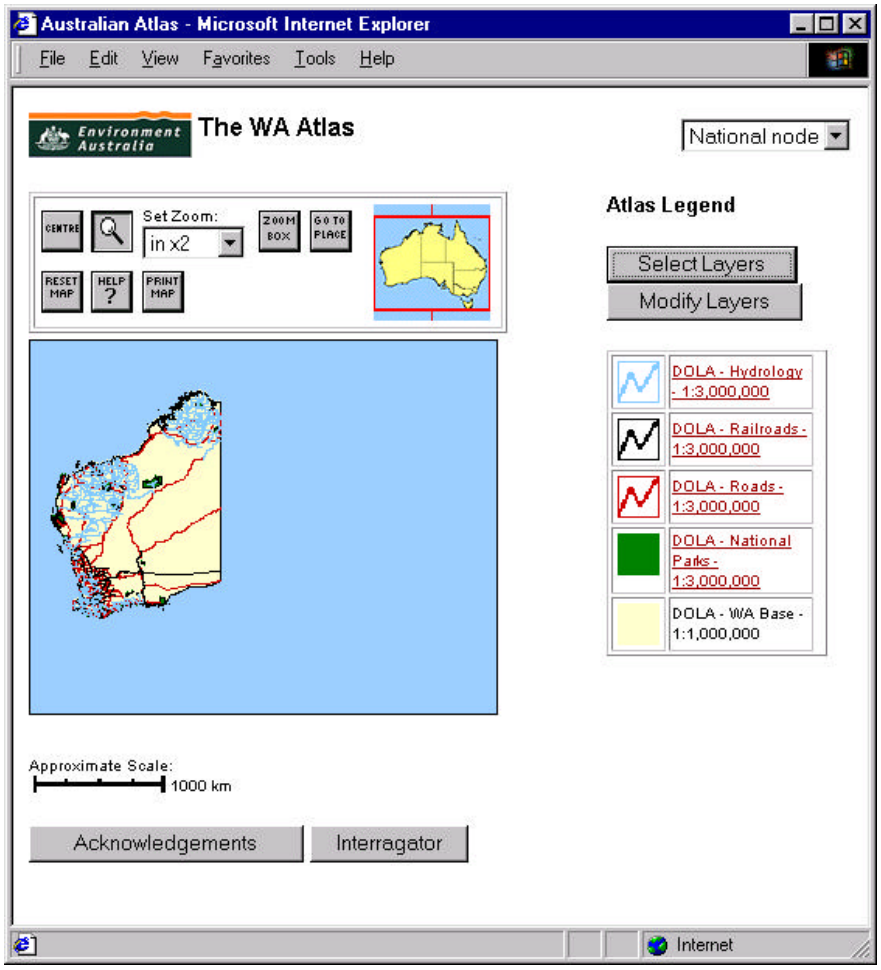
The *WA Atlas* is found on the web at the web address http://www.walis.wa.gov.au/atlas. From the main start-up page click the button "Create Your Own Map!" – this opens a new page on your web browser (see figure 17). Alternatively, a user can select a Ready Made Map from the list on the left hand side of the entry page. These Ready Made Maps are updated regularly and we envisage an MCMP map will be listed here. The concept behind these Ready Made Maps is do the hard work for the user – present something quick and easy for them to look at and interact with immediately.

Click on the *select layer* button where all the community monitoring data is contained as layers of information that can be added to the baseline of Western Australia.

Selecting the beach litter layer

Within the Select Layers form the layers are listed under general category headings: Base, Administrative/Management Boundary, Economics and Human Use, Environmental, Socio-cultural, Marine Community Monitoring Program and North West Shelf Layers. The *WA Atlas* will launch with a background layer and some general topology. To add to these layers, the user should expand the MCMP list by keeping the Control key pressed down and clicking the Category heading once. Keeping the Control key pressed down, the user can then click on any layer to add it to the mapframe. You have a choice of three scales (see Figure 18). These are:

- **60 Nautical Mile grid**; gives you an overview of the whole WA coastline;
- **Five Nautical Mile grid**; gives you a more detailed overview which is useful for looking at your data on a regional scale; and



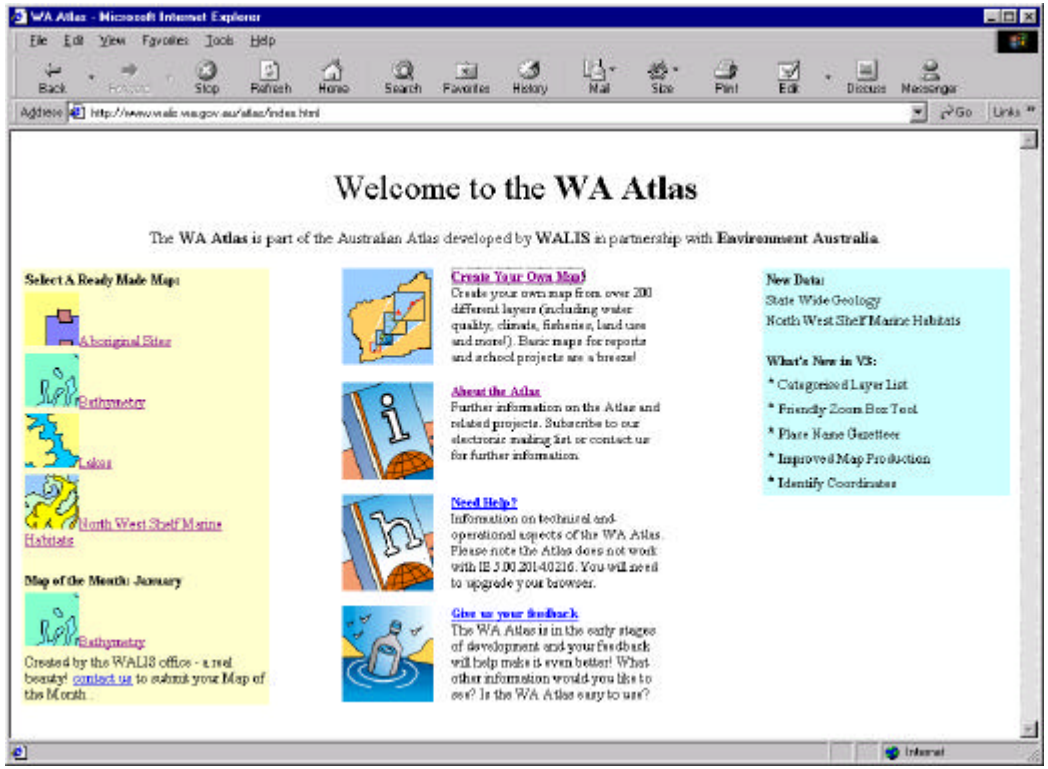


Figure 17. Start using the WA Atlas now.

- **Site Data**; gives detailed information at of information collected at each site which can be seen as a point data on the map. When you click on the point the data collected at that point is revealed in a separate box.

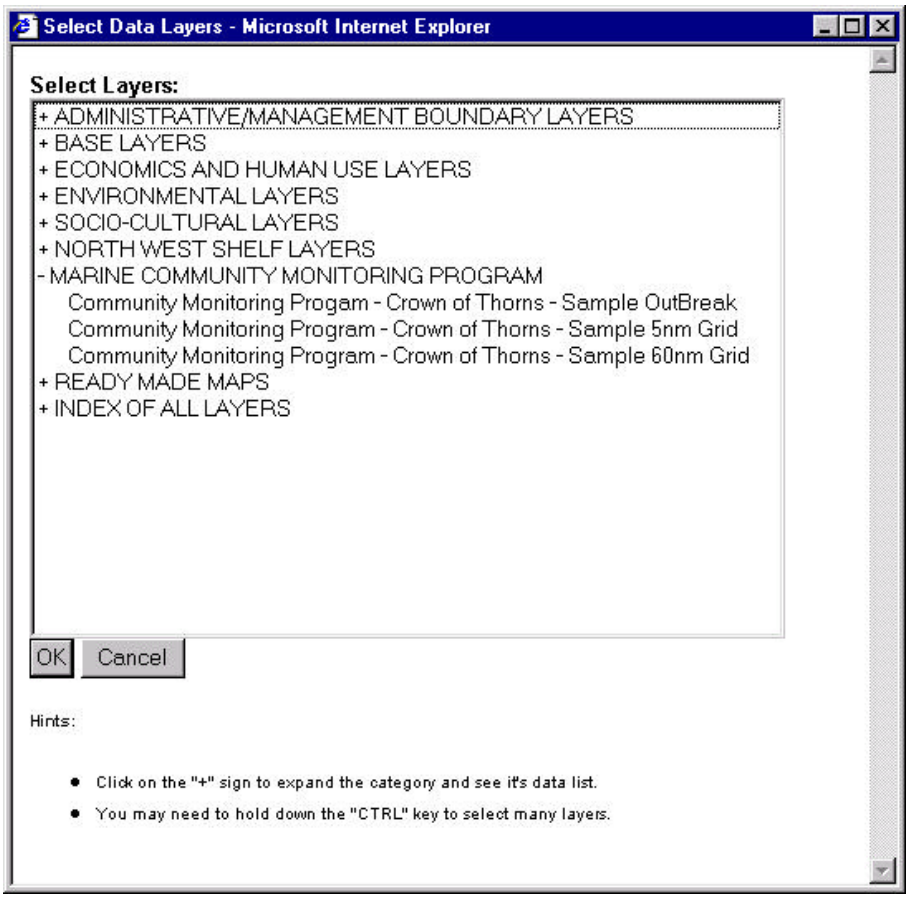


Figure 18. Select data layers

Viewing your map

Once you have selected your data layer, click on the OK button and you will see that the data layer you selected is shown in the right hand corner next to the map box.

In this example we want to look at the largest scale available so we to select *the Community Monitoring beach litter 60NM* data layer and click ok.

We now have to set the area we want so we click the zoom box, then click and drag a box to delineate the are of interest on the map of WA. This should give you a map similar to the one in Figure 19. Remember that there is a lot of other interesting environmental and infrastructure data layers within the *WA Atlas* so take some time to experiment with different combinations of data layers.

Printing your map

When you are happy with your map you can print a copy using the *Print Map* button in the top left hand corner. Periodically the interface for the *WA Atlas* changes so for the latest changes and new information see the *Atlas online help.*

GENERAL INSTRUCTIONS HELP FOR USING THE *WA ATLAS*

Using the navigation buttons

Zoom Box

- to define the area of interest press the *zoom* box button;
- click a point on the map and drag the box to form a box around the area of interest
- the map will automatically zoom to the area defined by the box.

Centre

- press the *centre* button;
- click on the area of the Australia map you wish the map to centre on; or
- click on the area of the thumbnail map you wish to the map to centre on; and
- the map will automatically redraw to display the new region.

Zoom

- press the *zoom* button;
- from the *Set Zoom* drop down menu, select the desired zoom scale (whole numbers zoom in, fractions zoom out);
- click on the area of the Australia map you wish to zoom to; or
- click on the area of the thumbnail map you wish to zoom to; and
- the map will automatically redraw to display the new region.

Reset

- on clicking the reset Map button the user is presented with 2 choices:
- Start Again – reset the map to all of WA and resets layer to default set
- Reset Extent of Map - resets extent to all of WA but maintains selected layers – care should be taken with this option as it may take a long time to draw if many detailed layers are selected.

Go To Place

- on clicking the Go To Place button the user is presented with a free text field to enter a place name. The user is presented with any matching entries and can choose to zoom to place or search again.

Using the thumbnail

- the thumbnail map of Australia is an interactive navigation tool. At any time, a red box on the thumbnail map will display the region you are currently viewing in the main frame; and
- the user may also click on the thumbnail to pan and/or zoom in to a different area of Australia.

Data layers

Selecting data layers

- *Select Data* will spawn the pop-up window (see figure 20);
- layers are listed under Category headings: currently these categories are base layers; administrative/management boundaries; economics and human use; environmental, socio-cultural; Marine Community Monitoring Program and North West Shelf Layers. There is also an Index of All Layers and a list of Ready Made Maps. When selecting layers it is important for the user to keep the control key pressed down to ensuring they are adding to their selection; and
- press *OK* to confirm your theme selection

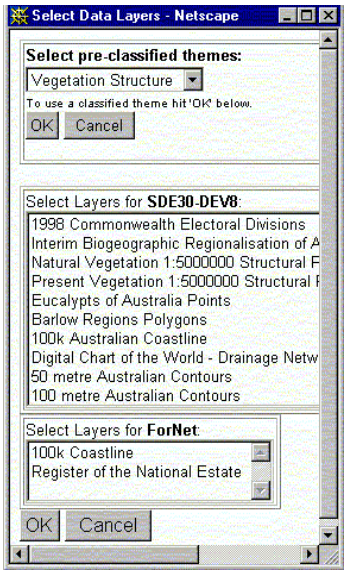


Figure 20. Select data layers

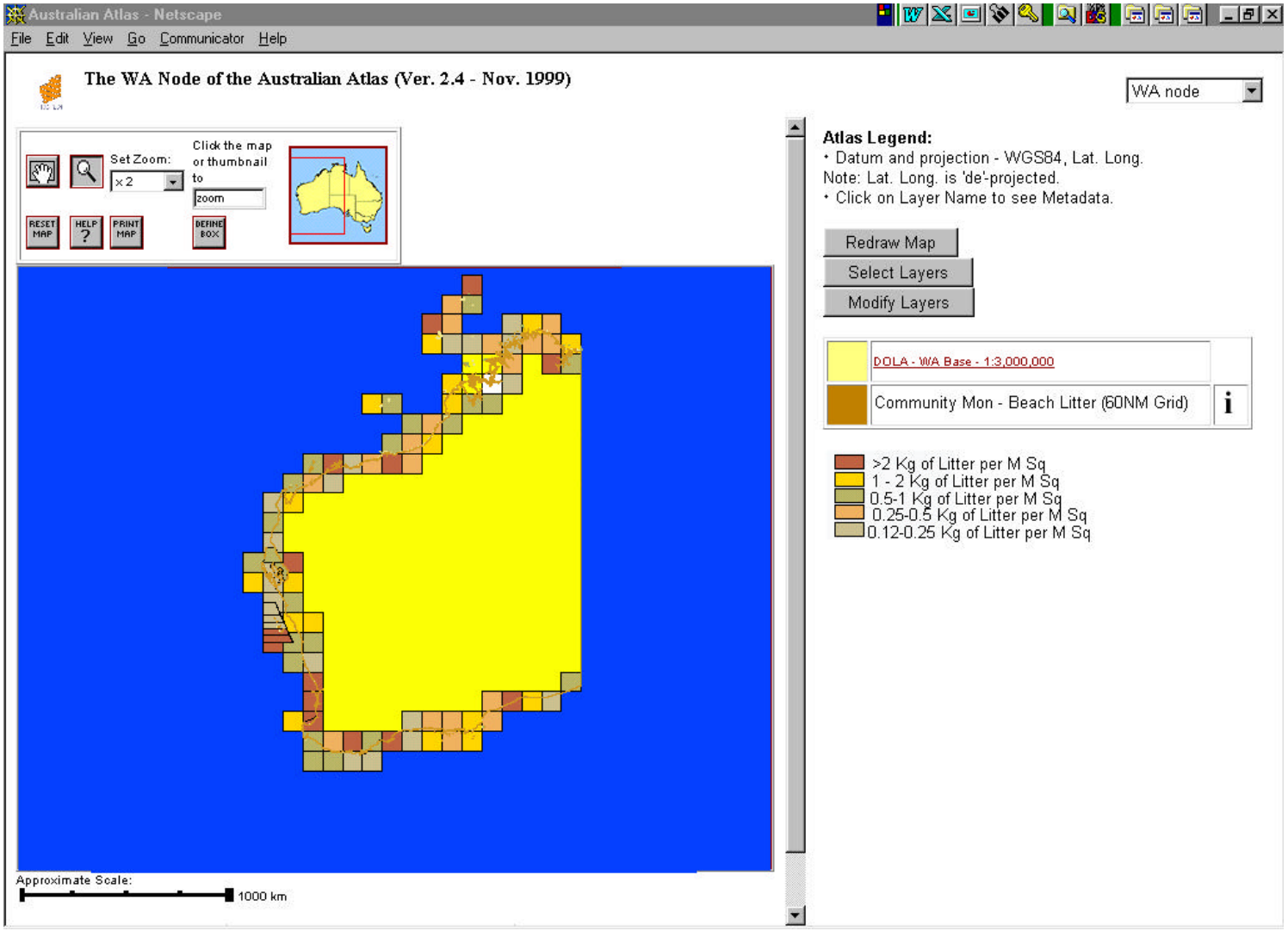


Figure 19. Final Map

Editing data layers

- *Modify layers* will spawn the pop-up window for editing data layers (see figure 21);
- click in the *Colour* box for each theme to spawn the colour selection tool. Selecting a new colour from this palette will change the colour of your selected theme;
- click in the *Name* column to change the name of each theme;
- type in the name of the attribute to be labelled. These can be obtained from performing an *info* query on the layer. Once the map is re-drawn, labels will automatically generate. Type an "N" in this box if you do not want to label that layer;
- use the *Order* drop down menu to select the order in which you want the layers to draw. Selecting "1" will draw that layer on top of any layers numbered 2,3,4 etc. Selecting "X" will mark that layer to delete and will therefore not draw that layer;
- check the *Info* box next to a layer to make it active. This layer may then be queried for feature information and is identified in the legend by the letter "**i**";
- select *OK* to commit changes, *reset* to start again; and *cancel* to close the pop-up window without saving changes.

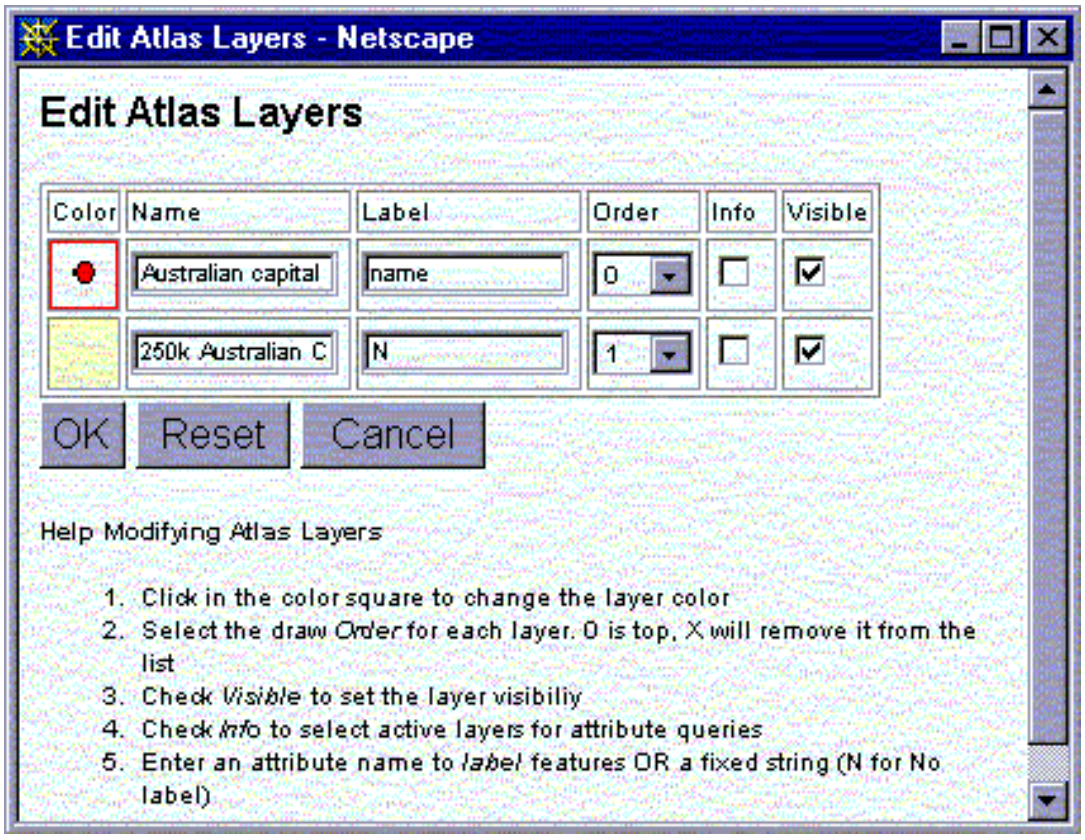


Figure 21. Edit atlas layers

Querying* Info *layers

- Press the *Info* button;
- click in the map on a feature in an active *Info* layer to display its attributes in a new window.

Re-drawing the map

- *Re-draw Map* will refresh the main map frame with your new selected layers and any edits you have made to these layers;
- this button will only appear beneath the legend if you have modified any of the layers.

Printing

- Press the *print map* button;
- select the map size; and
- press *print* to print your map to the default printer.