

Channel Islands National Park Data Management Plan Assessment and Recommendations

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1. Channel Islands National Park Data Management Goals

Channel Islands National Park was established “to protect the nationally significant natural, scenic, wildlife, marine ecological..and scientific values of the Channel Islands in the State of California...” The design and implementation of adequate management strategies to insure such resource protection requires information on ecosystem elements and processes. With access to information on long-term resource condition and trend, managers will be more able to determine the effects of human activities on park resources, and can then prescribe and implement appropriate mitigative measures.

The National Park Service has a strong nationwide commitment to long-term inventory and monitoring of the natural resources under its stewardship. In addition, Channel Islands National Park (CHIS) has a specific legislative mandate to conduct resource inventory and monitoring. The enabling legislation for CHIS required development of an “an inventory of all terrestrial and marine species, indicating their population dynamics, and probable trends as to future numbers and welfare” with biennial reports to Congress which include “recommendations as to what actions should be considered for adoption to better protect the natural resources of the park.”

Because of the unique mandate, Channel Islands National Park has much better knowledge of its natural resources than do most National Park Service units. A recent survey of the status of natural resource databases in the National Park Service Western Region (Stohlgren and Quinn 1991) found that Channel Islands National Park had the most complete inventory of all parks in the region. Nonetheless, the park does not meet the minimum level of baseline information as defined in NPS-75, Natural Resources Inventory and Monitoring Guideline (National Park Service 1992).

The purpose of this data management plan is to use recent developments in database-independent applications (see Appendix A: ODBC - Database Independent Applications) and integrated applications running in the Microsoft Windows environment to accomplish the following CHIS data management goals and objectives:

- Facilitate the annual process by which data from monitoring programs is stored, analyzed, summarized, and presented in annual report form.
- Provide for seamless (automatic) transfer of data from database to statistical packages for analysis, to spreadsheet/graphic packages for graphical display, to summary tables for inclusion in annual reports.
- Allow for easy production of ad hoc reports.
- Facilitate periodic trend analysis of data from the monitoring program, allowing enough flexibility for future analysis by as yet undetermined methods.
- Provide for trend analysis of data over temporal and spatial scales, allowing comparisons between locations, years, etc.
- Allow researchers the ability to perform diverse types of statistical analysis for both research and resource management programs
- Provide for cross-referencing of data by location, time, species, etc., in standardized format, for linkage to other datasets.
- Provide for linkage to GIS.
- Provide for long-term secure storage of datafiles.

This plan will not disrupt the existing data entry, quality control, and data analysis procedures which have served Channel Islands National Park so well. It will instead focus on increasing the level of automation available for routine reporting tasks, and improving access to resource monitoring data for trend analysis, research, and resource management. Table 1 summarizes the natural resource monitoring programs in terms of age, database format, and analytical software used:

Table 1: CHIS Monitoring Programs

Resource	Data Since	DataBase Format	Existing Software
Pinnipeds	1984(quarter)	National Marine Fisheries Services	
Seabirds	1985	dBase III +	SPSS
Rocky Intertidal Communities	1982	dBase III +	SPSS/PC+
Kelp Forest	1982	dBase III + (lots of data)	SPSS
Terrestrial Vertebrates	1988	dBase III	dBase III & Capture
Land Birds	1988(yearly)	dBase III	Statistical
Terrestrial Vegetation	1988	ASCII Files	Transect(Basic)
Fisheries Harvest		California Dept. Fish & Game	imprecise data
Park Visitors	1982		
Weather		Automated Weather Stations	
Terrestrial Invertebrates		dBase III	dBase III
Beach Debris	1988	Nova Univ. (Dr. Cole)	Lotus or Excel
Water Quality	1993(biweekly)		

2. Overview - Channel Islands Data Management Plan

The primary goal of this plan is to simplify and automate access to the data in the Channel Islands resource monitoring databases. The implementation of this plan will proceed incrementally, with minimal disruption to existing data collection, analysis, and reporting procedures. The three phases of this plan are outlined in Table 2. This section provides an overview of each phase, with particular emphasis on Phase I.

Phase	Description	Goals	Cost
I	Customize Windows Environment	Reports & Research	\$65K
II	Convert Databases/GIS Support	Trend Analysis & Research	To be determined
III	Client/Server Support	Secure Data Storage	To be determined

Table 2: Data Management Plan Phases

2.1 Phase I - Customize Windows Environment

Access to CHIS data files will be customized to seamlessly assist in annual report generation, statistical and trend analysis, and data extraction for research purposes. The customizations will work with existing Channel Islands Resource Monitoring databases, but will not be dependent upon a particular database platform (dBase, FoxPro, etc.). All existing data entry and analysis techniques will still be useable. Windows applications will be easier to use to retrieve data for reports and analysis. This report demonstrates the integrated applications in Microsoft Office 4.2. Customizing the Windows environment for CHIS involves the 5 tasks listed below:

- EcoAnalysis will setup a graphical query interface to existing Channel Islands databases. The databases will be accessible by multiple users concurrently. Data retrieved with the query interface will be accessible by all Windows applications.
- As a pilot project EcoAnalysis will customize access to all Kelp Forest data files for annual report preparation, trend analysis, and data entry.
- EcoAnalysis will customize access to all other CHIS resource monitoring data files for annual report preparation, trend analysis, and data entry.
- EcoAnalysis will provide a generalized query interface (CHIS-Query) to support research queries and trend analysis with all CHIS resource monitoring data.
- This data management plan will be updated. A database platform (dBase for Windows, FoxPro 2.6, Microsoft Access 2.0, etc.) will be recommended. If it is appropriate to convert existing databases to the new platform, data entry and analysis programs to be updated/replaced will be prioritized. Additional statistical analysis tools will be recommended for customization in the Windows environment. Tasks to add a GIS interface to CHIS-Query will be defined.

The first task in customizing the Windows environment is by far the most dramatic. Once they are defined as datasources in Windows, the existing dBase III files will appear to be a relational database which can be accessed with Structured Query Language (SQL) statements. This means that any conceivable request for data can be satisfied without writing or modifying any dBase or SPSS code. As a result, this task provides the foundation for addressing all of the goals and objectives listed in section 1. It specifically allows researchers to perform diverse types of statistical analysis for both research and resource management programs, and provides for cross-referencing of data by location, time, species, etc., in standardized format. It also facilitates periodic trend analysis of data from the monitoring program, allowing enough flexibility for future analysis by as yet undetermined methods and provides for trend analysis of data over temporal and spatial scales, allowing comparisons between locations, years, etc..

To define CHIS natural resource databases in the Windows environment, EcoAnalysis will set up the existing dBase III files as a datasource (refer to Appendix A: ODBC - Application Independent Databases) in a centralized network directory. Once this is accomplished a variety of Windows applications can readily be used to access the datasource. One of the most powerful and yet intuitive graphical datasource access tools is Microsoft Query (MS-Query). This is an application which is included with Microsoft Excel 5.0 for Windows. MS-Query will retrieve and organize data from a variety of sources, including those in the following formats: Microsoft Excel, Microsoft FoxPro, Microsoft Access, Paradox, dBase, Microsoft SQL Server, ORACLE Server, text, and Btrieve. The existence of database-independent applications (all of which support dBase) running under Windows has several significant impacts on this CHIS data management plan. The first has already been mentioned, the existing CHIS dBase files can be used as a relational datasource. It also provides a much more orderly and less expensive growth path for accomplishing the goals and objectives of this data management plan. The tasks in this phase present an orderly progression because all CHIS data entry and analysis procedures can still be used. All customizations will be implemented with database independence in mind. If it is later decided to move to a different desktop database or client server platform, all customizations performed during Phase I will still work.

The existing procedure for preparing kelp forest quadrat data for analysis starts with a dBase III session to erase all the records in QUADYEAR.DBF and then appending data for the years to analyze. The resulting dBase III file can then be run with an SPSS/PC+ program to compute means and standard deviations, and output summary reports for each location by species. This procedure is highly labor intensive, and does not lend itself to analysis for selected locations, species, etc. .

Contrast this with using MS-Query to retrieve the data (automating the analysis and report generation is shown in Figure 5 on page 8). An example of a query on the kelp forest quadrat file with MS-Query is shown in Figure 1. In addition to the usual menu selections and toolbar buttons, the query window has three parts. The upper portion titled Query1 is the table pane. The center portion is the criteria pane, and the bottom portion is the data pane. The upper table pane shows the tables being queried, their data fields, and any links between the fields of the tables. The table in the middle is the QUADRAT dBase III file. The tables on the right and left contain information about each of the sites at which kelp forest quadrat data is collected, and about each of the species for which data is collected. This information is not

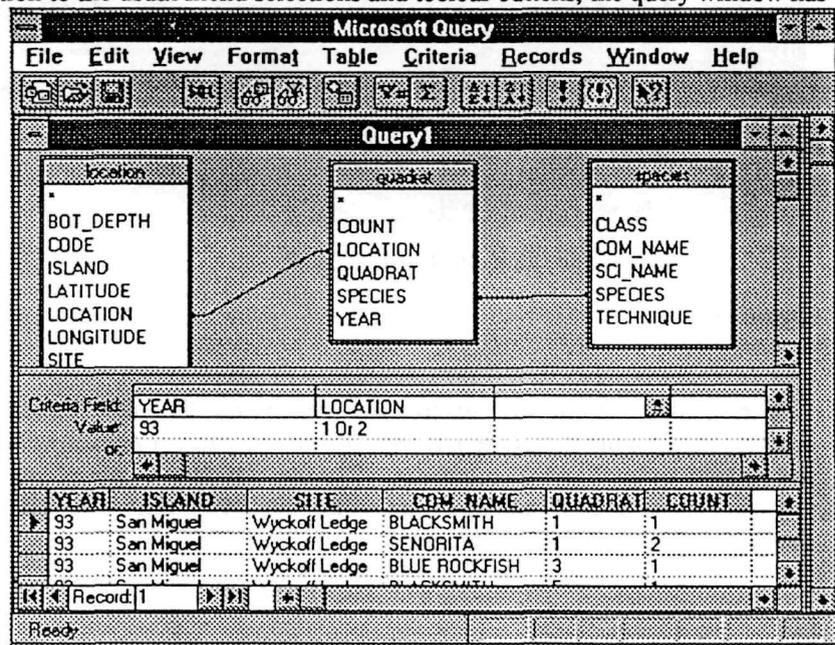


Figure 1: Querying Kelp Quadrat Data

currently in any of the dBase III files used for kelp forest monitoring. A portion of it can be found in the data base conversion programs written in SPSS. The location table on the left will have 16 records, one for each kelp forest monitoring site. By linking the location field in the QUADRAT table to the corresponding location field in the LOCATION table, all of the information specific to each location is

associated with each record in the QUADRAT table. This makes it possible to retrieve quadrat data for an island, for a depth range, for a latitude and longitude, etc. It also translates the encoded location value into a variety of more meaningful island names, site abbreviations, etc. for use in tables, charts, and reports. Similarly the species table on the right will have several hundred records, one for each species. This information can be used for both retrieving data by species or to add meaning to reports. The criteria pane (in the center) allows selected data to be retrieve. In this example QUADRAT data for the year 93 and location 1 or 2 is being retrieved. The data retrieved is shown in the data pane (bottom). It consists of data retrieved from all three tables. The YEAR, QUADRAT, and COUNT columns contain data from the QUADRAT table. The ISLAND and SITE columns contain data from the LOCATION table, and the COM_NAME column contains data from the SPECIES table.

The full structure and some of the data in the LOCATION and SPECIES tables is shown in Figure 2 and

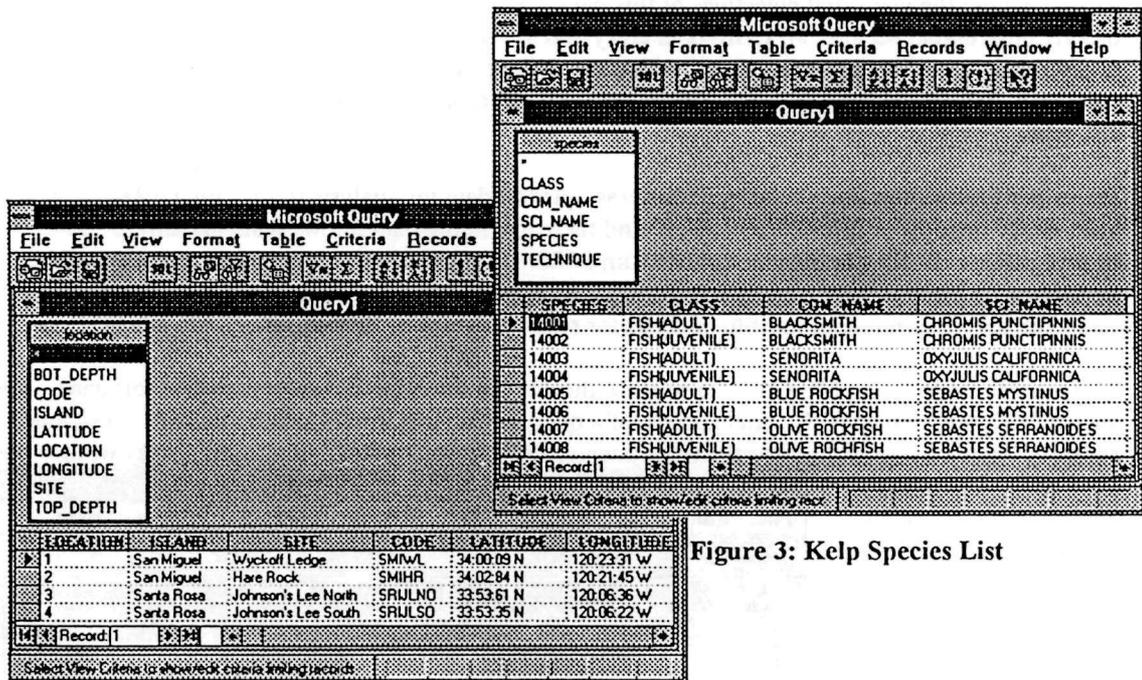


Figure 3: Kelp Species List

Figure 2: Kelp Location List

Figure 3.

This example illustrates why this first task of defining CHIS data files as a Windows datasource is so critical. It will immediately enable users to retrieve data for a much wider variety of needs without resorting to using dBase III commands. The data can then be moved into a wide variety of Windows applications for analysis and reporting, rather than being limited to using an existing SPSS+ program or having to write a new SPSS+ program.

The power of an easy to use graphical interface is evident from the complexity of the SQL statement which MS-Query generates to perform the Kelp Forest quadrat query in Figure 1 above. The only

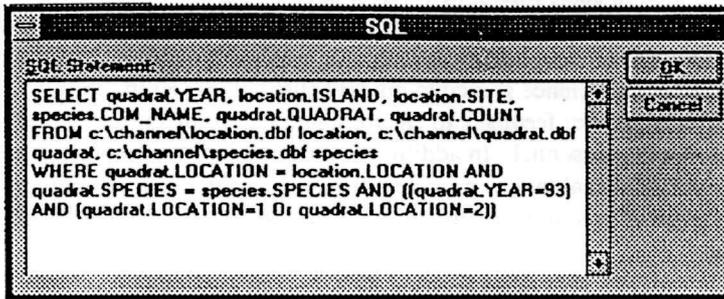


Figure 4: SQL Statement for Quadrat Query

keystrokes which were entered for the query were to type in the year (93) and the locations (1 or 2). Everything else was set up by making selection from lists of valid names or by dragging and dropping field names (holding the mouse button down over a field name in the table pane and then moving the mouse with the button down to select that field name in the criteria or data pane). The generated SQL statement is shown in Figure 4.

Unfortunately the MS-Query interface can be quite intimidating to users who are not familiar with relational data base and SQL concepts. A thorough knowledge of the relationships between tables and allowable value for all fields is also required to make full use of the MS-Query capabilities. The purpose of the remaining tasks in Phase I will be to automate and simplify this somewhat intimidating but very powerful interface.

After the initial task of defining CHIS data files as Windows datasources environment is completed, the emphasis of this data management plan is to simplify and automate access to the CHIS datasources.

EcoAnalysis will implement user friendly interfaces for generalized access to the CHIS datasource and also to seamlessly integrate the CHIS data files for annual report generation.

EcoAnalysis will customize CHIS data access to seamlessly transfer data into Microsoft Word 6 and Microsoft Excel 5 for graphical display and for inclusion into summary tables for annual reports. As a pilot project to demonstrate the feasibility and benefits of this approach, one of the monitoring programs will be selected for complete customization. The kelp forest monitoring program has the largest amount of data and much of the annual report can be automated.

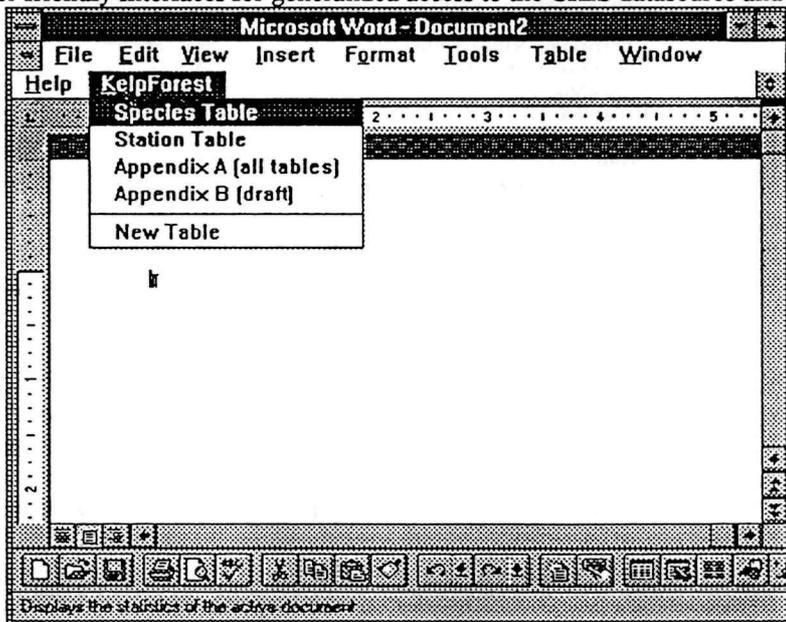


Figure 5: Kelp Forest Custom Menu in Word

Based on the results of the

pilot project, the remaining CHIS monitoring programs will be customized. Figure 5 indicates a custom menu item, KelpForest, which will be added to Word for use in producing the kelp forest annual report. The species table and station table menu items will generate summaries of the LOCATION and SPECIES tables discussed above. The Appendix A menu item will generate all of the tables in Appendix A of the Kelp Forest Annual Report. This appendix was more than one-half of the 1991 annual report. The data for the year will be retrieved, analyzed, formatted, and automatically inserted into the annual report with this menu item. Appendix B of the annual report contains extra information not included in the kelp

forest data files. The Appendix B menu item will generate a draft version of this table, to which the additional information can then be added.

The lessons learned and experience gained in customizing kelp forest data access during the pilot project task will be used to perform the next task, customizing data access for each monitoring program. The pilot project approach will allow EcoAnalysis to thoroughly develop and test customization techniques for one monitoring program, and then use the experience gained to quickly customize the remaining programs. It will also allow Channel Islands user feedback to ensure that the customizations actually improve the productivity of Channel Islands personnel. In addition to customizing each monitoring program, EcoAnalysis will perform an additional task to provide a flexible, easily usable general purpose query interface. This will allow data from all monitoring programs to be retrieved for trend analysis, reasearch, and resource management.

One possible design for a generalized query interface specific to the CHIS data files is indicated in Figure 6 and Figure 7. Generalized queries will be supported with this interface. Data from one or more monitoring programs can be retrieved (Figure 6). Data from one or more locations can be retrieved (Figure 7). Data for specific species, and for specific time frames can also be retrieve. Combinations of

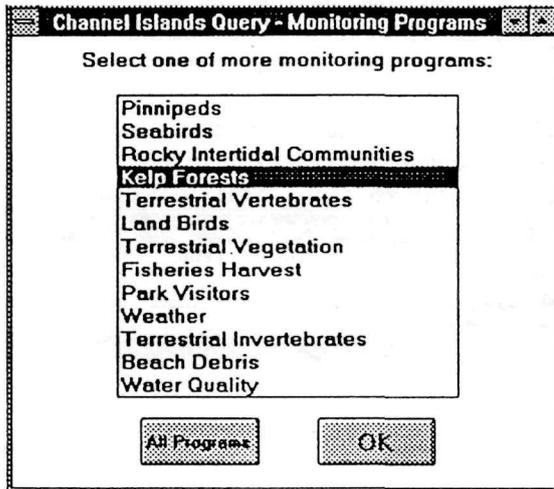


Figure 6: Monitoring Program Dialog

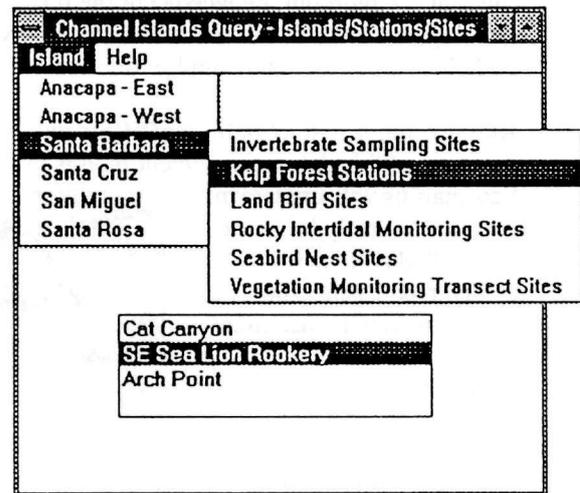


Figure 7: Islands/Stations/Sites Dialog

programs, locations, species, and time periods can also be specified. The goal of this customized query interface is to provide all the power of MS-Query in retrieving data, but without the need to know SQL concepts, CHIS datasource table name, links between tables, field names or field values. The detailed knowledge required when using MS-Query will be built into this interface. The software behind this interface will provide the names of all the data tables, the links between the data tables, the names of the fields in each data table, and the possible values for the data fields. This will allow researchers to perform diverse types of statistical analysis for both research and resource management programs, and provide cross-referencing of data by location, time, species, etc. in standardized format.

2.2 Phase II - Convert Databases/GIS Component

Phase II will carry out the recommendations about database conversion made in the last task of Phase I. This will allow such issues as CHIS network performance and developments in available dBase compatible database platforms to be considered.

- EcoAnalysis will convert existing databases, data entry, and data analysis programs as required to the recommended database platform.
- EcoAnalysis will customize selected statistical analysis tools to work directly with CHIS datasources.

- EcoAnalysis will implement a GIS component and add a geographical interface to CI-Query
- EcoAnalysis will update the data management plan to evaluate the benefits and costs of moving into a client/server environment. If appropriate, a particular client/server platform will be recommended. Alternative medias (CD-ROM, hypertext, etc.) for distributing research and monitoring results will be investigated and recommended..

2.3 Phase III - Move to Client/Server

The primary reason to move to a client/server environment is performance. As the volume of CHIS resource monitoring data increases and access to the data increases, poor network performance may become an issue. Since all of the tasks performed in Phase I and Phase II have been directed at database independence, moving to a client/server environment will be relatively easy. The cost of client/server software and hardware has been steadily decreasing. Performance which used to cost \$150,000 to \$200,000 just 2 to 3 years ago can now be obtained for \$10,000 to \$20,000. If moving to a client/server environment becomes necessary, EcoAnalysis will assist in converting all Channel Islands databases to the selected client/server platform

3. Phase I - Customize Windows Environment

The primary goal of Phase I is to customize access to CHIS Windows datasources to assist in annual report preparation, statistical and trend analysis, and data extraction for research purposes. The six tasks in phase I are outlined in Table 3. This section provides an overview of each task.

Phase I Tasks	Description	Cost
1	Datasource/SQL Query Definition	\$2.5K
2	Support Capture, Transect, and SPSS/PC analysis programs	\$2.5K
3	Customize Kelp Forest Monitoring Program	\$20.K
4	Customize all CHIS Monitoring Programs	\$25.K
5	Implement CHIS-Query	\$12.5K
6	Update Data Management Plan for Phase II	\$2.5K

Table 3: Phase I Tasks

3.1 Task 1 - Datasource/ SQL Query Definition

EcoAnalysis will setup a graphical SQL based query interface to existing Channel Islands databases. The databases will be accessible by multiple users concurrently. Data retrieved with the query interface will be accessible by all Windows applications.

The ODBC software for use with Windows is included as part of many other software products. An updated version comes with Excel 5.0. EcoAnalysis will insure that the ODBC drivers for dBase III, dBase IV, FoxPro 2.0, Excel .XLS files, FoxPro 2.5, Access 1.0, and Access 1.1 are available to Channel Islands personnel. The most current version of ODBC allows multi-user access to database files in network directories. But each user must have a definition of ODBC data sources in his own WINDOWS\SYSTEM directory. EcoAnalysis will assist a designated Channel Islands person in correctly installing the data base drivers on their individual computer. It will be that person's responsibility to assist other Channel Islands users in installing the ODBC drivers on their individual computers.

The drivers and ODBC data source definitions must exist on each user's computer. The databases can exist in network directories or on individual user's computers. EcoAnalysis will assist in establishing a network setup for all existing Channel Islands Environmental Monitoring databases. One or more network directories will be created for each monitoring program. All of the databases for an individual monitoring program will be placed in the defined directories. In some cases it may be desirable to combine several existing database files into one database file. For instance kelp forest quadrat monitoring data is stored in multiple dBase III files, one for each year. Since one of the fields in each database file is the year of the data, it is possible to append all quadrat databases together as one file. EcoAnalysis will assist a designated Channel Islands person in defining all existing Channel Islands environmental monitoring data bases as ODBC multi-user data sources. It will be that person's responsibility to assist other Channel Islands users in defining the databases as ODBC data sources on their individual computers.

Once this is accomplished, Channel Islands personnel will be able to access all of their environmental monitoring data; view, edit, and organize the data, and insert the data into Windows application files, such as Microsoft Word tables and Microsoft Excel spreadsheets. Microsoft Query is a powerful graphical tool to retrieve and organize data from ODBC data sources. It can be used by itself or integrated with Microsoft Office 4.2 applications.

EcoAnalysis will use MS-Query to create a set of query definitions to serve as models for the most common requests for data. SQL queries can be set up to perform calculations on the data retrieved. Functions built into MS-Query include Sum, Average, Count, Minimum, and Maximum. Calculated fields can also be included in query result sets. When possible the queries created in this task will use SQL's computation features to transform data for use in Word tables. More complicated calculations can be done using Excel's spreadsheet features. The queries will be saved in the network directory for each monitoring program. This will assist in simplifying the use of MS-Query for casual computer users, but it is only the first step. Figure 1 (above) shows an MS-Query session which is retrieving selected data from a data source consisting of multiple linked dBase tables.

3.2 Task 2 - Support Capture, Transect, and SPSS/PC analysis programs

This is an optional task because all databases can be used with Channel Islands analysis programs as they have been in the past. The purpose of this task would be to simplify data access for use with older DOS programs, as well as to be able to analyze a more flexible subset of data. The problem is that MS-Query returns query results either through the Windows clipboard or as a new database file. The Windows clipboard provides temporary storage for information you want to transfer. You can cut or copy information from a Windows application onto the clipboard and then transfer that information from the clipboard to another Windows application. This works fine with Windows applications, but not with existing DOS applications.

EcoAnalysis will implement a Windows program to translate MS-Query clipboard result sets to DOS files formatted to be used by the Capture and Transect analysis programs. The Transect program would probably be a priority under this task. The program will be written in Visual Basic 3.0, will be ODBC compliant and not limited to any specific database platform, and the source code for the program will be supplied to Channel Islands.

3.3 Task 3 - Pilot Project - Customize Kelp Forest Monitoring Program

The goal of this task is to facilitate the annual reporting of monitoring data. Seamless transfer of data from database to Excel 5 for statistical analysis and graphical display, and to Word 6 for inclusion in annual report summary tables will be provided. The pilot project will concentrate on customizing Windows applications for one of the CHIS resource monitoring programs - kelp forest is suggested but any one can be used.

3.3.1 Update Data Entry Program

EcoAnalysis will develop a data entry program for the kelp forest monitoring databases. The data entry programs will include ease of use features such as using default field values for year and site, the default values will be easily changeable. Data integrity will also be ensured by providing species lists from which valid species can be selected. Bounds check will also constrain numeric input fields to reasonable values. The programs will be implemented in Visual Basic 3.0, will be ODBC compliant, and independent of the database platform file format. The source code for this program will be provided to Channel Islands.

3.3.2 Customize MS-Query

EcoAnalysis will add a menu item to Microsoft Word and Excel to simplify retrieving kelp forest data with MS-Query. The purpose of the menu item will be to make the use of MS-Query transparent to casual users. The custom menu item will display a dialog box which prompts the user for the monitoring program, and once the program is selected, the table to retrieve data for. MS-Query will be displayed as a

small icon while the data is being retrieved, none of the MS-Query screens will be displayed. Of course behind the scenes the ODBC data source for the monitoring program is being accessed with one of the queries which was defined and saved in earlier. One of the dialog box table choices will be "New Table". When this is selected an interactive session with MS-Query will allow an existing query to be modified or a new query generated. Powerusers will also be able to access all of the features of MS-Query. In all cases the data retrieved from the query will be returned in Word table format or Excel spreadsheet format.

3.3.3 Customize Word and Excel for Kelp Forest Annual Reports

This task will provide a very high degree of integration with the Channel Islands kelp forest monitoring databases, and make it extremely easy for casual users to create annual reports.

Word provides wizards for creating letters, memos, resumes, newsletters, and other common types of documents. EcoAnalysis will add an annual report wizard to Word. The annual report wizard will define the format of Channel Islands annual reports in terms of page orientation (portrait or landscape), margins, headers and footers, page numbers, line numbers, and also enter standard text where appropriate. For instance it can include the basic outline of the annual report. It will also prompt the user for much of the information needed to retrieve the data to be used in creating the tables and charts in the report. This information will be saved with the report so that it will not be necessary to repeat these prompts as the report is edited. The list of Word wizards is displayed when you select **FILE** and then **NEW**. Figure 8 shows the Word **FILE / NEW** screen with the addition of the annual report wizard.

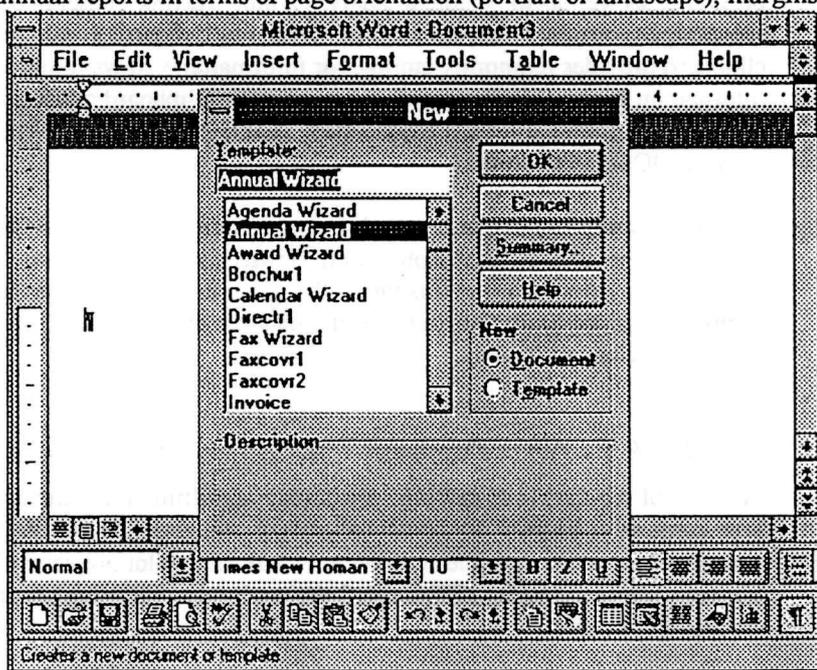


Figure 8: CHIS Annual Report Wizard

The annual report wizard will have several screens to prompt for all the information needed to initially create the annual report.

Figure 9 shows the prompts to define the year of the report and the monitoring program that the annual report will be about.

The year of the report and the subject of the report will be used in all queries to retrieve monitoring data to be included in the report. Since Word allows this information to be stored in the report (accessible by Word macros but not visible in the text of the report), it can be used to customize Word to the needs of the people writing the report. In this example the 1994 Seabirds annual report is being set up. All data base queries will automatically be restricted to seabird data. EcoAnalysis will also use this information to

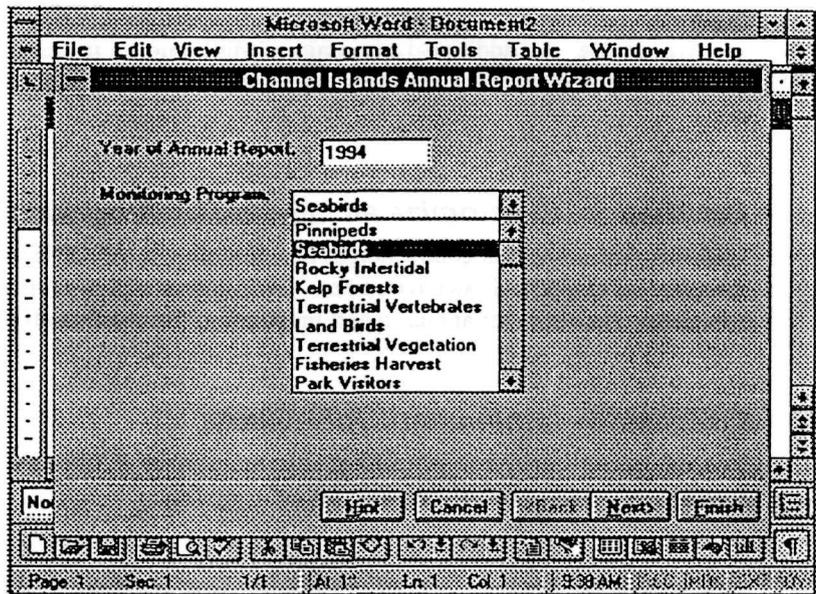


Figure 9: Channel Islands Annual Report Prompts

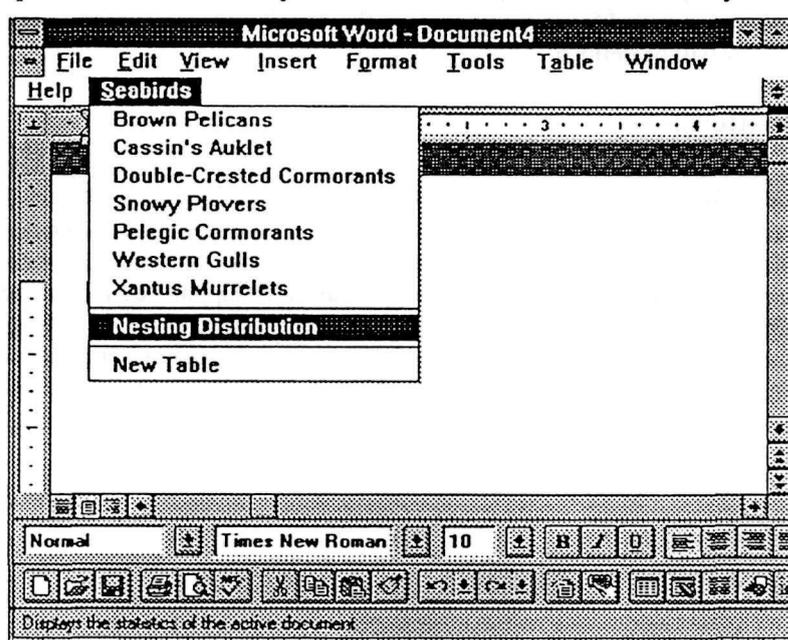


Figure 10: Seabird Menu for Inserting Tables

This discussion has focused on automatically inserting tables, but the same considerations apply to charts. The exact format for customizing Word and Excel will be approved with Channel Islands personnel, these examples are to indicate that a high degree of automation is possible with the existing environmental monitoring data bases in dBase and FoxPro format.

customize the Word menu bar options. In this example, a Seabird menu option is added (Figure 10). The pulldown items under Seabirds would be used to insert a table for the selected species directly into the report. If the species selected has populations on more than one island, a dialog box would be displayed to specify the island to place into the table. The purpose of this customization is to automate as much as possible access to the monitoring databases.

Additional customizations specific to each table will include defining the heading for each column in the table so that it is repeated across page breaks, defining column width and row height, formatting the data within each column (font, size, justification, format, etc.), labeling the table with a caption and table number, and specifying the overall table style. Tables which require more analysis than can be performed during the underlying SQL query will first be retrieved as Excel spreadsheets, analyzed, and then inserted as a Word table. An additional advantage of this approach is the flexibility to later convert some or all of the existing monitoring data to a new database platform, without modifying the customizations described here.

3.4 Task 4 - Customize all Monitoring Programs

Following the successful completion of this pilot project, all CHIS resource monitoring programs will be integrate into the Windows environment. EcoAnalysis will customize access to all CHIS resource monitoring data files for annual report preparation, for trend analysis , and for data entry.

3.5 Task 5 - Implement CHIS-Query

EcoAnalysis will provide a generalized custom interface (CHIS-Query) to support research queries and trend analysis with all CHIS resource monitoring data.

3.6 Task 6 - Update Data Management Plan for Phase II

This data management plan will be updated. A database platform (dBase for Windows, FoxPro 2.6, Microsoft Access 2.0, etc.) will be recommended. If it is appropriate to convert existing databases to the new platform, data entry and analysis programs to be updated/replaced will be prioritized. Additional statistical analysis tools will be recommended for customization in the Windows environment. Tasks to add a GIS interface to CHIS-Query will be defined

3.6.1 Select DataBase Platform

It is quite possible the recommendation in the updated data management plan will be to upgrade to dBase IV format. The only difference between dBase III and dBase IV formats is the addition of memo fields to dBase IV. Most existing databases are in dBase format. This creates tremendous pressure for database vendors to support dBase files and programs. Paradox for Windows currently supports both dBase III and dBase IV formats, along with Paradox 4.5 files. Several candidate database platforms which fully support dBase have just been released or are about to become available. FoxPro 2.6 (released in March) promises 99% compatibility with existing dBase programs. dBase for Windows (from Borland) should be available in June and will provide another possible platform which would require minimal changes to existing CHIS databases and programs

4. Phase II - Convert Databases/GIS Component

The primary goal of Phase II is to customize access to CHIS Windows datasources to assist in annual report preparation, statistical and trend analysis, and data extraction for research purposes. The four tasks in phase II are outlined in Table 4. This section provides a short overview of each task.

Phase II Tasks	Description
1	Convert Databases & Programs
2	Customize Statistical Tools
3	Add GIS component
4	Update Data Management Plan for Phase II

Table 4: Phase II Tasks

4.1 Task 1 - Convert Databases & Programs

If task 6 from Phase I recommends a new database platform, EcoAnalysis will convert existing databases, data entry, and data analysis programs as required to the recommended database platform

4.2 Task 2 - Customize Statistical Tools

EcoAnalysis will customize selected statistical analysis tools to work directly with CHIS datasources. Experience gained in Phase I will be used in selecting statistical analysis tools. The following quote is from an ad for SPSS (Visual Basic Programmer's Journal, March/April, Vol. 4 No. 2)

“In addition to accessing the proven functionality of SPSS, OLE 2.0 Automation gives you off-the-shelf capability to customize SPSS to fit the way you, or your users, work. Create special applications that use SPSS as an integral component - choosing only the features that fit your needs. Without knowing SPSS command language, a user can run involved analysis through your application - with SPSS running hidden or exposed. Alter or replace the SPSS interface to suit your purpose. Set up difficult analyses so they run with push of a button. Users can easily perform repetitive or complicated statistical tasks with a simplified, intuitive interface.”

This is from an advertisement for an SPSS Developer's Kit which will allow customized applications to be easily written in the Window's environment. The kit is scheduled to be available in November 1994, and will support OLE, DDE, OLE 2.0 automation, and database independence through ODBC.

4.3 Task 3 - Add GIS component

EcoAnalysis will implement a GIS component and add a geographical interface to CI-Query. This GIS software might range from ESRI's ArcView to workstation ArcInfo depending on the Park's computer resources and analytical needs.

The emphasis of this task will be to build a solid and flexible GIS infrastructure rather than simply the accumulation of various maps and coverages. The same data management principles that were applied to databases will be applied here, with special focus on quality control, easy user access, and automation. The goal is to provide GIS capabilities to the desktop in a way that allows non-programmers to make use of the technology.

EcoAnalysis will assist in locating, acquiring, and integrating GIS data from outside sources (UCSB, Teale Data Center, USGS). Many of the sources have substantial relevant data, such as elevation and bathymetric files, that will be of great use.

4.4 Task 4 - Update Data Management Plan for Phase III

EcoAnalysis will update the data management plan to evaluate the benefits and costs of moving into a client/server environment. If appropriate, a particular client/server platform will be recommended. Alternative medias (CD-ROM, hypertext, etc.) for distributing research and monitoring results will be investigated and recommended

5. Phase III - Client/Server Database

The primary reason to move to a client/server environment is performance. As the volume of CHIS resource monitoring data increases and access to the data increases, poor network performance may become an issue. Since all of the tasks performed in Phase I and Phase II have been directed at database independence, moving to a client/server environment will be relatively easy. The cost of client/server software and hardware has been steadily decreasing. Performance which used to cost \$150,000 to \$200,000 just 2 to 3 years ago can now be obtained for \$10,000 to \$20,000. If moving to a client/server environment becomes necessary, EcoAnalysis will assist in converting all Channel Islands databases to the selected client/server platform

Appendix A - Database Independent Applications & Integrated Office Suites

ODBC - Database Independent Applications

Microsoft's Open Database Connectivity (ODBC) is conceptually similar to the Windows print model. Windows handles the intricacies of printing to a very large variety of printers. Application developers do not have to design for each of the printers that their users may want to use. Windows users just have to select the printer they are using from a long list of supported printers. Similarly users of Windows applications which incorporate ODBC can select a large (and growing) number of database formats to store and retrieve data. Some of the more well known applications that use ODBC are Excel 5.0, Word for Windows 6.0, MicroSoft Query, PowerBuilder, Visual Basic 3.0, MicroSoft C++ 1.5, AutoCad, Pagemaker, SAS, ObjectView, Lotus 1-2-3 and Improv, Crystal Reports, Clear Access, SQLView, WordPerfect and Ami Pro. The databases supported by ODBC include nearly every major SQL DBMS platform, dBase III and IV, FoxPro 2.0 and 2.5, Access 1.0 and 1.1, Paradox 3.5. The ODBC interface supports the following data base platforms as well

Database Platform	Microsoft	Q+E
dBase III & IV	Single-tier	Single-tier
FoxPro 2.0 & 2.5	Single-tier	Single-tier
Paradox 3.5 & 4.X	Single-tier (3.X only)	Single-tier
Access 1.0 & 1.1	Single-tier	Single-tier
Oracle		Two-tier
Microsoft SQL Server	Two-tier	Two-tier
Sybase SQL Server		Two-tier
Gupta SQLBase		Two-tier
Informix		Two-tier
NetWare SQL		Two-tier
Ingres		Two-tier

Figure 1: ODBC Database Platforms Supported

Single-tier ODBC drivers are designed for use with database platforms that do not process ANSI SQL queries. These drivers translate SQL queries into a series of database calls which obtain the desired data. Two-tier drivers primarily rely on the client/server platform to process ANSI SQL statements. This causes less network traffic in a multiuser environment.

The ODBC terminology for a database is data source, it includes the data in the database and the information needed to get to that data. A directory containing a set of dBase files is a data source, each dBase file in the directory is considered to be a table within the data source. Data sources are defined thru the ODBC control panel, where they are registered, updated, and removed. It is possible to move a data source to a different drive and directory, convert it to a different database platform, update the ODBC data source description for the data source, and not have to change the ODBC compliant applications which retrieve data from it.

ODBC also provides an SQL interface for each database supported. This means that quite involved queries can be performed with dBase databases, even though dBase is not itself a relational database. Unfortunately, general purpose query interfaces build on ODBC tend to be hard to learn and very unfriendly. This state of affairs seems to be improving. Q+E, the query interface included with Excel 4.0 is VERY unfriendly and limited. Microsoft Query, included with Excel 5.0, is much more friendly and capable. It is an excellent tool for assisting power users in learning SQL by automatically generating SQL Queries. But the necessity to understand SQL concepts also detracts from its ease of use for casual users.

Microsoft Office 4.2

Microsoft Office 4.2 is recommended over its competitors because it provides a more tightly integrated set of tools. Also all of the tools work well with a very large number of database platforms ranging from dBase III and IV to client/server platforms. And the tools (Word and Excel) can be easily customized because they include similar versions of Microsoft Visual Basic as a macro language. The alternatives to Office 4.2 are offered by Lotus and Novell/Borland. The components in each of these office suites is indicated in the following table:

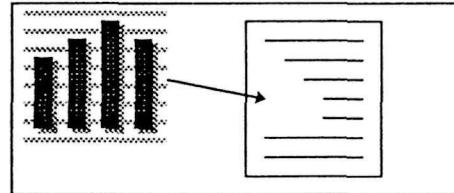
Vendor/Suite	Word Processor	SpreadSheet	Presentation	Database	OLE Level
Microsoft Office 4.2	Word 6.0	Excel 5.0	PowerPoint 4.0	Access 2.0	2.0/Automation
Novell/Borland Office	WordPerfect 6.0	Quatro Pro	Quatro Pro	Paradox	1.0
Lotus Smartsuite	AmiPro	Lotus 123	Freelance	Approach	1.0

Figure 2: Integrated Office Suites

OLE - Integrated Applications

Object Linking and Embedding (OLE) permits Windows applications to be used together to create compound documents. Compound documents result when two or more applications are used to create a single document. For example, a Seabird Monitoring Annual Report is a compound document consisting of text, charts, maps, and tables of data. The text is entered with a word processor. Charts are created with a spreadsheet or chart program. Maps are scanned and edited with a drawing package, and tables can be created from a database using either a word processor or a spreadsheet program. In this instance it is natural to think of the text of the report as being the document that contains the chart, map, and table documents.

The most familiar feature of OLE is in-place editing. You place a spreadsheet chart in the text of the report by starting the spreadsheet from the word processor. You use the spreadsheet to access the database or file containing the data to be graphed. After you format the chart in the spreadsheet, a graphic picture of the chart is saved in the text of the report, and a link to the worksheet containing the chart data is established. The image of the chart stays fixed relative to the text of the report as additions and corrections are made to the report. You can change the size and format of the chart by restarting the spreadsheet from the image of the chart. The data link automatically provides the original data used to make the chart. If the data has changed, the worksheet can be updated, and the chart automatically reflects the updated data.



A relatively new feature of OLE (introduced in OLE 2.0) is OLE Automation. This allows one OLE aware application to programmatically control another OLE application. In this example a database program could guide the spreadsheet program through the process of querying updated data from the database and putting it in the worksheet.

Visual Basic Macro Languages

In 1991 Microsoft declared its intention that all of its mainstream Windows applications would share a common macro language derived from BASIC. Each major release of its applications has brought Microsoft closer to this goal. The most recent version of a common macro language is the Visual Basic

for Applications built into Excel 5.0 and Project 4.0. It is a combination of Word for Windows 2.0's Word Basic and Visual Basic 3.0 for Windows. Microsoft currently supports four versions of BASIC as indicated in the following table:

Application	BASIC Dialect	OLE Automation Level
Excel 5.0	Visual Basic for Applications	OLE Client & Server
Project 4.0	Visual Basic for Applications	OLE Client & Server
Visual Basic 3.0	Visual Basic	OLE Client
Word 6.0	Word Basic	OLE Server
Access 2.0	Access Basic	OLE Client

Figure 3: Microsoft Macro Languages

OLE automation level indicates the level of integration that the application supports in its macro language. Word 6.0 is an OLE server only, Word Basic commands and objects can be directly controlled by programs written in OLE client such as Excel 5.0 or Visual Basic 3.0. Visual Basic 3.0 is a client only, it can control OLE server objects in Excel, Project, and Word, but cannot be controlled from other OLE clients. Excel 5.0 and Project 4.0 can function as either OLE clients or servers. Microsoft Access programs can serve as OLE clients.