A FEASIBILITY STUDY TO ASSESS

THE DEVELOPMENT OF A MARINE RESEARCH DIRECTORY

FINAL REPORT

SECOND REVIEW DRAFT
_____

APRIL 1980

ANDY CAMERON
Center for Coastal Marine Studies
University of California, Santa Cruz

JENS SORENSEN
Center for Marine Affairs
Institute of Marine Resources
University of California, San Diego

TABLE OF CONTENTS

TABLES

APPENDICES

I. INTRODUCTION

In California both the number of institutions and the number of individuals in each institution conducting marine and coastal research make it difficult for those who could benefit from the knowledge of a particular research project to be aware of its existence -- particularly in a timely fashion. According to a recently compiled directory of California Marine Science Programs, there are eighteen private and twenty-one public institutions of higher education in this state with marine education programs.[1] Twenty-eight of these institutions either have their own marine research facility or have access to a facility.

Studies on improving state-university relations have identified a computerized directory of applied research as a top priority item.[2] Accordingly the start-up plan for the Center for Marine Affairs proposed a directory of marine research conducted by California universities as an appropriate initial effort. Last June participants at a meeting on the formation of a California Regional Coastal Information Center concurred that a directory of applied research in comparison to the development of other data bases would be of the most utility to the legislature, government agencies, marine advisors, and university researchers.

It was envisioned that the development of a marine research directory could assist the Sea Grant program fulfill its designated responsibility as liaison point between the University of California and state government on matters of coastal resources management. The directory should also assist University researchers, research administrators, and research funding organizations in setting program priorities and identifying future projects.

The feasibility study on developing a marine research directory had four interrelated objectives:

o   To assess the possibility of accumulating and managing a large data base that can be used to identify experts and applied research in the field of marine resources.

o   To assemble a pilot data base consisting of fisheries research conducted on all California higher education institutions and all marine research on one campus.

o   To test the capabilities of the system with appropriate users.

o   To determine and develop interconnections between an applied research directory and other information operations such as the California Environmental Data Center, data bases consisting of published research, and the Smithsonian's Scientific Information Exchange Program.

Terminology

To reduce misunderstanding of terms used in this feasibility study, a few definitions are in order. "Data base" refers to a collection of information organized on a subject area. The data base resides on a computing machine in one or several "files". An individual entry in a data base is called a "record". Each record is divided into "fields" that contain specific sets of information. For example, a telephone book is a data base made up of records, each of which consists of fields containing a name, an address and a phone number. Such a data base is considered to be "machine-readable" if it can be transported between computers without being interpreted by a human being. Paper tape, IBM cards and magnetic tape are examples of machine-readable data holding devices.

Similar Efforts

As one might expect, other research-related institutions prepared both directories of individuals and projects as a means of achieving program planning and coordination objectives. In 1975, the National

Academy of Sciences published one <u>U.S. Directory of Marine Scientists</u>.
This directory is organized by state and zip code. Approximately four
hundred and fifty marine scientists are listed under the California
heading. Each listing includes institutional affiliation, title of the
scientist and from one to fifteen categorical descriptions of the scien-
tist's research areas. The American Fisheries Society composes a member-
ship directory on a periodic basis. The last directory was issued in
October 1978 and contained the names and addresses of approximately 6,600
members. The Fisheries Society directory does not indicate the members'
area of interest. Thus, distinction cannot even be made of whether the
member's primary interest is fresh, anadramous, or salt water species.
The membership directory is arranged alphabetically by last name. It
is not even indexed by state.

Since 1974, the University of California's Water Resources Center
has issued four editions of a <u>Directory of Water Resources Expertise</u>.
The directory is organized by research category. The category, marine
resources coastal programs in oceanography and aquaculture, lists
seventy-eight individuals. Only faculty members within the University
of California system are listed. A complete address (including phone
number) and a statement of research interest is presented for each
individual listed.

The University of California's Council on Energy and Resources has
produced two directories on Energy Research. The 1977 edition of
<u>Energy Research at the University of California</u> lists 584 projects and
indexes approximately five hundred researchers associated with the projects.
The energy projects are organized by research area categories. Each entry
includes name, campus affiliation and a brief description (one sentence)
of the project.

In 1976, the North Carolina Department of Administration compiled a _Directory of Marine Scientists_. The Directory lists two hundred and five marine scientists in the state of North Carolina. The scientists are listed according to nine disciplinary categories (e.g. biochemistry, physical oceanography). Scientists working in each discipline are listed alphabetically with their affiliation, educational history, and a brief description of research interests.

A _Compendium of Current Marine Studies in the Pacific Northwest_ has been compiled by the Oceanographic Institute of Washington on an annual basis for the last five years. The latest edition (1978) lists 780 active marine research projects in Washington, Oregon, and British Columbia waters. Project summaries, arranged in 14 research categories (e.g. water motion, engineering and technology) are indexed by investigator, subject, geographical area, and both sponsoring and performing organizations. A key word index with 546 items is also included. The Compendium comes the closest to the type of data base envisioned by this feasibility study; however, the data base has not been computerized.

II. DATA COLLECTION

Sources

In order to obtain complete coverage of the fishery research area, a number of sources were consulted (See Table 1). These sources were chosen on the basis of their detail, breadth of information, and the ability to provide a machine-readable copy of the data.

The first organization consulted was the Smithsonian Scientific Information Exchange (SSIE). Through Dr. James Wheatley, Chief, Biological Sciences Branch, Division of Scientific Affairs, SSIE, a search was run of their 1976-1978 data base. The search produced a printout of all federally-funded projects involving fishery research

in California. Dr. Wheatley included some aquaculture and marine resource management projects as well. The SSIE printout consisted of 360 records. The SSIE interchange tape included an extensive key word coding list for each record which was used to formulate a shortened list for preparing the feasibility study's data base. Because of the formatting of the SSIE tape, it was not possible to use the tape for data transfer.

Another source in compiling the data base was the California State University and Colleges' document, <u>Reporting Activity in Research, Workshops, Institutes and other Special Educational Projects for Fiscal Year Ending June 30, 1978</u>. Eighty-nine entries of interest in the marine area were identified by this document. A new directory has been published this fiscal year, but it was not received in time to identify the few new entries for 1978-1979.

A document entitled, "A Directory of Data Collection Projects on West Coast Fisheries" (WCFD), and compiled by Brian J. Brown, National Marine Fisheries Service (NMFS), Southwest Region, Fisheries Development Division, yielded 38 entries. This directory lists all NMFS and California Department of Fish and Game (DFG) data collection projects from this state. Additional chapters describe the projects in Washington and Oregon.

The largest single source of data was the FY 1978-79 directory of research awards of the UC Systemwide Contracts and Grants Office (UWCG). This data base consisted of 7,553 records on a magnetic tape. After some minor communication problems, a copy of this tape was obtained. A search of the UWCG tape produced 80 records of individuals performing marine-related research at Berkeley <u>and</u> 100 records of fisheries research on all other UC campuses.

Table 1

Data Collection Sources

Name	Number of Individuals Identified
SSIE	360
CSUC	89
WCFD	38
UWCG	180
TOTAL	667

Obviously, this listing of 667 individuals contained a considerable amount of redundancy. The redundancy was removed during the encoding process. Once the first round of encoding was complete, the data base consisted of 240 unique records of persons named as investigators on one or more California marine research projects.

The original intent was to list only applied research projects and their principal investigators. As the data collection proceeded, it became apparent that just applied research would produce a narrow data base that would not adequately test the feasibility of a larger area covering all marine research. In addition, it was often difficult to draw the fine line that separates pure and applied research on the basis of only a research title. Therefore, it was decided to include any project, pure or applied, whose title appeared to be marine-related.

Encoding

The most efficient encoding service to produce a machine-readable data base turned out to be the Administrative Data Entry Service at UCSC. This service was made available on a recharge basis. In consultation with the supervisor of that service, a form was designed to transfer information to be encoded (See Appendix A). This method was used to

establish the initial 200 records. The 40 records garnered from the University of California Contracts and Grants tape and from the Southwest Fisheries directory were encoded using the entry function of the data base management system. This and subsequent editing was done by a part-time encoder. Once an experienced encoder becomes familiar with the programming procedure, 8 records can be entered per hour.

Information Limits

There are individuals who are conducting fisheries research at California institutions of higher education and conducting marine research at UC Berkeley who are not listed in the directory (Appendix C). These individuals are not listed because their research was not administered through their respective campus contracts and grants office. This would include:

- Emeritus professors, those only supported by faculty research awards from the Academic Senate.

- Faculty only supported by private consultation fees.

- Those individuals (faculty and students) not receiving research support.

If the research title does not reflect a marine activity, the project and investigation could still have a strong connection with marine-related pursuits. An example might be species-related titles such as "Mating Behavior of the Spiny Dogfish", which did not indicate that the spiny dogfish is a marine species. Therefore, the data base also does not include investigators whose research has a marine connection but the title of the project does not indicate this connection.

Documents such as the University of California research awards directory of State University Funded Research Report were not solicited from Stanford, Cal Tech or USC. Information on these institutions was

obtained from the SSIE data base and the NMFS Southwest Fisheries directory. This approach seemed to be cost-effective since a considerable number of records were obtained in this manner for those three institutions. However, since SSIE listings lag behind current work by at least one year, it is expected that listings from Stanford, USC and Cal Tech are not as up to date as the UC and State University systems. Also, there is no secondary means of identifying the individuals employed at small private colleges, the community college system or private research facilities unless they are supported by nationally funded projects which are listed by SSIE.

If one wished to assemble a complete listing of marine-related research in California regardless of institution or magnitude of effort, a concerted effort involving bnth survey questionnaires and follow-up personal interviews would be required. Such a concerted effort has been done for the past four years to compile the Pacific Northwest Compendium. Ms. Metsker, the Compendium editor, has spent six weeks each year conducting personal interviews among Washington, Oregon, and British Columbia officials and academics.

The National Academy of Sciences, Ocean Science Affairs Board plans to update its 1974 Directory of Marine Scientists next year. The updating activity will include a nationwide mailing of a questionnaire to marine scientists. The Ocean Science Affairs Baord has not yet determined the various means it will use to identify the recipients of the questionnaire. However, since it will be a nationwide survey, the level of detail and the degree of completeness would be expected to be considerably less than if a similar effort is conducted at the California level.

Costs

The costs for just data accumulation and final encoding have amounted to approximately $720, or $3 per record. This amount does not include decisions concerning key word assignment or general office expenses. Based on the number of records identified in the feasibility study, it is estimated that a full data base of all marine research projects conducted by institutions of higher education, government agencies, and industry in California would contain approximately 1,500 records. If costs were projected to a full data base of 1,500, encoding costs should be less than $4,500. Costs savings would be achieved because some expenses are one-time costs that would be amortized over the larger number of records.

III. DATA BASE MANAGEMENT SYSTEM

Attributes

The system for managing the data base was chosen on the basis of five criteria:

1. The system should be available on a commonly used computing machine available at several locations, particularly campuses of the University of California and the California State Universities and Colleges.

2. The system should run on low overhead, thus increasing the response time for on-line operation. If a system uses a large proportion of the time-shared core memory of the computer on which it runs, then it will run more slowly.

3. The system should have a broad range of handling capabilities so that data input, searching and data output are all easily handled.

4. The system is widely used and, therefore, should be well supported by the computing machine staff.

5. The system should structure the data in such a way that it is compatible with bibliographic data bases and it can be easily transported to other computing machines and operating systems.

Initial Choices

After reviewing a number of systems by brochure and interview, three systems were selected that were available on UNIX operating systems: Info-11 Information System written in BASIC; the Ingres Data Base Management System written in "C" and available from Bell Labs; and the "INP" Data Base Management System also written in "C" at UC Berkeley Graduate Division. "C" is the language in which the operating system is written.

"INP" was chosen for the following reasons: INP runs with very low overhead. It uses as little as 10% of the computer and therefore the response time is faster than Ingres with 40% and Info-11 which must pass through the BASIC language interpreter. The data entry function of INP is very well designed and easy to use. It includes a capability of validating the data entered. Before each word is written to the file, the program checks the fields against a pre-defined table of possible ranges of alpha-numeric characters or words. In addition, the display program uses decoding tables to reduce computer memory reserves. The documentation for the potential data entry personnel is clear and easily understandable. On the other hand, Ingres has essentially no data entry function and Info-11 has inadequate documentation. Of the three, only the INP package possesses a full library of computer commands to manipulate and error-check the data base. Also, INP has a Boolean search program. This search capability is necessary to perform analytical functions such as all the salmon research funded by National Science Foundation on the UC Berkeley campus. Ingres incorporates only a few of the manipulative functions and a Boolean search routine in the main program and the Info-11 system has neither.

Use of the "INP" System supports our initial conclusions. The system has allowed numerous changes in the data base as it developed. Further modifications would be just as easily performed, while the data base could be used as it now exists.

The objectives of creating a marine research data base posed a specific set of questions that, in turn, determine the structure of the record and its component fields. The record was designed to have twenty-four fields necessary to answer at least the following questions:

1. Who (including the complete address) is conducting marine-related research in institutions of higher education within a _particular_ field of investigation (e.g. who is investigating the environmental effects of oil spills)?

2. Who is conducting studies in a particular geographical area?

3. What granting agencies are funding marine research in California and what is the amount and duration of that funding?

4. The general nature of the research as implied by the title of the research project (e.g. method of analysis or range of technique being employed?

5. Analysis of the distribution of research activities and/or funding by: topic, geographical location, institute of higher education and investigator.

The number of fields and additional questions which the data base could address were limited to the information provided by the sources. One example of the data base's capabilities is the analysis of the distribution of support to fisheries research (Appendix B). The analysis indicates that Sea Grant supports about half the fishery research work in California higher education institutions (either measured in terms of dollars or number of projects). Appendix B also indicates the dominant areas of investigation are the ecology of fisheries and commercial fisheries.

Structure of the Record

Table 2 lists the twenty-four fields that comprise each record.
The name and address entries are self-explanatory. The address listing
was designed to allow the user to contact easily the listed person.
The research title is derived by the data base manager from whatever
combination of sources was used to generate the entry. The next six
fields are key word entries which are a subset of the Smithsonian
Scientific Information Exchange (SSIE). This key word indexing
system organizes one of the largest and most complete data bases
of research activities in existence. It includes tens of thousands
of possible combinations of terms. In an effort to render our system
compatible with theirs, we chose to use the subset of "fish and wild-
life biology" and "ecology" plus two levels of modifiers. These could
usually be copied directly from the original SSIE tape transcript
although occasionally modification was necessary. Three fields which
listed the geographical locations of the work done by each investigator
appear next in the records. Wherever possible, California county
names were used as entries. The last four entries describe the
major source of funding for the person listed; this includes: source
agency, total award, beginning data of the grant period and the end
of the grant period.

Table 2

At present the logical record includes 24 fields in the following configuration:

	Description	Size in Characters
1.	Accession Number	6
2.	Last Name	25
3.	First Name and Middle Initial	8
4.	Department	20
5.	Campus	6
6.	Address	24
7.	City and State	15
8.	Zip Code	5
9.	Phone Number	12
10.	Rank or Title	24
11.	Research Title	62
12.	Key Word 1	15
13.	Key Word 2	15
14.	Key Word 3	15
15.	Key Word 4	15
16.	Key Word 5	15
17.	Key Word	15
18.	Geographical Location 1	15
19.	Geographical Location 2	15
20.	Geographical Location 3	15
21.	Agency funding the activity	62
22.	Total Award	8
23.	Start Date	6
24.	End Date	6

IV. CONCLUSIONS

The feasibility study indicates that a complete data base could be prepared on a cost-effective basis listing all marine research conducted by institutions of higher education and governmental agencies in California. This conclusion is based on the following findings:

1. This complete data base will consist of a relatively small number of records. The resources needed to assemble the complete data base will not be great.

2. The cost of entering, updating and maintaining the data base is minimal. It amounts to about $7 per record. Total expenses amounted to $34 per record, including management, salaries and overhead. This compares favorably with the costs of the Pacific Northwest Compendium of Marine Research which amounts to $50 per record.* This compendium has only the indexing structures on a computer.

3. The benefit to user groups such as Sea Grant will be especially attractive:

   -- duplication of effort can be minimized

   -- coordination between those doing similar work can be encouraged

   -- priorities for research funding can be set and important topics where investigations are lacking can be identified

   -- potential peer reviewers for research proposals can be identified

   -- expeditious identification of potential researchers when new funding sources and programs are announced (such as new pass-through arrangements)

Data Collection and Encoding

The procurement of data on magnetic tapes has not proven to be useful. Machine-readability should not be a criterion for data source choice. Too much computer time and programmer labor is required to extract the data from these tapes. The resources are better spent filling in encoding forms from printed sources.

All state and federal projects including National Marine Fisheries Service and California Department of Fish and Game should be included with the institutions of higher education. This will produce better coverage of the research being conducted in California.

The data collection should be coordinated with bibliographic data bases such as Bio Abstracts, Oceanic Abstracts and Ohio College Library Catalog system. This will produce a fully compatible data base. Also, personnel can be accumulated on the basis of papers published in a particular research

*the direct cost for each record is approximately $25.00.

area. While these would overlap with information on funded research, some unique data should result.

Personnel

The data collections scheme presently used and proposed for any further development of this data base has been designed to include a knowledgeable person who would make decisions about the incoming data and use personal contacts to collect data. This person would also make annual updates of the data such as with questionnaires and a round of interviews. The data base manager is absolutely essential to this system. Someone must make decisions about assignment of various indexing terms. Also, experience has shown that personal contacts are a more efficient method than questionnaires for collecting complete data. The Pacific Northwest Compendium of Marine Research is managed by a full-time editor trained as a librarian. Any future system should include such a person.

Operating System

If a UNIX operating system is available and the personnel directory is kept on-line, INP data base management programs should be retained. Very often applications-oriented data base management systems are quite rigid and difficult to change without a complete overhaul. This can be both time-consuming and expensive. The INP data base management programs in conjunction with a UNIX-PDP computer comprise a system that allows relatively inexpensive and easy modification; therefore, conversion to an applications-oriented system should be avoided until more usage confirms whether the present configuration fits the needs of the Sea Grant College Program.

Data Base Structure

If the data base is expanded to include all marine-related research conducted in California by institutions of higher education, government

agencies, and private organizations (1,000 to 1,500 records total),
the person-oriented record does not appear the most efficient arrange-
ment. A record for each research project rather than each investigator
would be a better framework for organizing the data base for the
following reasons:

   o   a clearer understanding of the exact nature of research
        being conducted

   o   better analysis of the extent and coverage of the research
        activity

   o   data collection and processing requiring fewer decisions

   o   no loss in accuracy of the personnel listing

In addition to the current fields, a field listing the research
abstract should be added to the newly structured record. This configura-
tion would require more computer storage, encoding support and more
elaborate search procedures, but it would enable more informed decisions
about the research area. Collaborating investigators would be listed on
each project record along with the principal investigator. Then, relation-
ships between principals and collaborating investigators could be analyzed.
For example, two principal investigators may collaborate mutually or a
statistician may collaborate on many proposals but never act as a principal
investigator.

Key Words

The key word search has been so general and redundant as to hinder
specific searches. Originally the SSIE index was apparently generated
with enough redundancy to assure finding groups of projects from the
many thousands listed. However, since there are few records and more
specific search images are needed, a new key word system should be
developed. The Pacific Northwest Compendium for Marine Research uses

a two-level indexing system which they in turn cross-index to a glossary of 546 key words. It has the following advantages:

1. It has been tested by marine research users over the past four years.

2. It is oriented specifically to marine topics as opposed to the SSIE system which covers all scientific topics.

3. If the California system adopts it, the key words for all marine research from California to British Columbia will be consistent.

4. It can be tailored further for California use, particularly with input from the Marine Advisors and marine researchers.

It is recommended that the key words be converted to the Pacific Northwest Compendium system.

Access, Visibility and Support

At the outset of this feasibility study there was concern that the data base be controlled in order to prevent researchers from being disturbed by queries and requests. According to the editors of the Pacific Northwest Compendium and the U.C. Energy Research Directory, the public visibility of researchers listed in their directories has not been a problem. Apparently the more names in a directory and the more listings in each research category, the less any one researcher stands out. With rare exception, researchers have not complained that the visibility produced annoying inquiries or burdensome requests. On the contrary, when researchers realized that the directory was of utility in planning and coordinating their own efforts, they willingly cooperated with the editors in providing information.

The first year of operation will be both the most expensive and the most inefficient. Establishing the network of contacts will be time-consuming. However, once the contacts have been made and researchers can see the benefit of being included in a data base, information should

come more readily and at less cost. Furthermore, the majority of the research activities will be multi-year efforts and do not have to be re-entered into the data base. For example, the Pacific Northwest Compendium, on the average, has 30% new projects and 70% continuing projects each year.

If a data base is developed, it is recommended that directories be compiled and published on an annual basis. In such a case, it can be expected that cooperation by individuals and institutions will be much greater after publication of the first directory. Accordingly, evaluation of the full program should not be conducted until the first directory has been published and researchers have had an opportunity to use the product.

Neither the Pacific Northwest Compendium nor the U.C. Energy Research Directory was computer-automated. Editors of both these directories strongly recommended computer automation. A computerized data base, however, could conceivably create an exposure problem. Such a system makes it quite easy for those who have direct access to quickly identify researchers. This ease of identification may pose visibility problems for those individuals working on controversial issues -- particularly if there are relatively few researchers engaged on the topic. If a computerized data base is developed, direct access should be controlled to prevent researchers from receiving too much unwanted visibility. Access control should also enable the data base manager to efficiently and effectively place those seeking information in contact with the most appropriate persons.

V.   OPTIONS FOR FURTHER WORK

It is apparent that a number of options are possible at this point.

-18-

The experience gained during the preparation of this prototype can shed some light on pitfalls and prices.

Complete Data Base

It is recommended that this data base be expanded and modified in the following ways:

1. Complete the data base for all marine research in California which is administered by institutions of higher education and state and federal agencies such as NMFS and DFG.

2. Use SSIE, UC Contracts and Grants, Southwest Fisheries, and the State University and College Directory as the first data sources, then send out a questionnaire.

3. Convert the record structure to a research project-oriented one.

4. Convert the existing key word listing to one similar to that of the Pacific Northwest Compendium. Redefine the key word list through feedback from Marine Advisors and marine researchers.

5. Move the data base system to Scripps making the system compatible with the Scripps Library Bibliographic Data systems and the computer system available.

The costs for this option would be about $45,000 the first year and possibly $30,000 each succeeding year. Fully half of this cost is based on the employment of a full-time editor the first year and a half-time one the succeeding years. This person holds a key position in the data stream and will greatly facilitate collecting hard to find data through personal contacts. The rest of the costs are evenly divided between data collection costs, computer costs and general maintenance expenses.

Maintain Fishery Directory

This option would entail keeping the directory on the UNIX system at UCSC and updating it. This would cost about $10,000 per year and could be completed in three months of half-time editor salary with the concommitant data collection, computer and general office expenses.

Archive Data Base

The least expensive option is to produce an archive tape for storage until some unknown future use. No additional cost is involved.

CALIFORNIA SEA GRANT MARINE RESEARCH DIRECTORY ENCODING FORM

Version I.0, August 1979: Cameron, Gage, Sorensen

Accession No. [_____] (6)

Last Name [_____] (15)   First Name [_____] (7)   Middle Initial [__] (1)

Department [_____] (20)   Campus [_____] (6)

Campus Add. [_____] (24)   City/State [_____] (15)

Zip Code [_____] (5)   Campus Telephone [_____] (12)

Rank/Title [_____] (24)

Research Title [_____] (62)

Keywords [_____] (15) [_____] (15) [_____] (15)

Keywords [_____] (15) [_____] (15) [_____] (15)

Geograph. Area [_____] (15) [_____] (15) [_____] (15)

Notes: Consult SSIE catalog of INDEXING TERMS for keywords.

Geographical Area should be California County names when possible.

-11-

Analysis of the distribution of support to fisheries research
in California, by campus.

The existing data was used to generate a table detailing the extent
of research support (Table 3) on each campus in California. The support
was summed for all agencies and for the California Sea Grant College
Program. The proportion of projects reporting the funding amount is
difficult to ascertain from the investigator-oriented record since
several investigators may have been listed on one grant in which only
the first investigator was considered to have the funding. Therefore,
the proportion reporting is unrealistically low. Also, Sea Grant
projects always had funding information while other agencies did not;
therefore, real proportion of Sea Grant projects may be somewhat lower.
It is doubtful if these errors are more than 10-20%. From this analysis,
it can be seen that Sea Grant supports about one-half of the fisheries
research in California.

In some cases, several investigators were listed on one grant. Only
the first investigator was credited with an award amount in subsequent
analyses. This has two effects:

1. In Table 3, the number of projects reporting in the
    "Total Funding" column and "Sea Grant" column will
    be more unrealistically lower than "Number of Investi-
    gators" column.

2. In Table 4, the "Number Reporting" will be less than the
    true proportion of "Total Projects" in the "Area" column.

Table 3

FISHERY FUNDING ANALYSIS

Campus	Number of Investigators	Total Funding (Number of Projects Reporting)	Sea Grant (Number of Reporting Projects)
BML	1	52,682 (1)	52,682 (1)
CIT	2	124,988 (2)	124,988 (2)
CSUF	3	117,373 (2)	0
CSUH	1	0	0
CSULA	4	100,000 (2)	0
CSULB	6	172,243 (4)	0
CSUN	2	0	0
CSUSD	15	123,182 (4)	123,182 (4)
CSUSLO	1	0	0
HML	1	65,993 (1)	65,993 (1)
HSU	12	242,840 (7)	105,222 (4)
MLML	9	112,970 (1)	112,970 (1)
NKFS	20	1,371,977 (16)	0
SFSU	2	0	0
SIO	19	1,148,857 (12)	348,842 (7)
SJSU	2	0	0
SSU	1	0	0
SU	2	176,800 (2)	141,800 (1)
UCB	19	252,643 (12)	172,525 (6)
UCD	27	289,934 (8)	272,934 (6)
UCLA	3	40,596 (2)	7,324 (1)
UCLLL	1	0	0
UCR	3	18,001 (1)	18,001 (1)
UCSB	16	490,176 (11)	335,185 (9)
UCSC	9	166,914 (7)	93,379 (3)
UCSD	3	272,347 (2)	173,913 (1)
USC		276,763 (10)	241,763 (9)
TOTAL	203	5,449,980 (106)	2,390,703 (57)

Analysis by Subject Area

The next (Table 4) shows a breakdown of the support of various aspects of fisheries research by subject area. The subject areas are groupings from the key word listing.

Table 4

Area (Total Projects)	Total Amount (Number Reporting)
Legislation (1)	6,891 (1)
Management (9)	373,959 (7)
Chemistry (1)	25,366 (1)
Commercial Fisheries (40)	1,496,080 (29)
Wetlands (3)	152,943 (2)
Ecology (49)	2,277,613 (26)
Aquaculture (49)	947,261 (29)
Recreational Fishing (4)	140,276 (4)
Shellfish (5)	258,805 (3)
Public Information (2)	103,428 (1)
Endangered Species (3)	7,065 (1)
Total	5,789,687

The difference in totals between Table 3 and Table 4 results from the fact that some records did not include a campus affiliation and some did not include a key word list.