RESEARCH SUPPORT

Preparation of the *Continuation Plan 1996–2001* entailed a review of current aquaculture literature and discussions with many aquaculturists to determine research needs and constraints to aquaculture development. In addition to limited knowledge of various aspects of production systems, lack of access to training and to information were found to restrict aquaculture development. In response to these needs, the program created research support as a separate building block of its proposed research activities. Research support activities build capacity through education, technology transfer, information management, and networking.

Central Database, Education Development, and Information Management and Networking are the three branches of the CRSPs research support activities. Annual activity reports for these three projects make up this chapter.

CENTRAL DATABASE MANAGEMENT

MOU No. RD009G

Staff

Oregon State University, Corvallis, Oregon

John Bolte	US Co-Principal Investigator, Project Leader
Doug Ernst	Database Manager (Research Assistant, US)

Networking and Educational Outreach

The PD/A CRSP website continues to expand its network of electronic resources through the work of CRSP researcher and Database Manager Doug Ernst with links to CAMEL Database, the Agrisurf web index, and the National Fishing Industry Education Center of TAFE located in NSW, Australia. The CAMEL database, a collection of databases created at Oregon State University, can be accessed by internal and external data and literature search and referencing systems. Agrisurf web index, an invaluable resource for students, researchers, and aquaculturists, contains over 12,000 separate agriculture-related websites in its directory that link users to products and information in aquaculture and agriculture. The National Fishing Industry Education Centre of TAFE provides training, aquaculture industry news and information, and learning resources to members of the aquaculture community.

Ernst visited two high schools in Oregon to answer questions about aquaculture, supply literature about fish culture, and provide tilapia fry for production.

Publication

Ernst, D., 1999. Fish performance engineering, In: R. Stickney (Editor), Encyclopedia of Aquaculture. John Wiley and Sons (submitted).

Work Plan Activities

The following report describes Central Database activities carried out during the first year of the Ninth Work Plan.

REPORT: PD/A CRSP CENTRAL DATABASE MANAGEMENT AND DEVELOPMENT

Ninth Work Plan, Database Management 2 (9DM2)

Douglas H. Ernst and John P. Bolte
Department of Bioresource Engineering
Oregon State University
Corvallis, Oregon, USA

BACKGROUND

The PD/A CRSP Central Database is a centralized storage and retrieval system for aquaculture research data (Hopkins et al., 1987; Batterson et al., 1991; Bolte et al., 1998; Ernst et al., 1997; Ernst and Bolte, 1999). The Database currently contains datasets from CRSP-sponsored research, but it is open to other aquaculture research with compatible objectives and compliance with standardized methodology. The Database is available cost-free and is of interest to researchers, educators and students, outreach and extension agents, and producers in pond-based aquaculture. Datasets may be searched and retrieved based on specified location (research site), calendar year, fish species, fish culture method, and desired type of data. An interface to the data and related information in the Database is provided at the Database website, located at <biosys.bre.orst.edu/crspDB/>. For intensive users of the Database, the contents are also available on electronic media.

The Database currently contains over 100 aquaculture production studies and represents the world's largest inventory of standardized aquaculture data. The majority of studies currently in the Database are for production of Nile tilapia (*Oreochromis niloticus*) in subtropical and tropical solar algae ponds receiving inputs of plant materials, inorganic/organic fertilizers, and/or prepared feeds. Studies of other pond fishes and penaeid shrimp, under monoculture and polyculture management, are also available. Countries with research and research-support projects that have contributed to the Database include Egypt, Honduras, Indonesia, Kenya, Panama, Peru, Philippines, Rwanda, Thailand, and the USA.

The Database was started by the CRSP in 1985. Rationales for its ongoing development include:

1) To provide a mechanism for analysis of variance and multivariate analyses among geographically dispersed aquaculture research sites, in addition to analyses within single ponds and among ponds at a single location; and
2) To support development of predictive models for aquaculture pond processes and software for aquaculture design and management. More simply, the Database can be applied directly to aquaculture design and management analyses.

For this purpose, the Database provides comprehensive methods and results of applied studies for specific fish culture sites (regions), culture methods, and fish species. These datasets can serve as empirical benchmarks for evaluation of fish production at a given facility and provide a basis for the evaluation of alternative design and management methods.

OBJECTIVES

Objectives of work to be completed under the Ninth Work Plan address needs of both data suppliers and users. For data suppliers, objectives are to support and enhance the ongoing entry of new datasets into the Database, including current research projects and past-due data submissions from CRSP research projects prior to the Eighth Work Plan (that is, before 1 August 1996). This effort includes continued improvements in the technical support provided to data suppliers and in the mechanisms used to administer data submissions from CRSP research projects. For data users, objectives are to improve Database query procedures, provide linkages for extracted datasets to related information resources, and provide statistical processing and data reduction for extracted datasets.

Objectives of this report are to describe accomplishments to date and ongoing work for each of the tasks to be completed under the Ninth Work Plan. Technical methods and Internet and software tools used in this work are described in Ernst et al. (1997). The reporting period is 1 August 1998 to 31 July 1999.

TASKS AND ACCOMPLISHMENTS

Data Submission

As of 31 July 1999, the Database contained datasets from 101 research studies performed under CRSP work plans through the Eighth Work Plan (Table 1). Data submissions to the PD/A CRSP Central Database can be broken into two major periods. From 1983 until the beginning of the Eighth Work Plan in 1996,

Table 1. Total experiments reported in the PD/A CRSP Central Database as of 31 July 1999, organized by research site and Work Plan. Numbers shown indicate number of studies submitted to date. Additional studies for past and current Work Plans are due for many sites. If experiments were not conducted or datasets are not due to the Database, cells are marked with an "X."

Site Code	Site Name	Work Plan									Total
		1	2	3	4	5	6	7	Int	8	
A	Aguadulce, Panama	2	2	2	X	X	X	X	X	X	6
B	Gualaca, Panama	2	X	2	X	X	X	X	X	X	4
C	Ayutthaya, Thailand	1	2	2	3	4	5	1	1	5	24
D	Nong Sua, Thailand	1	X	X	X	X	X	X	X	X	1
E	Bogor, Indonesia	2	1	2	X	X	X	X	X	X	5
F	Comayagua, Honduras	2	2	2	2	4	2	0	X	0	14
G	Iloilo, Philippines	2	2	2	X	X	X	X	X	X	6
H	Rwasave, Rwanda	2	X	2	4	3	0	0	X	X	11
I	Asian Inst. Tech., Thailand	X	X	X	3	3	3	3	0	5	17
J	Choluteca, Honduras	X	X	X	0	X	0	0	1	0	1
K	Abbassa, Egypt	X	X	X	X	X	X	1	X	X	1
L	Univ. of Oklahoma, USA	X	X	X	X	X	X	X	X	0	0
N	Auburn University, USA	X	X	X	X	X	X	X	X	1	1
O	Oregon State Univ., USA	X	X	X	X	X	X	X	X	2	2
P	FAC, Philippines	X	X	X	X	X	2	3	0	0	5
Q	Univ. Arkansas, PB, USA	X	X	X	X	X	X	X	X	X	0
R	UNAP, Peru	X	X	X	X	X	X	X	X	1	1
S	Sagana, Kenya	X	X	X	X	X	X	X	X	1	1
U	Huay Luang, Thailand	X	X	X	X	X	0	1	0	0	1
	Total	14	9	14	12	14	12	9	2	15	101

CRSP researchers were not contractually required to submit data to the PD/A CRSP Central Database. Efforts to collect past-due data submissions are ongoing and ultimately depend on the goodwill of CRSP researchers. Significant progress has been made regarding submission of past-due datasets but roughly 25% remain outstanding.

Beginning with the Eighth Work Plan, researchers are contractually required to submit data. In addition, improved data submission protocols are now in place to address systematic problems in past procedures. These upgraded procedures are more flexible with respect to data formatting and more comprehensive through the use of data identifiers and provision of supporting information (see the *Database Submission Manual* available at the Database website). Data submissions from CRSP projects under the Eighth Work Plan have been proceeding according to project schedules.

Work Plan and Experiment Summary Tables
Summary tables for each work plan, listing CRSP research projects and experiment specifications, are critical to data submission procedures; to communication among CRSP researchers, the Database Manager, and the Program Management Office (PMO); and to the value of the Database to users. Absence of these tables in the past has limited the utility of the Database to users outside of the CRSP.

Work plan summary tables are used by the Database Manager to track data submission requirements and to provide a single, current accounting of project specifications for all interested parties. Work plan summary tables are used by Database users to access related information of extracted datasets or simply to provide a tabular overview of past and current CRSP research projects. For data entry and editing access to these tables within the CRSP, an interface is provided at the Database website, consisting of a number of linked and interactive data entry and review forms.

Work plan summary tables list and describe CRSP projects performed under each work plan. Project specifications include:

1) Project identification code (actively linked to experiment treatment specifications);
2) Research location (actively linked to site descriptions);
3) Start and end dates of study period;
4) Project leader name and contact information (actively linked email addresses);
5) Project titles, thematic classification, and abbreviated descriptions;
6) Related CRSP and other publications (actively linked for the Eighth Work Plans and onward); and
7) Data availability in the Database.

Summary tables have been partially completed for the First through the Fourth Work Plans; currently 49 projects are listed with project specifications consisting of references to CRSP Data Reports. Summary tables are fully completed for the Fifth through the Ninth Work Plans, with 198 projects listed with complete project specifications.

Experiment treatment summary tables list and describe the treatment protocols used for a given research project. This information essentially consists of the fish culture methods employed and includes:

1) Fish (or shrimp) stocking densities under monoculture or polyculture management;
2) Initial fish sizes;
3) Frequencies and rates of applied fertilizers and/or prepared feeds; and
4) Additional treatment specifications such as water exchange and aeration.

This information is required by Database query procedures that use fish culture methods as search criteria and for the interpretation of extracted datasets with respect to the materials and methods used in the study. For the Eighth Work Plan and onward, experiment treatment specifications are submitted in conjunction with project datasets (see *Data Submission Manual*). Prior to the Eighth Work Plan, materials and methods information was not provided. To the extent possible, experiment treatment specifications for past projects have been developed by reviewing project reports and by compiling management data in the Database. Results, questions, and incomplete information identified by this work were reviewed in a prior Database report (Ernst and Bolte, 1999). To verify and augment this information, CRSP researchers access study-specific forms available at the Database website for adding, editing, and reviewing the experiment treatment specifications used in individual studies.

Using the work plan and experiment treatment forms together, past-due data submissions can be added to the Database. To support this objective, forms were developed in collaboration with the CRSP Technical Progress Subcommittee (TPS). At the 1997 CRSP Annual Meeting, the TPS was assigned the responsibility of developing work plan summary tables for the First through Interim Work Plans and, in collaboration with the Database Manager, determining which datasets prior to the Eighth Work Plan were past due and contacting responsible researchers. To date, the TPS has added project specifications for the Fifth, Sixth, Seventh, and Interim Work Plans to the work plan summary tables.

Supported Data Types and Analytical Methods
The specific types of data supported by the Database originally included physical, chemical, and biological variables of pond-based fish production. These include: 1) weather; 2) pond soil analyses; 3) pond applications; 4) water quantity and management; 5) water quality and primary productivity; and 6) fish productivity. Additional data types now supported by the Database, include: 1) fish reproduction; 2) socioeconomic; 3) economic; and 4) additional weather and pond soil variables. Original and new data types are defined in the *Database Submission Manual*.

Standardization of datasets for fish reproduction studies is still under development, pending a determination of the common themes that would be most useful to Database users. For socioeconomic studies, a standardized questionnaire, developed by Joe Molnar (Auburn University), is available for assessing the adoption of specific aquaculture technologies by fish producers. For economic studies,

standardized templates and data types are available for partial enterprise budgets and related analyses. Partial budget analyses support comparative economic analyses of experimental treatments in comparison to a base production scenario (control treatment) and may include on-farm production trials as well as research experiments. Budget templates were developed in collaboration with Carole Engle (University of Arkansas at Pine Bluff). In conjunction with this work, the *Database Submission Manual* continues to be updated with new data types and associated formats.

Closely related to the comprehensive listing of data types in the *Database Submission Manual* are the analytical methods used to generate these data. For physical, chemical, and biological variables, methods are described in the PD/A CRSP *Handbook of Analytical Methods* (Piedrahita et al., 1991). In addition to an in-house printed version, the handbook is available at the Database website for use by research personnel and Database users, for which copyrighted sections of the printed version have been replaced with references. This public domain version is useful to data users as contextual information for research projects (materials and methods) and to aquaculture research projects outside of the CRSP that are required to submit data developed under standardized methodology. The Database provides permanent and electronically accessible storage for this important document. The CRSP Materials and Methods Subcommittee has been charged with revisions to the handbook, which can be easily added to the handbook in its electronic form.

Database Search Procedures

Two improvements to Database search and extraction procedures have been accomplished. Database search criteria (query constraints) used to define data searches originally consisted of fish production site, dates (organized by work plan), fish species, and desired data types. Search criteria now also include fish production methods, described earlier under the experiment treatment summary tables. Use of fish production methods as search criteria requires the availability of complete experiment treatment specifications. Treatment specifications for studies funded under the Eighth and Ninth Work Plans are complete and available for use at this time.

A second improvement concerns the list of data types shown to the Database user, from which desired data types are selected. Originally, this list included all data types in the Database and resulted in queries that returned no data when the selected data type was not available for the given query. This problem reflected a greater-than-anticipated variability in data types collected across all CRSP projects. To alleviate this problem, the Database was inventoried, data types available for each study were compiled, and the list of data types shown to the user for the currently selected study dates and research site is limited to available data types.

Contextual Linkage for Extracted Datasets

Considerable progress has been made in the ability to direct the user to related, context-specific, Internet-accessible information for a given extracted dataset. These linkages utilize both automated (active links) and manual (references) website navigation. These linkages take advantage of project information and literature maintained at the PMO website as well as new components of the Database developed for this purpose. Availability of related resources enhances the ability of the Database user to interpret and apply datasets. Related information includes site and facility descriptions, analytical methods and data type descriptions, experiment treatment specifications, related publications (electronic and printed), and author citations and contact information.

Site and facility descriptions are linked directly by the site name used in a query. Analytical methods and data definitions are available in the CRSP *Handbook of Analytical Methods* and *Database Submission Manual*. Discussed earlier, experiment treatment specifications prior to the Eighth Work Plan are incomplete but available in their current states. For studies funded under the Eighth and Ninth Work Plans, complete treatment specifications are available. Linkages to related publications and author information are completed for the Fifth through Ninth Work Plans. Prior to the Fifth Work Plan, this information is generally lacking except for references to CRSP *Data Reports*. To support linkage to project literature, a CRSP publications database has been developed and is available at the Database website. Additions to the publications database are ongoing, and there are currently 469 publications listed. The publications database contains titles, authors, abstracts, keywords, descriptions, and links to full-text electronic documents maintained at the PMO website. The publications database can be searched based on keywords, subjects, and authors.

Statistical Data Summaries and Data Reduction

Three major Ninth Work Plan tasks are still in progress to provide Database users with dataset statistics and reduction tools. Currently, extracted datasets contain raw, time-series data for every sample or measurement taken of the selected data type, for every replicate (three to four per treatment) in the experiment treatment(s) selected in the data query. These datasets can be viewed in tabular and graphical formats or downloaded in delimited format for use in spreadsheets. This type of data is of most use to people working in aquaculture research and model development. Users such as educators, students, extension agents, and producers, and collaboration with related aquaculture databases are best supported by statistically distilled presentations of these data and by design and management tools calibrated with these data.

To address this need, three tasks are in progress to develop:

1) automated mechanisms to generate experiment-treatment summary statistics (range, mean, and variance statistics and support for analysis of variance);
2) automated regression procedures to determine equation parameters for fish growth models; and
3) automated mechanisms to summarize treatment specifications and generated statistics and parameters to tables that combine multiple treatments from multiple experiments.

Generated data also include variables calculated by combining time and sample data, for example, fish growth and feeding rates, feed conversion efficiency, and biomass density and productivity. As with raw data, generated data will be available in tabular and graphical formats at the Database website or can downloaded.

Progress to date for these tasks includes:

1) improved mechanisms to group replicates (ponds) into their original experimental treatments;
2) development of models for fish growth based on fish size, water temperature, and availability of prepared (exogenous) and natural (endogenous) foods; and
3) development of models for estimating natural foods based on primary productivity, whole pond respiration rates, and "critical standing crop" and "carrying capacity" fish biomass densities.

Database Promotion

Promotion of the Database to potential users is ongoing. Critical issues are awareness of the Database availability, content, and applications. To date, the Database has been promoted through aquaculture conferences, publications, and linkages to related websites and databases. Direct promotion to specific user groups remains to be accomplished, following completion of the statistical data summary and reduction tools discussed earlier and a supporting *Database Users Manual*. Data submission from outside the CRSP has shown no success to date, but the potential for this type of collaboration will increase as the analytical capacity available at the Database website is further developed and made known.

Indicators used to assess the impact of the Database project and accomplishment of its stated objectives include numbers of linkages completed with other organizations and requests for use of the Database. Since its inception in January 1997, the Database website has received 2,940 visitors, 1,540 of these in the last year. While it is not known how these visitors utilized the site, questions directed to the Database Manager come primarily from prospective or active fish culturists with questions about pond management or the suitability of tilapia culture to their specific conditions. Negative comments regarding resources available at the Database website have not been received, but it is assumed that the majority of users are interested in summary fish production data and linked literature resources rather than large sets of raw data. The only known intensive users of the Database come from within the CRSP.

Collaboration with related databases has been established for some time. Collaborators include the International Center for Living Aquatic Resources Management (ICLARM), Network of Aquaculture Centres in Asia-Pacific (NACA), and Consortium of International Earth Science Information Networks (CIESIN). Data content and format requirements have been established for these potential indexing links and access points to the Database, but completion of the intended scope of these collaborations will follow completion of the statistical data summary and reduction tools discussed earlier. Simple site-to-site web linkage with major fishery, aquaculture, and agriculture professional societies, research groups, universities, and information providers continue to be developed. These links are not listed here and are available in the periodic Database impact reports.

LITERATURE CITED

Batterson, T., H. Berkman, K. Hopkins, R. Piedrahita, and T. Popma, 1991. Final Report on Database Management. Pond Dynamics/Aquaculture CRSP, Oregon State University, Corvallis, Oregon, 51 pp.

Bolte, J.P., D.H. Ernst, and D. Lowes, 1998. Central Database management. Fifteenth Annual Administrative Report. Pond Dynamics/Aquaculture CRSP, Oregon State University, Corvallis, Oregon, pp. 36–45.

Ernst, D.H. and J.P. Bolte, 1999. PD/A CRSP Central Database management and development. Sixteenth Annual Administrative Report. Pond Dynamics/Aquaculture CRSP, Oregon State University, Corvallis, Oregon, pp. 9–14.

Ernst, D.H., J.P. Bolte, and D. Lowes, 1997. PD/A CRSP Central Database: An information resource for pond-based aquaculture. In: K. Fitzsimmons (Editor), Tilapia Aquaculture, Proceedings from the Fourth International Symposium on Tilapia in Aquaculture (ISTA), November 1997. NRAES-106, Vol. 2. Northeast Regional Agricultural Engineering Service, Ithaca, New York, pp. 683–700.

Hopkins, K.D., J.E. Lannan, and J.R. Bowman, 1987. A Database Management System for Research in Pond Dynamics. CRSP Research Reports 87-1. Pond Dynamics/Aquaculture CRSP, Oregon State University, Corvallis, Oregon, 4 pp.

Piedrahita, R.H., C. Boyd, and J. Szyper, 1991. Handbook of Analytical Methods. Pond Dynamics/Aquaculture CRSP, Oregon State University, Corvallis, Oregon, 150 pp.

EDUCATION DEVELOPMENT

MOU No. RD009E

Staff Information

Oregon State University, Corvallis, Oregon

Marion McNamara	Education Development Coordinator (US)
Gabriela Montaño	Student Worker (Mexico)

Background

The Education Development Component (EDC) was established in response to the need to improve human capacity development, one of the constraints to aquaculture to be addressed by the CRSP during this grant. The goal of the EDC is to complement the research activities of all CRSP projects by strengthening human capacity in participating countries and regions.

Networking and Educational Outreach

Education Development Coordinator Marion McNamara provided organizational assistance for the Fifth Central American Symposium on Aquaculture (18–20 August 1999). The EDC received submissions from and corresponded with authors of invited and contributed papers and responded to requests for information regarding the Symposium's Call for Papers. Additionally, the EDC compiled the papers to be presented at the Symposium and designed, edited, and laid out the Symposium proceedings.

The Philippines Education Advisory Panel recommended in a previous reporting period that the CRSP provide support in the form of small stipends to graduate students. In this period, the Panel specifically recommended support of a doctoral student at the University of the Visayas.

McNamara assisted three public school teachers in securing the sponsorship of the Oregon Department of Education to attend regional aquaculture workshops.

Publication

Green, B.W, H.C. Clifford, M. McNamara, and G.M. Montaño (Editors), 1999. V Central American Symposium on Aquaculture, 18–20 August 1999, San Pedro Sula, Honduras. Asociación Nacional de Acuicultores de Honduras, Latin American Chapter of the World Aquaculture Society, and Pond Dynamics/Aquaculture CRSP, Choluteca, Honduras (in press).

McNamara, M. and J. Molnar, 1999. Human capital impacts of the Pond Dynamics/Aquaculture CRSP. International Center for Aquaculture Communiqué, International Center for Aquaculture and Aquatic Environments, Auburn University (in press).

Work Plan Activities

Twelve EDC activities were funded under the Eighth Work Plan. With the exception of Human Capacity Development 1B (8HCD1B) "Create a CRSP Fellowship Program to Provide Appropriate Support for Graduate-Level Students," these activities were completed. Activity 8HCD1B was commenced in this reporting period by the EDC but will be continued via a subcontract issued by the ME to Auburn University.

The following Eighth Work Plan studies continued into the current reporting period:

- Create a CRSP Fellowship Program to Provide Appropriate Support for Graduate-Level Students at each CRSP Host Country Site/8HCD1B. The report submitted for this activity was a progress report. (Future reports on this activity will be submitted by the Auburn University Principal Investigator who will be serving as the student's major professor.)
- Coordinate Evaluation of CRSP-Sponsored Short Courses and Workshops/8HCD1D. While activities for this work plan were completed in the previous reporting period, the final report for this activity follows.
- Maintain and Improve the Database of CRSP Education and Training Alumni/8HCD1F. The final report for this activity follows.
- Establish a Library of Information on CRSP Institutions/8HCD1I. The final report for this activity follows.
- Seek External Support for Additional Activities to Follow-on ISTA IV/8HCD1J. While activities for this work plan were completed in the previous reporting period, the final report for this activity follows.
- Work with Institutions in CRSP Host Countries to Seek Additional Scholarship Funding from Government Agencies, Foundations, and the Private Sector to Support Masters and Doctoral Students/8HCD1K. The final report for this activity follows.
- Seek External Support for a Station Manager Workshop to Be Held in the US/8HCD1L. While activities for this work plan were completed in the previous reporting period, the final report for this activity follows.

The EDC was offered but declined funding for proposals submitted for consideration under the Ninth Work Plan Request for Proposals. The Philippines component of EDC activities to be carried out under the Ninth Work Plan, among them the support for a doctoral student at the University of the Visayas, has been taken up by the lead Philippines Project.

REPORT: ACTIVITIES OF THE EDUCATION DEVELOPMENT COMPONENT UNDER THE EIGHTH WORK PLAN

Marion McNamara
Office of International Research and Development
Corvallis, Oregon, USA

All of the following reports are printed as submitted. Referenced attachments are not included here because of space constraints but are available upon request to the Program Management Office.

CREATE A CRSP FELLOWSHIP PROGRAM TO PROVIDE APPROPRIATE SUPPORT FOR GRADUATE-LEVEL STUDENTS AT EACH CRSP HOST COUNTRY SITE

Eighth Work Plan, Human Capacity Development 1B (8HCD1B)
Progress Report

Following the recommendations of the Honduras Education Advisory Panel, the EDC worked with the US PI in Honduras during the summer of 1998 to publicize the availability of the two-year scholarship to support a student who planned to work in the Honduras aquaculture industry for a masters degree in aquaculture. Over 50 application packages were distributed. The EDC worked with Dr. John Grover, Auburn University's Academic Coordinator for the Department of Fisheries and Allied Aquacultures, to establish selection criteria which were stringent enough to ensure academic success. These included a bachelors degree in aquaculture or related sciences, strong letters of recommendation from teachers and or employers, experience with aquaculture, commitment to making a contribution to the development of aquaculture in Honduras, and satisfactory scores on the TOEFL and GRE. Four applications were received. The EDC organized a scholarship committee to evaluate qualified applications. The committee selected Oscar Zelaya, and the EDC processed his application to Auburn and arranged for his travel and support. Zelaya began his Masters program in March 1999, and began work on his thesis in May 1999. He will examine the relationship between pond soil and water quality, evaluating the efficiency of recirculating systems and the impact of high density stocking rates on water and soils. His projected completion date is March 2001.

COORDINATE EVALUATION OF CRSP-SPONSORED SHORT COURSES AND WORKSHOPS

Eighth Work Plan, Human Capacity Development 1D (8HCD1D)
Final Report

The EDC conducted evaluations for three CRSP-sponsored workshops, including two in Honduras and one in the United States. Copies of those evaluations are attached. *

MAINTAIN AND IMPROVE THE DATABASE OF CRSP EDUCATION AND TRAINING ALUMNI

Eighth Work Plan, Human Capacity Development 1F (8HCD1F)
Final Report

The EDC maintains records of formal and informal training efforts conducted by CRSP researchers. These records are updated yearly with the data supplied by Principal Investigators in their Annual Reports. Data through January 1999 is included in the attached spreadsheet, which will be updated as reports are received from Principal Investigators.*

ESTABLISH A LIBRARY OF INFORMATION ON CRSP INSTITUTIONS

Eighth Work Plan, Human Capacity Development 1I (8HCD1I)
Final Report

The EDC established a library of information on CRSP institutions, including graduate and undergraduate bulletins, and information specific to aquaculture programs and centers. In addition, links to CRSP institutions are found on the PD/A CRSP web page.

SEEK EXTERNAL SUPPORT FOR ADDITIONAL ACTIVITIES TO FOLLOW-ON ISTA IV

Eighth Work Plan, Human Capacity Development 1J (8HCD1J)
Final Report

The EDC planned and advertised a post-ISTA IV workshop on utilizing information resources for aquaculture (see flier*), but did not attract the minimum number of paid registrants needed to make the course. Fliers were sent to the CRSP mailing list, to all past ISTA participants, to all APEC Marine Resources Working Group participants, and included in all mailings for ISTA IV publicity and registration (see partial mailing lists*).

* Referenced attachments are not included in this publication because of space constraints but are available upon request to the Program Management Office.

WORK WITH INSTITUTIONS IN CRSP HOST COUNTRIES TO SEEK ADDITIONAL SCHOLARSHIP FUNDING FROM GOVERNMENT AGENCIES, FOUNDATIONS, AND THE PRIVATE SECTOR TO SUPPORT MASTERS AND DOCTORAL STUDENTS

Eighth Work Plan, Human Capacity Development 1K (8HCD1K)
Final Report

The following institutions were contacted seeking additional support for Masters and Doctoral Students, although none of them were able to offer assistance to CRSP graduate students:

Institute for Science, Stockholm, Sweden
APEC Marine Resources Working Group
Carnegie Corporation of New York
The Ford Foundation
Global 2000
W.R. Kellogg Foundation
Tinker Foundation
National Science Foundation
The Rockefeller Foundation
The Spencer Foundation

SEEK EXTERNAL SUPPORT FOR A STATION MANAGER WORKSHOP TO BE HELD IN THE US

Eighth Work Plan, Human Capacity Development 1L (HCD1L)
Final Report

Partial support for the Station Managers Workshop was received from the Honduras, Philippines, and Kenya CRSP projects, which provided round trip transportation from their respective countries for the participants. Funding external to the CRSP was sought but not obtained.

INFORMATION MANAGEMENT AND NETWORKING

MOU No. RD009D

Staff

Oregon State University, Corvallis, Oregon

Danielle Clair*	Information Manager
Ingvar Elle*	Systems Administrator and Webmaster
Kris McElwee	Graduate Research Assistant (through September 1998); Assistant Information Manager (from October 1998)
Deborah Burke*	Graduate Research Assistant
Heidi Furtado*	Undergraduate Student Worker (from October 1998)
Josh Moentenich*	Undergraduate Student Worker (February through May 1999)
Matt Niles*	Graduate Research Assistant

* Employed at less than full-time.

Presentation

Egna, H.S., C.K. Lin, and D.Z. Clair. The Pond Dynamics/Aquaculture CRSP: Developing technologies and networks for sustainable aquaculture and rural development. Presented to the Join FAO/NACA Expert Consultation on Sustainable Aquaculture for Rural Development at Chiang Rai, Thailand, March 1999.

Conferences

Oregon Academy of Science 57th Annual Meeting at Salem, Oregon, February 1999. (Burke, Egna, McElwee)
Copyright Law Workshop at Eugene, Oregon, April 1999. (Clair)
Professional Management Institute Series at Corvallis, Oregon, April 1999. (Clair)
Essentials of Design for the Editor at Chicago, Illinois, April 1999. (McElwee)
Graduate Student Association Conference at Corvallis, Oregon, April 1999. (Burke, McElwee)
Northwest Anthropology Meeting at Newport, Oregon, April 1999. (Burke)

Work Plan Activities

The following report describes Information Management and Networking Component activities in the first year of the Ninth Work Plan.

REPORT: ANNUAL ACTIVITIES OF THE INFORMATION MANAGEMENT AND NETWORKING COMPONENT

Ninth Work Plan, Information Management and Networking 2 (9IMNC2)

Danielle Clair, Ingvar Elle, Deb Burke, Matt Niles, and Kris McElwee
Office of International Research and Development
Oregon State University
Corvallis, Oregon, USA

BACKGROUND

The mission of the Information Management and Networking Component (IMNC) is to increase awareness and visibility of the PD/A CRSP by publishing and providing accessible technical and programmatic information, to monitor and report CRSP impacts, and to foster networking among persons involved in aquaculture.

Of the CRSPs research support components, IMNC works in closest concert with the Program Management Office (PMO) in disseminating technical and programmatic information in accordance with grant reporting requirements and in collecting and analyzing program impact information. Component objectives are to:

- Disseminate technical and programmatic information generated by the CRSP by providing appropriate materials and avenues;
- Identify target audiences for publications;
- Track outputs of CRSP investigations; and
- Promote networking of CRSP participants with aquaculturists around the world.

In the reporting period IMNC activities have encompassed publication production and distribution, Internet activities, impact monitoring, and program promotion and networking.

CRSP PUBLICATIONS

Data and Resource Management

An ongoing IMNC activity is managing the program's mailing database, which increases by about 10% per year. The database currently numbers 1,065 entries from 96 countries. IMNC staff also maintain a detailed inventory of PD/A CRSP publications and track publication circulation. In addition, IMNC staff work together with the PD/A CRSP Central Database Manager to facilitate the data submission

request process. Because study completion dates form the Database Manager's basis for requesting data submissions of CRSP researchers, reference to an up-to-date information source that reflects the most recent status of any study is essential. IMNC staff thus maintain a web page accessible by the Database Manager that identifies the funded studies under a given work plan and reflects study completion dates and any changes reported by CRSP researchers.

Production

IMNC has produced and distributed a variety of publications and informational materials during the reporting period, listed below.

Sixteenth Annual Administrative Report
Clair, D., D. Burke, K. McElwee, M. Niles, and H. Egna (Editors), 1999. PD/A CRSP, Oregon State University, Corvallis, Oregon, 100 pp.

Sixteenth Annual Technical Report
McElwee, K., D. Burke, M. Niles, and H. Egna (Editors), 1999. PD/A CRSP, Oregon State University, Corvallis, Oregon, 190 pp.

PD/A CRSP Site Descriptions
McElwee, K. (Editor), 1999. PD/A CRSP, Oregon State University, Corvallis, Oregon, 84 pp.

"CRSP-Developed Technologies Provide Domestic Rewards and Returns"
Printed October 1998 and reprinted April 1999, 8-panel brochure.

Annual External Evaluation Panel Review Report
Printed January 1999, 35 pp.

Ninth Work Plan
Printed April 1999, 92 pp.

Second Addendum to the Eighth Work Plan
Printed Spring 1999, 18 pp.

"PD/A CRSP Databases and Software: Promoting Research and Dialogue within the World Aquaculture Community"
Printed May 1999, 8-panel brochure.

Aquanews, quarterly newsletter (distributed by hard copy and available on the CRSP website): Vol. 13, No. 4 and Vol. 14, Nos. 1, 2, and 3.

EdOp Net, monthly newsletter of aquaculture-related education and employment opportunities (distributed by hard copy and electronic mail and available on the CRSP website): Vol. 3, Nos. 8, 9, 10, 11, and 12; Vol. 4, Nos. 1, 2, 3, 4, 5, 6, and 7.

CRSP Research Reports, an in-house publication series which includes *Notices of Publication*:

98-125 Acute and sublethal growth effects of un-ionized ammonia to Nile tilapia *Oreochromis niloticus* (10/98)
98-126 A water budget model for pond aquaculture (10/98)
98-127 A strategic reassessment of fish farming potential in Africa (10/98)
98-128 A bioenergetics growth model for Nile tilapia (*Oreochromis niloticus*) based on limiting nutrients and fish standing crop in fertilized ponds (10/98)
99-129 Aquaculture extension in Rwanda (4/99)
99-130 Dry matter, ash, and elemental composition of pond-cultured tilapia (*Oreochromis aureus* and *O. niloticus*) (4/99)
99-131 The effects of fertilization and water management on growth and production of Nile tilapia in deep ponds during the dry season (4/99)
99-132 Relationship between Secchi disk visibility and chlorophyll *a* in aquaculture ponds (4/99)

CRSP Participant Directory, published August 1998 and February 1999.

Following the 1997 publication of *Dynamics of Pond Aquaculture* (Eds. Hillary S. Egna and Claude Boyd), the CRSP commissioned Dr. Christopher Knud-Hansen, former CRSP researcher, to write a pond fertilization booklet entitled *Pond Fertilization: Ecological Approach and Practical Application*. The 137-page booklet is written primarily for educated farmers, extension workers, and aquaculture students and scientists. The overriding objective of the guide is to help fish farmers worldwide optimize their resources for efficient fertilization—obtaining higher yields at reduced costs. The manuscript was significantly revised following review by four reviewers internal and external to the CRSP, and was published in September 1998.

Besides the IMNC-produced publications listed above, a 10-year bibliography of publications, presentation, and theses authored by CRSP participants, including those published in the current period, appears in Appendix 7 of this report.

WORLD WIDE WEB

PD/A Website Developments

IMNC is responsible for the development and maintenance of the PD/A CRSP website <www.orst.edu/dept/crsp/homepage.html>, which was brought online in 1995. The

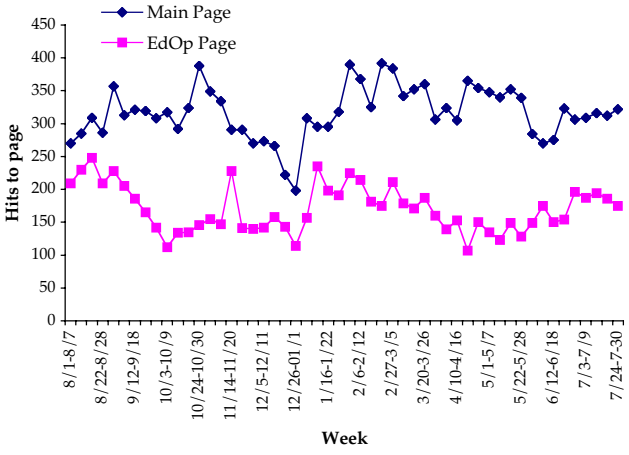

Figure 1. Weekly hits to the PDA/CRSP website's home page and EdOp Net page. The EdOp Net section contains searchable and timely announcements of educational and employment opportunities in aquaculture and related fields.

IMNC tracks usage of the website. The site averaged over 300 external hits each week , with the EdOp Net page, rebuilt by IMNC since its initiation by the EDC, the most visited, averaging 170 hits per week (Figure 1). The Publications page was also popular, with an average of 125 hits per week (Figure 2). Other pages feature programmatic information, links to aquaculture-related websites, and links to the PD/A CRSP Database and other data tools. Web-related activities in the current reporting period have included:

- Additions to the publications section;
- The development of a new section directed toward PD/A CRSP principal investigators;
- Major improvements to the PD/A CRSP Publications Database; and
- Changing delivery of educational and employment opportunities from static to dynamic markup via a Filemaker Pro–based database application.
- Use of the PD/A CRSP ftp site for disseminating the Honduras Request for Proposals and related forms and documents.

Publications and their Formats

The Publications page of the PD/A CRSP website is an important source of programmatic and research material. Documents are placed on the site in one of two formats: PDF and HTML. Documents containing many complex graphics and a detailed layout are generally placed on the site in PDF format. These documents can be read with Adobe Acrobat. Documents added in this format to the Publications page in the last year include:

- *Pond Fertilization: Ecological Approach and Practical Applications*
- *Lessons Learned in On-Farm Trials: The PD/A CRSP Experience*
- *Aquanews*–PD/A CRSP quarterly newsletter (4 issues)
- *Sixteenth Annual Technical Report*
- *Sixteenth Annual Administrative Report*
- Full versions of *PD/A CRSP Research Reports* 87-1, 88-8, 92-45, 93-54, 96-94, 98-124a, and 98-124b

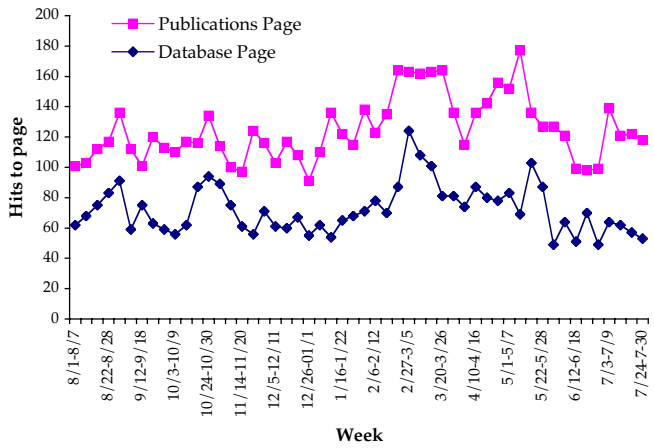

Figure 2. Weekly hits to the Publications and Data Tools pages of the PD/A CRSP website. The Publications section contains descriptions of, links to, and ordering information for most PD/A CRSP publications. The Data Tools page contains descriptions of and links to the Central Database and POND© decision support software.

Documents that contain few graphics and can be divided into relatively short sections are placed on the web in HTML format. Publications added in the last year in this format include:

- *PD/A CRSP Notices of Publication* (including French and Spanish versions where available)
- Monthly editions of *EdOp Net* (see more on *EdOp Net* below)
- Complete list of PD/A CRSP Publications

All tables of contents are placed on the web in HTML format to allow rapid browsing of publication contents.

PD/A CRSP Key Program Information Section

In order to provide critical program information and to facilitate the reporting process for PD/A CRSP participants, a new section titled PD/A CRSP Key Program Information was developed. This section, which is password-protected, provides information of specific relevance to CRSP participants. Material available only from this section includes the External Evaluation Panel Scope of Work (1997-1998) and the External Evaluation Panel Report (1997-1998). Various forms, including the Impact Report Form, Travel Form, and Emergency Locator Form are also available here.

Central Database Additions and Improvements

The PD/A CRSP Central Publications Database is a joint effort between PD/A CRSP Central Database and IMNC staff. In the past year an estimated 250 references were added to the database to bring the total number of references to 469. Publications for which references were added this year include the *Sixteenth Annual Technical Report*, the *Eighth Work Plan*, and *PD/A CRSP Notices of Publication*, including the comprehensive set of English abstracts as well as the available French and Spanish versions.

A Boolean search was added to the database enabling users to search using any combination of keyword, publication type, author, language (English, Spanish, French), year, site, and investigation code.

Entry of publication references into the database is accomplished through a web-based interface. This interface has recently been greatly enhanced by the addition of an SQL-based update page.

Employment and Educational Opportunities Section

The PD/A CRSP EdOp Net section is a popular source of aquaculture-related employment and education opportunities made available from the PD/A CRSP website and in hard-copy format. Due to a growth in employment opportunities, statically updating position announcements in HTML became impractical. In response to this, IMNC dedicated resources to improving the site. EdOp Net's new content delivery is significantly more efficient and user-friendly through the use of a searchable relational database and its web-enabling plug-in. This has allowed opportunities in the database to be marked up into html "on the fly," which has resulted in considerable time savings. More recently, the database was moved to a much faster server, which has resulted in more rapid content delivery. This database also serves as the source for the information that is compiled into the monthly hard-copy newsletter format for individuals without access to online resources.

IMPACT MONITORING

The CRSP uses impact indicators to monitor the effects of its research on stakeholders, beneficiaries, extension services, the research community, and the field of aquaculture. In the previous reporting period, the CRSP commissioned a review of the existing project impact indicators to determine whether they adequately reflected and recorded project results. The reviewer (Dr. Candace Buzzard, now with USAID/Botswana) worked individually with CRSP principal investigators to refine the indicators associated with each subcontract. IMNC is responsible for annually soliciting and collecting researchers' quantifications of their impacts.

In addition to these formal impact indicators, IMNC staff collect project-specific impact information designed to capture CRSP participants' activities that were sponsored by the CRSP or came about as a result of CRSP work. These forms are requested on a quarterly basis and allow the IMNC to monitor, track, and report progress in the areas of outreach, public service, and professional development. The types of information collected include:

- Research progress
- Institution building (contacts with host country scientists, government officials, extension agents, farmer organizations, farmers, non-governmental organizations)
- New host country involvement
- Physical support for host country institutions (e.g., pond renovation)
- Linkage development (technical or professional communications with USAID missions, host country institutions, non-governmental organizations, and regional institutions)
- Conferences attended
- Students advised
- Lectures, seminars, presentations, and workshops given
- Outreach activities (community or school extension activities) undertaken
- Electronic linkages made
- Publications, including technical papers and book chapters, authored
- Theses published
- Awards or commissions received
- Informational material developed

Though formerly tracked by the CRSPs Education Development Component, IMNC this year collected information related to student activities supported by CRSP researchers. Support typically includes providing graduate research assistantships, hiring undergraduate student workers, providing research materials, and advising student workers' research papers. During this reporting period, five formal programs (two Masters and three Ph.D. degrees) were completed by CRSP-sponsored students. The following theses were completed this year with assistance from CRSP researchers:

Burke, D.A., 1999. An analysis of social relationships at a development site in Kenya. M.A. thesis, Oregon State University, Corvallis, Oregon.

Gross, A., 1999. Nitrogen cycling in aquaculture ponds. Ph.D. dissertation, Auburn University, Alabama.

Jamu, D., 1998. Modeling organic matter and nitrogen dynamics in integrated aquaculture/agriculture systems: effects of cycling pathways on nitrogen retention and system productivity. Ph.D. dissertation, University of California, Davis, California.

Sonnenholzner, S., 1999. Chemical and physical properties of shrimp pond sediment in Ecuador and some management strategies for pond preparation. Ph.D. dissertation, Auburn University, Alabama.

Tain, F.H., 1999. Impacts of aquaculture extension on small-scale *Oreochromis niloticus* production in northeastern Thailand. M.S. thesis, The University of Michigan, Ann Arbor, Michigan.

PROGRAM PROMOTION AND NETWORKING

IMNC sought to increase the visibility of the PD/A CRSP at Oregon State University through participation in two campus-wide events—University Day and Earth Information Day—and sponsorship of a third—the Graduate Student Conference. The CRSP hosted a booth for University Day and Earth Day, and in total the booths received approximately 200 visitors during these events. IMNC staff answered questions about the program and distributed informational materials such as program brochures, annual reports, *EdOp Net* (the program's educational opportunities network newsletter), and *Aquanews*, the PD/A CRSP quarterly newsletter. In addition to the distribution of informational materials, IMNC increased program visibility through the creation of a jovial atmosphere at the Earth Day booth with a fish placard for visitors to be photographed behind. To encourage people to acquaint themselves with the PD/A CRSP Website their photographs were placed on the web for viewing. Additionally, at each of the events tilapia recipes were available. The CRSP was also a co-sponsor of the session entitled "It Takes a Village to Raise a Fish: Multidisciplinary Perspectives of Natural Resources" at the Graduate Student Conference, held in April 1999 at Oregon State University.

IMNC also established new connections both domestically and internationally and provided information worldwide via CRSPMail, an electronic mail address for website visitors. During this reporting period, CRSPMail received 15 queries from individuals representing El Salvador, Belize, Brazil, Thailand, Cambodia, Sri Lanka, India, the Philippines, Japan, Austria, and the US. Questions addressed a variety of topics related to aquaculture such as the availability of inexpensive, high-quality feeds in the Philippines, the construction of an ozone-producing system for shrimp ponds, and the effects of tilapia as an exotic species. In a number of circumstances the PD/A CRSP Website and *EdOp Net* proved to be valuable resources for individuals contacting the program.

PD/A CRSP researchers were also responsive to CRSPMail inquiries and offered assistance and resources. For example, Project Leader for Philippines research Chris Brown at the University of Hawaii was able to offer assistance to an individual in finding extension agents and contacts in the Philippines related to the start-up of milkfish and shrimp farms. In another instance CRSPMail received a request for information regarding a research project that involved collaboration between the CRSP and the Food and Agriculture Organi-

zation of the United Nations to assess the aquaculture potential in South America using GIS. IMNC directed the individual with this request to contact CRSP researcher Shree Nath at the University of Georgia, who was a co-collaborator on the project. Nath was able to link this individual with researchers from both FAO and the University of Stirling. Though the CRSP does not conduct research on biological filtration, IMNC was able to direct an inquiry related to this topic to CRSP researcher Kevin Fitzsimmons (University of Arizona), who has done a great deal of work in biological filtration for recirculating aquaculture systems, for treatment of aquaculture effluents, and for treatment of other wastewaters, thus highlighting the dynamic nature and flexibility of the PD/A CRSP.

To increase communication within the PD/A CRSP community, an electronic mailing list, PDA-CRSP-L, was established to replace AQUACUL. The mailing list, which includes approximately 65 members, allows any subscriber to distribute a message quickly and at no cost to the entire group. Typical postings include administrative information of general interest, availability of new publications, requests for training materials, announcements of opportunities in the field of aquaculture, and relevant travel advisories.

In addition to these activities, IMNC worked closely with the PMO in creating materials for the following events:

- An exhibit of 24 photographs highlighting the accomplishments of the nine CRSPs entitled "Mutual Benefits for Developing Countries and the United States," in the USAID Information Center at the Ronald Reagan Building in Washington, D.C., from 21 September through 31 December 1998.
- A special symposium entitled "CRSP: A Unique USAID Partnership with Higher Education," which was part of the October 1998 Annual Meetings of the American Society of Agronomy, Crop Science Society of American, and Soil Science Society of America, held in Baltimore, Maryland.
- A case study project coordinated by the Association of International Agriculture and Rural Development (AIARD) to illustrate the win-win benefits of investments in international agriculture and rural development to both the United States and developing countries.