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REVIEW OF THE IMPACT OF THE ECO-RESEARCH PROGRAM ON ENVIRONMENTAL SCIENCES IN CANADA: Lessons for the Canadian Environmental Sciences Network

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Review of the Impact of the Eco-Research Program on Environmental Sciences in Canada

Lessons for the Canadian Environmental Sciences Network

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Science Policy Branch
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May 2004

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1 EXECUTIVE SUMMARY

The Eco-Research Program (ERP) operated for six years, distributing some $27 million to support environmental research in Canada. The program ended in 1997.

Judging from the responses of the recipients, the Eco-Research Program was, in most respects, a highly successful initiative.

Major successes include:

1. Providing unique training and skills in environmental research, which had a significant effect on the careers of individual researchers and, to a lesser extent, on the institutions in which they worked;
2. Addressing some significant environmental research issues;
3. Support and enhancement of cross-disciplinary research in Canada, in an academic environment where this was difficult to accomplish;
4. Encouraging the formation of networks of researchers that persist long after the program ended.

Environmental research is by its nature complex, involving natural science, physical science, engineering, and social science. Environmental issues do not fit neatly into the traditional disciplines around which academic institutions are traditionally organized.

Perhaps the greatest legacy of the program is that it encouraged individuals and organizations to confront this reality, and to develop new techniques and approaches more suited to the nature of the problems.

The Eco-Research Program has also provided a legacy of researchers trained in cross-disciplinary approaches to environmental problems, which continues to benefit Canada and the world.

Some other conclusions can clearly be drawn from the Eco-Research Program experience, including:

1. The need for a similar program in future;
2. The crucial importance of long term funding which is protected from annual pressures;
3. The importance of capturing the experience in managing the complexities of cross-disciplinary research projects, and of making that experience available to future funding recipients.

Future programs can learn much from the Eco-Research Program. The program objectives, strategy, and approach were very effective. Some areas for learning have been identified, including:

1. A more focused, strategic approach to environmental research issues to be addressed;
2. A more effective strategy for dissemination of results;

3. Improved support of partnerships and networks, in particular those with the private sector.

2 INTRODUCTION AND PROGRAM BACKGROUND

2.1 Purpose of the Review

It has been twelve years since the Eco-Research Program (ERP) began and six years since the funding ended. Enough time has passed to assess the impact of the Program on the careers of the recipients and on the field of environmental science in Canada.

A thorough review of the Eco-Research Program's strengths and benefits for the environmental sciences in Canada has never been conducted.

Using a number of sources—including interviews with recipients of the three categories of Eco-Research grants, interviews with program administrators, final project reports, and research on funding mechanisms—this review documents the impact of the Eco-Research Program on the organization and delivery of environmental sciences in Canada.

This report focuses on capturing a sense of the downstream outcomes of the Program, rather than its immediate outputs. It also focuses more on the program's personal and institutional impact, rather than its intellectual impact.

2.2 Organization of the Report

The report consists of five major components:

- **Section 2** describes the purpose and methodology of the report, and the background of the Eco-Research Program
- **Section 3** provides a brief overview of previous findings relevant to this report including results of the Eco-Research Program Evaluation of October 1996, the report of a workshop on cross-disciplinary research, a brief overview of the notions of multi- and interdisciplinary research, and the current state of the environmental research field in Canada
- **Section 4** discusses the findings resulting from the interviews and file review, including:
    - the impact of the Eco-Research Program on personal career and professional development;
    - the effect on academic institutions;
    - the impact on knowledge transfer and dissemination;
    - the effect on ability to attract funding; and
    - the changes to institutional barriers to cross-disciplinary research.
- **Section 5** discusses the lessons learned, conclusions and recommendations arising from the findings.

2.3 Review Methodology

A variety of methods were used to collect the required data to ensure appropriateness of method to type of information required, and to optimize resources.

2.3.1 Document Review

Project documentation reviewed included the Evaluation, Annual and Status reports for the Eco-Research Program. These provided valuable information and lists of potential candidates for interviews. As well a brief literature review of the current state of environmental research in Canada and the evolving understanding of multi- and interdisciplinary research was conducted to provide a context for recommendations.

2.3.2 Key Informant Interviews

The primary method of gathering data for this report was through telephone interviews with key participants in the different components of the program – funding recipients, program administrators and science advisors to Environment Canada. These interviews, conducted by telephone using an interview instrument specifically designed for the purpose, yielded a wealth of commentary and anecdotal information that has been reviewed and analyzed to develop the findings in this report.

Over 25 phone interviews were conducted with program administrators and program funding recipients. These were representative of the Chairs, Fellowships and Research Grants components of the program.

In general, the interview subjects were eager to tell their stories and the interviews lasted from thirty minutes to over two hours.

2.3.3 Impact Review Framework

A review framework was developed from the objectives for this report. This framework, once approved by Science Policy Branch, Environment Canada, was used to develop the interview instrument.

2.4 Eco-Research Program Background

The Eco-Research Program was a university granting program announced on September 29, 1991 by the federal government as part of the Green Plan. The Social Sciences and Humanities Research Council (SSHRC), the Natural Sciences and Engineering Research Council (NSERC) and the former Medical Research Council (now the Canadian Institutes for Health Research (CIHR)) administered the Program jointly with advice from Environment Canada.

The original funding was $50 million over six years. In 1995, as part of Program Review, the program was cancelled and as a result the final competition for fellowships and research grants was not held. In the end, the program provided funding of $27 million for cross-disciplinary environmental research from 1992 to 1997.

The stated goal of the Eco-Research Program was: "To strengthen Canadian research and training focusing on environmental issues, with particular emphasis on developing greater understanding of critical interactions between humans and the environment and of how these interactions may best be managed."

Towards this goal, the program had the following objectives:

- To support high quality, **cross-disciplinary** research integrating expertise from the social sciences and the humanities, the health sciences, the natural sciences and engineering;
- To contribute **fundamental and practical knowledge** about complex environmental issues facing Canadian society;
- To provide opportunities for **training specialists** in environmental fields;
- To encourage the formation of ongoing **national and international alliances** or partnerships between universities, private and public sector organizations, and public interest groups; and
- To ensure that research **findings** generated by this program are **widely available** to the various sectors of Canadian society.

2.5 Program Components

The Eco-Research Program had three components: Ecosystem Research Grants, University Research Chairs, and Doctoral Fellowships.

Ecosystem Research Grants were intended to support in-depth studies of Canadian ecosystems affected by environmental change. Around two-thirds of the research grants funds were to be used for stipends for students, fellows and assistants. The competition for research grants had two phases: a letter of intent followed by a full proposal for selected projects. Those passing the letter of intent stage were eligible for up to $25 000 to help defray the costs of developing a full proposal. There were two competitions, and a total of ten grants were awarded.

University Research Chairs were intended to foster Canadian research on environmental issues by establishing outstanding researchers as university chairholders. In addition to creating and training a core of researchers working specifically in environmental fields, the Chairs were required to secure collaboration from private and public sector sponsors. The Chairs were nominally funded for five years, but because of competition delays, three of the five chairs were guaranteed funding for only three years before the scheduled end of the program.

Doctoral Fellowships were intended to support environmental studies in each of the three major discipline groupings by supporting students in a doctoral program at a Canadian university. Cross-disciplinary research was not required, but was preferred. Fellowships were tenable for up to three years, at $18 000 per year. Three competitions were held.

The outputs of the three components of the Eco-Research Program are summarized in the following table.

Research Grants	Research Chairs	Doctoral Fellowships
$19 million (71%)	$4 million (14%)	$4 million (14%)
10 grants awarded	5 chairs funded	89 recipients
avg. $1.9 million per grant over 3 years	avg. $800 000 per chair over 5 years	avg. $45 000 per student over 3 years

2.6 Administrative Structure

The administration of the program was composed of two Tri-Council Committees, a Secretariat, and the Peer-Review Committee.

The Management Committee was composed of the Chairs of the three Granting Councils, plus one observer from Environment Canada. The Operations Committee was composed of senior representatives of the three Granting Councils. The Tri-Council Secretariat was composed of a program director and several program officers, and was located at SSHRC.

The Peer-Review Committee was composed of 17 individuals appointed by the three Granting Councils in consultation with EC, including policy makers as well as researchers. This Committee was responsible for reviewing and recommending on applications for all three program components.

3 CONTEXT FOR THE IMPACT REVIEW

There are several reports that are germane to this review, including the Program Evaluation,[1] the recommendations of the Evaluation Steering Committee[2] and a report on a workshop on the challenges of managing interdisciplinary research programs.[3] Some key findings of those reports are presented in this section. This is followed by a brief description of the current status of environmental research in Canada. Finally, this section provides a description of the notions of cross- and interdisciplinary research, and a discussion of the requirements of knowledge dissemination and knowledge transfer.

3.1 Program Evaluation and Recommendations

An Evaluation Steering Committee with representation from the three granting councils and Environment Canada was set up at the outset of the program to manage its evaluation. The main issue areas to be examined in the evaluation were: cross-disciplinarity of research; relevance and effectiveness of research training; likely use of findings by target groups; and disciplinary participation in the program.

The evaluation also included a study of alternative delivery mechanisms for a similar program. These alternatives included funding environmental research through other granting council programs; funding a single network of scholars and students (a "virtual institute"); directed or competitive research funded through contracts with identified deliverables; partnering with other levels of government and/or private sector organizations for delivery of the program; and funding an eco-research institute.

An expert panel reviewing these alternatives generally supported re-instatement of the Eco-Research Program in roughly the same format.

3.1.1 Some Key Points[4] of the Evaluation Report

For the most part, it was seen as too early to assess any of the research outcomes of the program. The findings that are relevant to this report can be summarized as follows:

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[1] Rideau Strategy Consultants, *Evaluation of the Eco-Research Program* (Ottawa: Eco-Research Program Management Committee, October 1996).

[2] *Recommendations of the Evaluation Steering Committee*, Evaluation of the Eco-Research Program (May 1997).

[3] Report on the Eco-Research Program Workshop on the Challenges of Cross Disciplinary Research Programs, January 1994.

[4] Some of this section draws on Science Policy Branch, "Eco-Research Program Overview, 1991-1997: Program description, evaluation, and recommendations," (Gatineau: Environment Canada, October 2003).

Rationale and Relevance

- The need for cross-disciplinary research on the environment was evident, urgent and likely to remain so for decades.
- The three components of the program mechanism (grants, chairs and fellowships) varied in their fit with program objectives.
- There was a continuing need for a program similar to Eco-Research.

Timelines

- The three- to five-year duration of projects was too short a period for appreciable progress to be made in ecosystem studies.
- The additional challenge of coordinating large cross-disciplinary teams of researchers extended the time required to set up the research projects.
- The investment of time and resources for a research project that would only last three to five years was cause for concern.

Peer Review Process

The Peer Review Committee was tasked with evaluating funding proposals against specific guidelines. These guidelines included how well the application corresponded with the objectives of the program, the excellence of the research proposed, the qualifications of the research team, and the integration of cross-disciplinary skills.

The Peer Review Committee grappled with challenges particular to cross-disciplinarity—cross-disciplinarity within the Committee and within the proposals. For instance, there were:

- Varying definitions of ecosystem;
- Varying opinions of what constituted cross-disciplinarity;
- Varying opinions of appropriate definitions of research problems and appropriate methodologies for solving them;
- Limited knowledge on the part of the Committee of the research needs of specific ecosystems, making it difficult to evaluate if these needs were being addressed by the proposal.

Program Objectives

The program objectives were very broad, and did not identify specific benchmarks or targets that would help in indicating when objectives had been met. Two issues related to the program objectives and relevant to this report emerged through the peer review activities:

(a) Cross-Disciplinarity

The program documentation for research grants defined cross-disciplinarity as substantial participation in the research team from at least two of the discipline groups defined by the jurisdictions of the three granting councils.

There was a spectrum in cross-disciplinarity: from individuals in separate disciplines working in isolation but sharing results, to a much closer on-going collaboration in defining research problems and developing methodologies to address them. It was not clear which the Eco-Research Program was targeting. Also, participants commonly took cross-disciplinarity to include work between different disciplines *within* the same granting council grouping (fish biology and water chemistry, for example, both falling within the NSERC grouping).

(b) Communication and Dissemination of Results

The last program objective was "to ensure that research findings generated by this program are widely available to the various sectors of Canadian society." Communication within research teams was seen as a way of facilitating cross-disciplinarity. Communication with communities outside the research teams was seen as a way to facilitate science-policy connections and to further policy-relevant research.

The evaluation indicated that the requirements for disseminating results were not rigorous. Projects that received Eco-Research grants were required to submit final reports but an assessment of these was not possible during the evaluation because not all the reports were available at the time the evaluation was being conducted.

3.2 Recommendations of the Evaluation Steering Committee

After receiving the evaluation report from the consultants, the Steering Committee submitted its own recommendations to the Eco-Research Program Management Committee. The Committee indicated they did not agree with all aspects of the evaluation but in general felt it provided a basis upon which to proceed in designing a new program.

The Committee recommended that Environment Canada take the lead in developing an explicit federal strategy for the conduct and support of cross-disciplinary environmental research in cooperation with Health Canada, the three original granting council partners and the National Research Council. The Eco-Research Program was seen as a good starting point for a future program and that program design and development staff should be engaged in the design of future programs.

3.3 Workshop on "The Challenges and Opportunities of Cross-disciplinary Research"

In January 1994, a workshop on cross-disciplinary research was held with researchers participating in Eco-Research-funded projects, staff of the granting councils and Environment Canada, and members of the Peer Review Committee.

The workshop report describes how the program's emphasis on cross-disciplinarity contributed to two divergent understandings of the essence of the program:

1. as defined by the nature of the problems being addressed: complex environmental problems requiring an integrated or cross-disciplinary response
2. as defined by the cross-disciplinary mode of research, which happened in this case to focus on environmental issues. In this sense, cross-disciplinarily was perceived as the end, rather than the means.

In addition, the participants noted several other challenges with regard to the management of cross-disciplinary research including the lack of support in universities (where departments and careers are built on uni-disciplinarity), the need for new and innovative cross-disciplinary courses, the need for training in the management of cross-disciplinary research and lastly the need to communicate the advantages and successes of using more integrative approaches when addressing complex problems.

3.4 Status of Environmental Sciences in Canada

Environmental research covers a broad range of disciplines—including the natural, physical, social, and engineering sciences, as well as the humanities. Environmental science activities are not easily classified. They are often transdisciplinary and undertaken or financed by many different institutions including government departments and agencies, universities, colleges, non-government and Aboriginal organizations, community groups, and private sector companies.

Canada has been a world leader in the generation of environmental knowledge. A 2001 study of environmental scientific outputs in the natural, physical and engineering sciences indicated that Canada is consistently within the top four nations in the world in terms of production. At some points in the recent past, Canada has been the second most productive nation in these areas of the environmental sciences.

The federal government has clearly made S&T investments a priority since the release of the Federal S&T Strategy in 1996. Significant new funding has been directed to the federal granting councils, as well as to new S&T institutions such as the Canada Foundation for Innovation, the Canadian Institutes for Health Research, and Genome Canada. Federal funding for research at universities, in particular, has increased substantially (Figure 1)—a trend which is also evident in other key countries, but is particularly prominent within Canada (Figure 2).

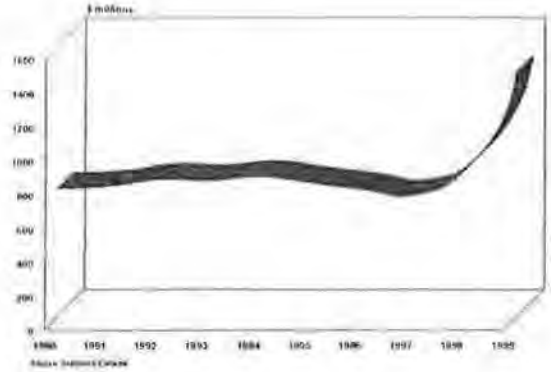

Figure 1. Federal Support for University R&D, 1990-91 to 1999-2000

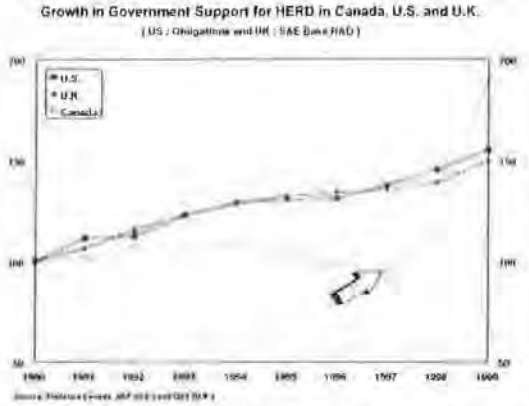

Figure 2. Growth in Government Support for HERD in Canada, U.S. and U.K.

In recent years, the government has made a very select number of investments to strengthen specific federal in-house scientific capabilities, including funds for biotechnology research and regulation, health, geographical information, toxic substances in the environment, and space. Most of these investments were for innovative S&T initiatives that deliver knowledge through new governance mechanisms linked to the broader science community. Examples include the Toxic Substances Research Initiative (TSRI), Geoconnections, and the Canadian Biotechnology Strategy. The Canadian health research sector, moreover, has been significantly transformed by the development of the Canadian Institutes for Health Research (CIHR), the Canadian Health Services Research Foundation, the Canadian Health Network, and the Canadian Institute for Health Information (CIHI).

3.4.1 Environmental Sciences at a Crossroads

Canada's environmental science and technology efforts are currently at a crossroads.[5] After more than two decades of steady growth, from the 1970s

[5] For the purposes of this document, science refers to research and development (R&D), as well as monitoring, scientific assessment, data collection, and reporting of information.

to the mid-1990s, Canadian investment in environmental science has levelled off or is starting to decline.

The demand for environmental knowledge, however, continues to grow. While unique institutional arrangements, in the form of environmental science networks, have been developed to improve the mobilization of Canadian scientific talent for addressing specific environmental issues, the overall Canadian environmental sciences community is relatively fragmented, uncoordinated, and lacking in common direction. There is no common vision, science agenda, or institutional framework to guide the environmental sciences in Canada and the notion of a Canadian environmental innovation system exists only in conceptual rather than concrete terms.

The Canadian environmental sciences community and its underlying funding infrastructure have not kept pace with these evolving demands. The federal government, which currently produces approximately 50% of Canada's environmental scientific knowledge in the natural and physical science areas, has significantly reduced its scientific capacity since the mid-1990s.[6] The provinces have also significantly reduced their expenditures on the environmental sciences over the past decade.

Concern is mounting that Canada's environmental sciences community, as currently organized and funded, will not be able to meet the expanding demands to provide the knowledge needed to support environmental decision-making, public policy development, environmental services, or new technologies in support of sustainable development.

3.4.2 The Environmental Sciences Research Deficit

Between 1980 and 1998, less than 2% of all the environmental science research papers published in Canada dealt with the social, economic, legal or cultural aspects of environmental issues. Less than 5% of Canadian social science researchers investigate environmental problems on an active, on-going basis. Although at least two dozen Canadian universities consider environmental research a strategic priority, few have doctoral programs designed to produce highly qualified researchers in the social, economic and cultural dimensions of environmental science. Currently, there is no national research support program that focuses the efforts of Canadian researchers on the broad, complex and increasingly vital environmental challenges facing all Canadians.[7]

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[6] A recent study of Canada's research publications in 1995 showed that 25% of Canada's environmental and 34% of Canada's atmospheric research publications were authored or co-authored by Environment Canada scientists. See *Environment Canada's Scientific Research Publications 1980-1997,* Science Policy Branch Working Paper Series No. 6 (Hull, QC: Environment Canada, 2000).

[7] With notes taken from *Canadian Environmental Sciences Network (CESN) Discussion Paper*, Science Policy Branch Working Paper Series No. 22 (Hull, QC:, Environment Canada, March 2001).

Only 2 of 22 Networks of Centres of Excellence (NCEs) funded by the federal government are dedicated to the environmental sciences—while no fewer than 7 focus on human health issues. Moreover, these NCEs tend to exclude environmental scientists from federal and provincial government organizations (in Canada approximately 50% of all environmental science is generated by the federal government).

Some other reasons for the situation that exists today include:

Inadequate Research Environment

Canada does not possess a mechanism through which efforts can be undertaken to attract and retain top scientists to work in the environmental sciences. Existing environmental science programs and funding initiatives are distinct and dispersed, and there seems to be no national focal point for the Canadian environmental sciences community. Together these have reduced the overall profile of Canada's environmental science efforts relative to other scientific areas.

Underfunding

Despite being an area of historic strength and leadership, Canada's current environmental S&T infrastructure and resources are in a state of decline. National facilities, scientific equipment, and important environmental monitoring systems maintained by Environment Canada and other federal departments have fallen into disrepair. Environment-specific university funding initiatives have been discontinued, and government S&T spending for environmental science has been scaled back at both the federal and provincial levels.

Inadequate Application of Knowledge

Insufficient attention has been paid to the use of environmental knowledge as a means for improving the environment or the health of Canadians. The result is confusion about where Canadians can find sources of environmental knowledge in a form that is readily useable. Environmentally sustainable economic development and job creation opportunities, which can result from Canadian efforts in environmental science, are not being fully realised.

3.5 Cross- and Interdisciplinary Research

In 1991, when the Eco-Research Program was designed, cross-disciplinary research was an idea that had been around for at least a decade but had never been supported in Canada in any significant way. At the time, SSHRC, the lead organization managing the Eco-Research Program, had just released a five-year strategy in which it stated:

> We must intensify our efforts to promote excellence in research. We must also quickly and systematically broaden our research infrastructures to promote collaboration among researchers in the social sciences and humanities, the medical sciences, and in the natural sciences and engineering. Researchers in these disciplines

> must become more adept at working together to analyze and suggest new approaches to specific problems of national concern.[8]

The Eco-Research Program was thus built on fertile ground and was seen as a pioneer in encouraging different disciplines to come together through an integrative approach to work on complex environmental problems.

Today, a quick trip through the Internet reveals literally hundreds of articles, reports and research centers dedicated to cross-disciplinary, interdisciplinary and multidisciplinary research. These terms seem to have shifting and overlapping meanings.

The National Institutes of Health in the United States distinguish between an interdisciplinary approach and a multidisciplinary approach:

> a multidisciplinary approach brings experts from diverse disciplines to address collectively a common complex problem, each from his or her unique perspective. By contrast, an interdisciplinary approach is what results from the melding of two or more disciplines to create a new (interdisciplinary) science. Biophysics, biostatistics, bioinformatics, bioengineering and social neuroscience, are just some examples of existing interdisciplinary sciences.[9]

Whatever the definition, there appears to be growing understanding of the need to address the opportunities and challenges inherent in such approaches.

The challenges expressed in recent reports mirror the findings of the 1994 Eco-Research Workshop. The current discussion on this issue often goes further, asserting that the complex problems facing the world today will only be resolved through integrative approaches.

> Today, many of the exciting problems in science are too complex to yield to a fragmented approach. They require the contributions of scientists from a number of different fields, each bringing their expertise to bear on aspects of the larger, systems-level problem...
>
> It is important to keep in mind, however, that strong interdisciplinary programs will succeed only if they build on strong disciplinary programs. The two go hand in hand. Today's scientists need to be both disciplinary and multidisciplinary, to have the breadth to see problems, and the depth to solve them.[10]

A review of the literature reveals that around the world the same issues with regard to training, research management and university hierarchical systems are being addressed by funding bodies. For example, a United Kingdom

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[8] *A Vision for the Future: A Five-Year Strategy from the Social Sciences and Humanities Research Council* (Ottawa: SSHRC, 1990), pp. 10-11.

[9] National Institutes of Health Research, March 2003.

[10] Richard M. Reis, "Interdisciplinary Research and Your Scientific Career," *Chronicle of Higher Education*, Chronicle Careers, online edition, 20 September 2000. Accessed at http://chronicle.com/jobs/2000/09/2000092903c.htm.

Report[11] of their six major granting councils resulted in a number of recommendations with regard to training, peer review and working within university hierarchical systems.

The National Institutes of Health in the United States have recently (February 2004) posted an RFP to develop training programs in interdisciplinary research. It states:

> The NIH is particularly interested in developing a new interdisciplinary research workforce. NIH recognizes the value and contributions that existing interdisciplinary approaches have made and are making to understanding of health, disease, and disability. NIH is announcing a series of initiatives that will provide investigators with the training to effectively lead and engage in integrative and team approaches to complex biomedical and health problems.

In addition there is increasing recognition of the need to manage cross-disciplinary research differently. "As the literature suggests, a defining feature of cross-disciplinary research is that organizational goals are dynamic and shift over the life span of a project... We need to re-evaluate the organizational structure in light of this..."[12]

3.6 Knowledge Dissemination / Knowledge Mobilization

In 1990, SSHRC was recognizing the need to work across disciplines. Today, it is recognizing the need along with many other government-granting programs, foundations, councils and agencies to support research that has practical application in a world looking for answers to complex problems.

> The research world has changed. Today, researchers are expected not only to conduct research and train graduate students but also to move knowledge from research to action and link colleagues and stakeholders across the country. To find out how best to support researchers now, and meet Canadians' need for knowledge, SSHRC is launching a nation-wide consultation, in partnership with universities, colleges, scholarly associations and other stakeholders.[13]

In 1991, the Eco-Research Program had as one of its goals the communication and dissemination of the findings of the research it was supporting. The Program Evaluation noted a lack of rigor in that aspect of the management of the Program and thus the requirements for researchers. Ten

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[11] Promoting Interdisciplinary Research and Training, Report of the Joint Research Council Visits to 13 UK Universities, February-May 2000.

[12] Gale Moore, "Managing Cross-Disciplinary Research: A Case Study," Ontario Telepresence Project, Information Technology Research Center, University of Toronto, 2003. Accessed at http://www.dgp.utoronto.ca/OTP/papers/managing.x.disciplinary/Mnging.X.Discipl.Research.html.

13 *From Granting Council to Knowledge Council: Consultation Framework on SSHRC's Transformation*, February 2004.

years later, as evidenced by the existing requirements of NSERC for example, and what is likely to emerge from the SSHRC process over the coming months, that issue is even more important. Findings ways to ensure that government funded research is tied more closely to public policy and program requirements has become known as "knowledge management" and plays an increasingly important role from the perspective of the granting councils and government funded programs.

4 FINDINGS

4.1 Profile of Interviewees

Over 90% of the interviewees were funding recipients of the Eco-Research Program. The distribution of the funding recipient interviewees' participation is shown in the following graph.

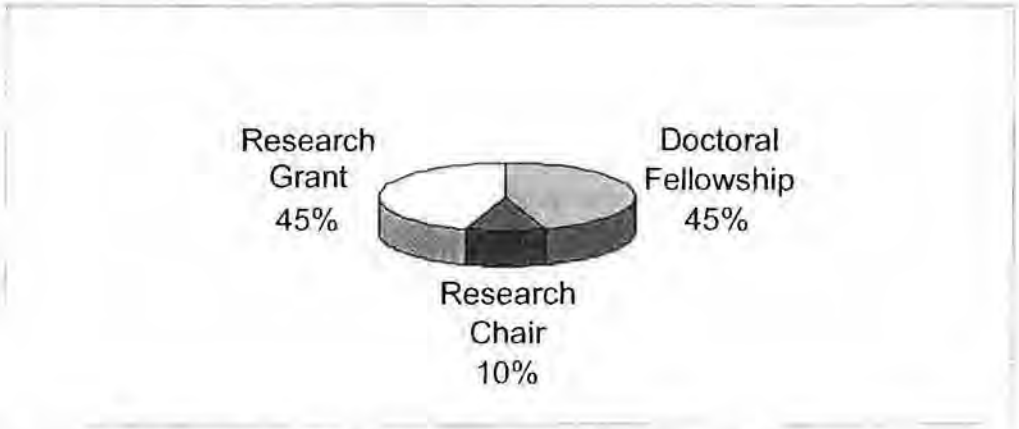

Figure 3. Distribution of Interviewees by Funding Type

The interviewees provided a balanced cross-section of participants, to ensure that all relevant views were represented. Over 70% of those interviewed were involved with the program for between two and five years, 20% for two years or less, and 10% for more than five years. The longest involvement was that of one of the Research Chairs, who remains in that position after 11 years (albeit funded by other sources). The duration of involvement is quite unusual for government funded research programs which typically have one or two year time frames.

4.2 Impact on Personal Career and Professional Development

This area was explored with several questions related to the effect the program had on career paths and the development of new skills.

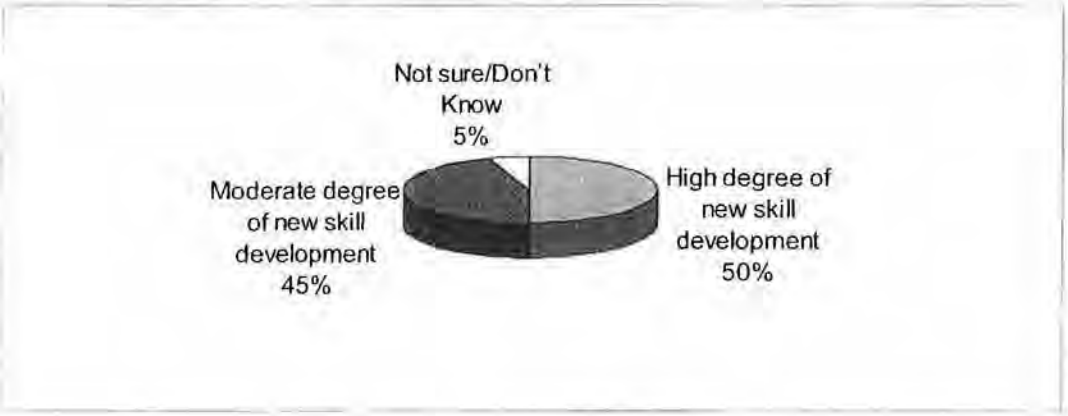

Figure 4. Degree of New Skill Development

Well over 90% of respondents credit the Eco-Research Program with enabling them to develop new skills.

Specific responses indicate those skills ranged from research skills, both within and across disciplines, to management skills in a cross-disciplinary team environment. The comments were very clear that participation in the Eco-Research Program provided invaluable opportunities to manage or participate in projects on a scale and complexity not possible in other research endeavours. The experience enabled some to develop world class skills in cross-disciplinary research, which have been recognized internationally.

"Professional skills were developed among mostly U of Ottawa and (some) Queen's researchers: ecologists, geologists, engineers, geographers, economists and political economists. Most importantly, there was a significant amount of interdisciplinary skill development, a rare thing in university research."

"I had to manage a team for the first time and a team that encompassed 30 scholars and 99 students spanning the Natural Sciences, Social Sciences, Health and Education. It launched my career in cross-disciplinary research management which I continue to this day."

"This opportunity changed my career and research dramatically. It changed my life. I developed management skills, specifically how to manage people from diverse disciplines. It also changed how I would frame and addresses the issues. Although I had been on research teams before, up until this point I hadn't done anything like this project."

"This was a tremendous learning experience that is now resulting in a new book coming out on ecosystems. I have also gone on to do projects all over the world as a direct result of the work done on the Eco-Research project. I am aware of a major project now going on in Japan with a person who is also using my materials and approach. This person flew to Canada to speak with me."

"It enhanced my people-related skill development both when doing the funding proposal and after receiving the grant. There were lots of people involved from different departments which enabled me to recognize the value of other people and of incorporating their different skills."

The impact on the career path of those interviewed was also significant, as shown in the following chart. Seventy-two percent of respondents indicated that the Eco-Research Program had a high or moderate impact on their career path. Impacts included providing a starting point for a career path, to completely changing the direction of some respondents' careers.

There is a strong indication of a broadening of focus, and the enhancement of cross-disciplinary research and project management skills among the respondents.

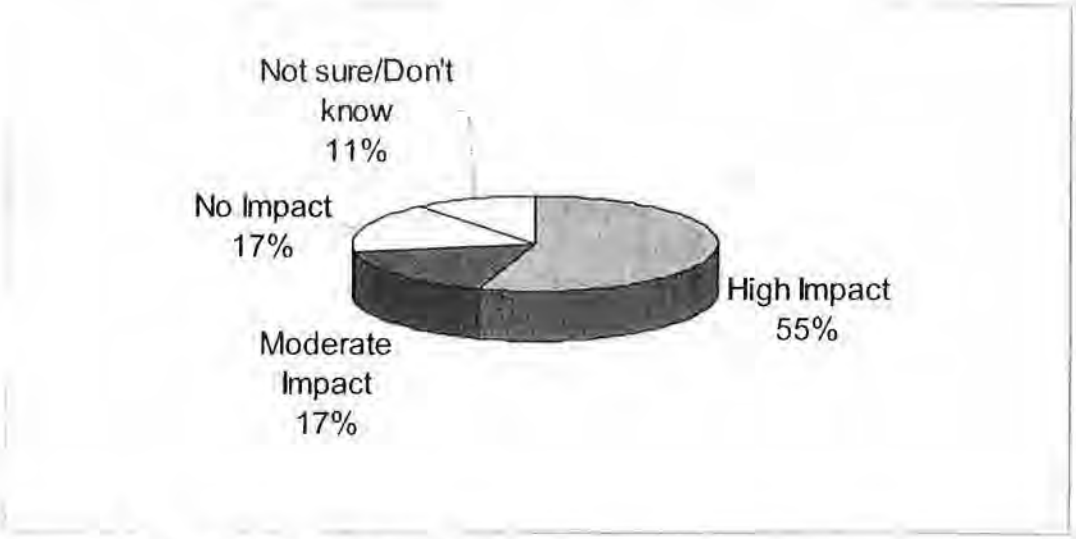

Figure 5. Effect on Career Path

Effect on Professional Contacts and Relationships

Over 85% of respondents reported that the Eco-Research Program resulted in expanded longer term professional contacts.

Many felt that the Eco-Research Program participation put them in touch with other researchers whom they would never have met in normal circumstances. Many report that these contacts remain strong to this day, many years after the program finished.

"The ERP enabled me to do research which I in turn presented at conferences where I gained long term professional contacts. Also as part of my research dissertation I had to interview private sector companies which evolved into both contacts and partners."

"The ERP helped me develop contacts with people I would otherwise not have had the opportunity to work with including sociologists, economists, and environmentalists. I have developed networks of people as well as new projects. There is still an information network of original participants who stay in contact through the Canadian Institute of Advanced Research (CIAR)."

"As Director of the ERP at Memorial University many partnerships were formed that remain viable and strong to this day. It is not a huge community so we have all tended to remain inter connected. I am the Chair for a number of organizations, one of which is the Human Dimensions Committee of the International Human Dimensions Program which is sponsored under the United Nations/UNESCO and funded through the International Council of Scientific Unions. I'm also a member of the International Scientific Steering Committee and the Global Oceans Ecosystems Dynamics Program, to name a few. The ERP was a world leader in ecosystem research globally at the time and spawned many collaborative relationships nationally and internationally that continue to grow to this day."

"A lot of the contacts I made had already been established before I started the ERP. The ERP didn't facilitate greater interaction between Environment Canada and the environmental community. I developed my own network and the ERP didn't increase that pool at all. It allowed me to maintain connections I had already made."

"As a result of participating I got to know other Principal Investigators. I also got involved with other complementary projects, specifically at the Universities of Guelph, Ottawa, and UBC. I

completed joint projects, acted as an advisor and sat informally on an advisory committee. I also developed new academic relationships that continue to date."

"All of the researchers that were part of the early Eco-Research and SSHRC funded projects became part of a formal network that I set up with IDRC funds to work both internationally and nationally. More recently, we has received $25M over 7 years for the Réseau d' Excellence, Artic Net, comprised of 25 projects focused on the impact of environmental/social changes and global warming on the health and life of the Inuit people and on the flora and fauna of the north."

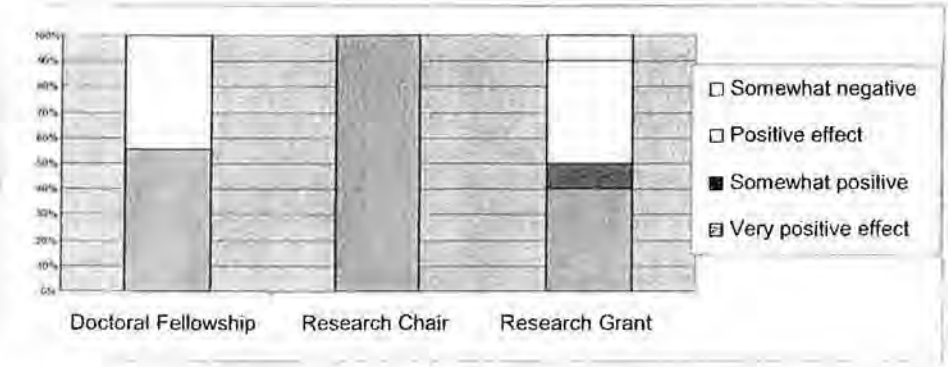

Figure 6. Overall Effect of ERP on Careers by Funding Category

Overall, a large number of respondents felt that the Eco-Research Program had a positive effect on their careers.

While Research Chairs were overwhelmingly positive in this regard, a small number of those receiving Research Grant funding rated it as somewhat negative.

Some of the positive reasons given were that the funds allowed them to concentrate on their research, enabled them to complete their studies more quickly, enabled expansion of their intellectual pursuits into other disciplines which made them more "rounded" scientists, and provided more rapid advancement up the academic ladder. Some negatives identified were the overhead of managing large projects, which was not recognized as academic achievement, and the continued lower recognition accorded to cross-disciplinary research.

"I credit the ERP with launching my career. My experience with the ERP has helped me to change institutions twice, to be on the boards of national and international committees and opened the door for my upper level participation in the world of ecosystem research; I completely correlate my career direction and success to my experience with and participation in the ERP."

"It allowed me to concentrate on my own project and not those of others; I was able to limit hours of teaching to those needed to develop teaching skills, get my research results, present them, improve my CV... It allowed me to go to conferences across the academic world, gave me ideas and approvals, etc"

"The ERP had an extremely positive effect. The fact that I am now [cross-appointed at the School of Environmental Studies and the Faculty of Law] demonstrates how the ERP allowed me to move more and more into social theory."

"The ERP was not positive for my career. I had to do too much complicated management and so was unable to publish adequately. I had to work hard to get people to communicate with each other on their part of the project."

4.3 Effect on Institutions / Organizations / Disciplines

4.3.1 Formation of Networks

A significant number of interviewees identified that the Eco-Research Program had resulted in the development of networks of researchers focused on particular topics.

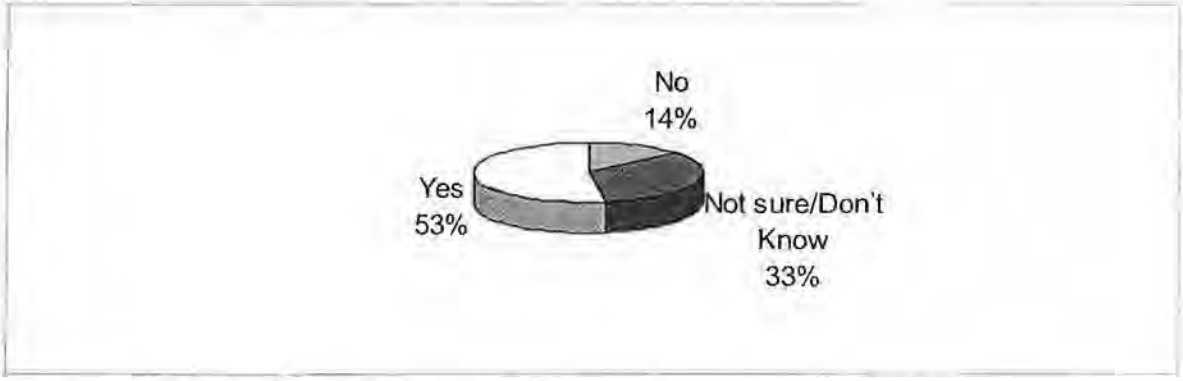

Figure 7. Formation of Networks of Researchers

"The ERP resulted in a large network of researchers who continue to keep in touch to this day. The connection between the natural sciences and the humanities, which was started with the ERP, is also seen as very important today, where it was not at the time."

"Today Rural Communities have a network of researchers at their service that span the gamut. of disciplines enabling stronger and more effective communication. Based on how the ERP was conducted, communities, the university, business, government and the individual disciplines within the universities are now connected in a way that never existed before the ERP."

"The whole development of the urban sustainability agenda including the involvement of the university itself has resulted from the ERP. UVic is restructuring its planning processes for the university itself. UVic will become a model of urban sustainability. There are lots of new students that are being attracted to the environmental law program and UVic itself as a result of this collaboration."

"The concept of community ecology did not exist before the ERP. Biology is now aware of the humanities for example. Also the impact on the mental health world has been very important because it forced the disciplines of health and the environment to come together and identified pathways to connect the health of the environment to human health."

"As part of the Faculty of Management, I have raised the interest of fellow faculty members in environmental issues and have brought in academics from the environmental sciences into management research."

"For certain it did at the time but it has not stood the test of time. Once the funded program was completed most of the contacts were lost and went back to doing their own thing."

"Not if you are at all restrictive in the definition of a network. There is a real network in BC but I was unable to create one after the Eco-Research money ran out. I did try to create a 'center of excellence' but there was no money."

Some of the topic areas around which networks formed included

- natural sciences and the humanities
- health and environment
- health, education and environment
- public administration and the environment
- human development
- social development and environment
- history and the environment
- philosophy and the environment

4.3.2 Partnerships

The Eco-Research Program also resulted in the creation of a number of partnerships. Sixty-five percent of respondents indicated that they were involved in partnerships of one kind or another.

These partnerships included a wide range of governmental organizations at municipal, provincial and federal levels, many non governmental and private sector organizations in Canada, aboriginal organizations, NGOs, conservation authorities, farmers and other private citizens, as well as a number of international organizations, such as the Centers for Disease Control (USA), the International Joint Commission, and the International Human Dimensions Program (IHDP) in the United Kingdom. Relatively few partnerships were developed with the private sector.

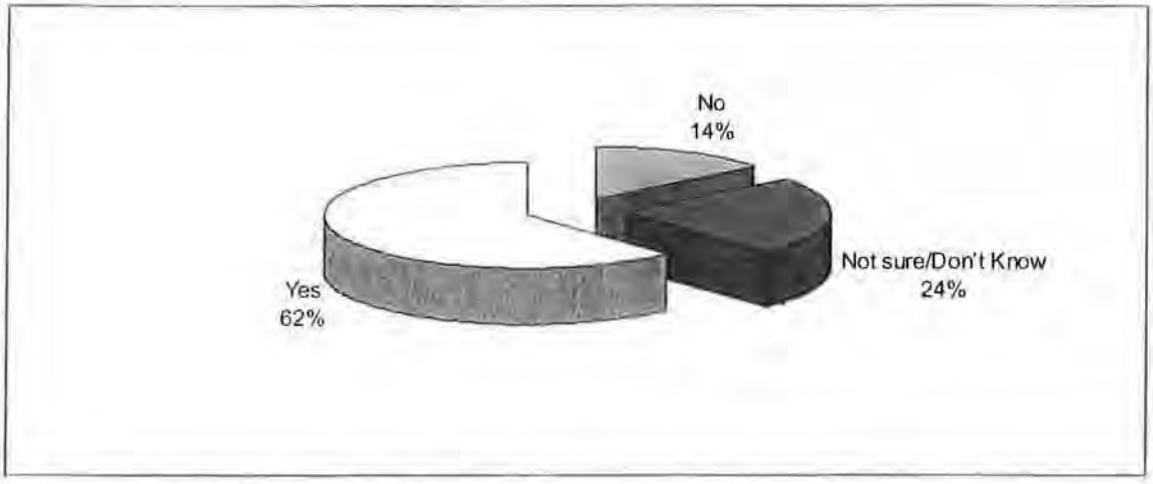

Figure 8. Formation of Partnerships

"If you include farmers and private citizens then the ERP resulted in the development of both public and private partnerships for the purpose of conducting research as they related to the projects being undertaken. Once the program ended, however, these partnerships dissolved."

"All our partnerships were comprised of public organizations. We did invite private organizations in the form of the fishing companies to participate but they declined. We assume

this was because they where threatened by what we might learn in our study and how it would effect them. The unions partnered with us, but not the businesses."

"Networks were formed around the local ecosystems, specifically within the region and local watershed. There was a diverse range of partners including the university and representatives from the conservation authority and private industry. There were also a number of municipal staff involved. The mayor was on the advisory committee as were a number of regional planners, and a person from the Canadian Centre for Land and Water."

"We had an Inuit Steering Committee for our Eco-Research project which advised not only on the logistical aspects of the research but also on orientation and issues, such as reorienting the study of impact from water to caribou. It was also in this project that a very long-term and still extant relationship was established with the municipality of Nunavik and its Nutrition and Health Committee. Relationships were also then established with national (and international) Inuit organizations and these relationships continue."

4.3.3 Private Sector Partners

Fifty percent of respondents indicated that they had private sector partners involved. However, as the graph below indicates, most respondents felt that these private sector organizations did not have much impact on the organization that received the funding, or on the research that was carried out.

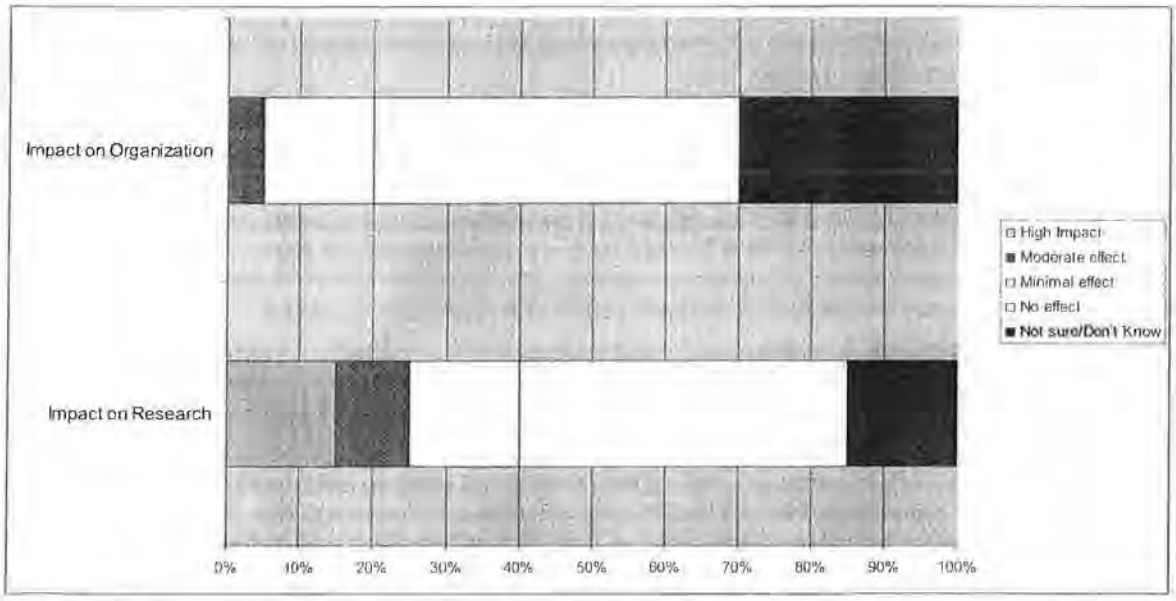

Figure 9. Effect of Private Sector Partners

Responses ranged from enthusiastic acceptance of private sector partners, to evidence of significant distrust of private sector values. Others were wary of the possible "refocusing" of their research by private sector partners. In some cases private sector firms were asked to participate, but declined. Some respondents indicated that working with private sector firms was refreshing, as it injected a note of reality into the research. At least one respondent indicated that the relationship led to a career opportunity in the private sector.

4.3.4 Cross-Disciplinary Partnerships

Seventy-five percent of respondents indicated that the partnerships that developed as a result of the ERP crossed academic disciplines. The diversity of disciplines that came together is noteworthy. It is also worth noting that, in most cases, the relationships were very complex, and the management challenges correspondingly greater because they were not simple one to one relationships, but many to many.

"Science, agriculture, health science, plant ecology and social sciences. Over the course of the program 29 graduate students completed the program, which facilitated much of the cross-discipline exchange. The cross-discipline focus was very purposeful and facilitated a very good exchange within the groupings. Though all the above listed areas where involved, the focus was generally within three groups: natural science (agriculture), social sciences / humanities and health sciences."

"Resource management, urban geography, hydrology... physical geography, economics, economic modelling"

"Absolutely. The entire ERP was about cross-disciplinary partnerships. We had active partnerships and participation from within the humanities, social sciences, health, education, sciences, and environmental studies. To this day, many of the networks and partnerships created as a result of the ERP remain in place today. Previous to the ERP cross-disciplinary study/partnerships where unheard of—the various disciplines did not speak the same language and tended to stay in their own worlds."

"As an academic in the Faculty of Management (itself a muti-disciplinary faculty), I have worked and continue to work with fellow researchers from sociology, geography, political sciences, environmental sciences and forestry sciences."

"1) Environmental studies—planning, biology, engineering and political science 2) Economics and sociology 3) Applied human health & biology 4) Rural planning school group—one rural watershed cooperated with Guelph 5) Engineering and political science—game theory and rational choice. Each one had their own contacts within the larger community."

"At first, when the funding was made available for research, the proposals funded appeared to be multidisciplinary but the research results were mostly from one discipline. Only the final analysis integrated the different disciplines of the environmental sciences, environmental engineering, human sciences, the economy together."

"Absolutely, at the organizational level. There were 7 different departments brought together under the ERP at UBC represented by 23 faculty and 60 graduate students. The primary departmental partnerships were with the Business School and Community and Public Health."

"Since the ERP the impact and success of cross-disciplinary partnerships has been significant and at least at Memorial University and the University of Victoria it has become a part of the research culture and there are programs that continue this methodology to this day. Again the disciplines we brought together under the umbrella of the ERP at Memorial included the social sciences, the [natural] sciences, humanities, health and education."

4.4 Overall Organizational Impact of Eco-Research Program

4.4.1 Impact of Funding on the Host Organizations

The respondents indicated that in many cases, the impact of Eco-Research Program funding was significant to their organizations. The following comments illustrate how these impacts were manifested.

"While the program funding was in place, it enabled the University to undertake new and different kinds of research by supporting individual graduate student research, which in turn created many new partnerships. It also brought a cross-disciplinary research strategy to the University that though not as strong as it could be, still continues today."

"I felt that there was a transient effect. There seemed to be some politics that came into it which complicated the situation. There was a tension between the veterinary school and the rest of campus because the vet school was a professional school not an 'academic' program."

"Working in cross-disciplinary fashion was very challenging to the university in the beginning. While the project was ongoing it forced the university to work differently and the notion permeated the rest of the school. When the funding was finished, working across disciplines was dropped. It is only just now that it is re-emerging. Today people are redeveloping this collaborative model. At the time I tried to push for a center or chair and nothing happened. However, the ideas have diffused out, now they are shifting and permeating in the campus. Now it is popular to break the silos. The Eco-Research Program was ahead of its time."

"The Eco-Research funding assured the start of the Institute of Environment and Health, which has continued to operate."

"The ERP raised the profile within the university of the validity of environmental research. It involved more people and demonstrated how what people do has an impact. It demonstrated that environmental research doesn't have to be hived off solely in environmental studies."

"The research was multi-disciplinary, this was new; it resulted in a new multi-disciplinary methodology for a multi-sectoral issue; partners were involved in all four of the case studies. As to funding, this was a major amount, which made the multi-disciplinary approach attractive to researchers. Not all have continued with this approach but many have, including the three post-docs."

"The ERP cost UVic a lot of money but it also brought in money. The ERP allowed us to bring in external funding which we estimate at almost $3 million to date. The university pays for my office space and salary. That money has enabled me to maintain average staff of 10 people on an on-going basis."

"Our project had many challenges. The ERP created jealousy and animosity in the department [Environment Canada]. The (government) scientists in the department badmouthed the program because they did not understand it. We realized we needed much more consultation with staff to gain acceptance. Many battles occurred over money. SSHRC wanted the social science perspective. Partners wanted to take money to fund their own programs. Our medical partner was angry."

It is evident from the responses that the Eco-Research Program funding opened up some major opportunities to promote cross-disciplinary research, and provided the environment in which some new and innovative research approaches could grow and flourish.

The graph below illustrates the overall assessment by respondents of the impact of the Eco-Research Program on their organization.

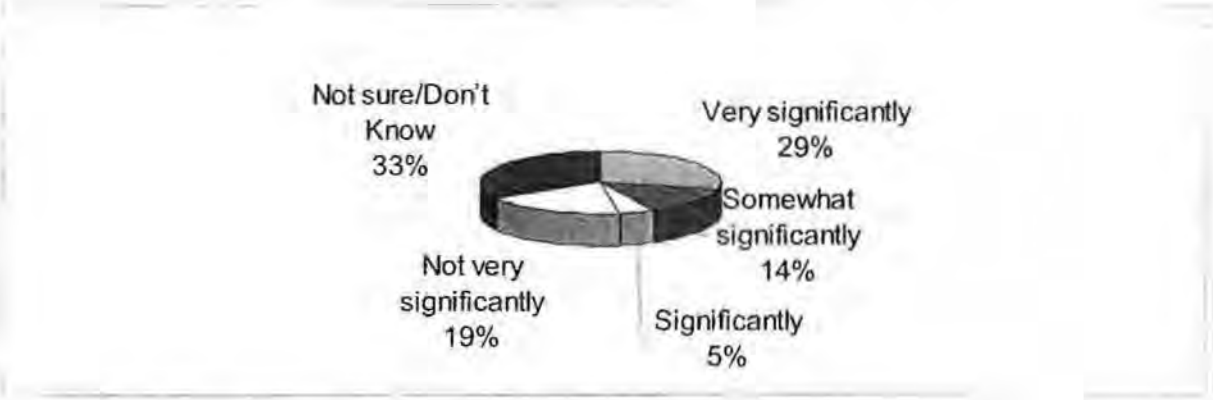

Figure 10. Overall Impact of ERP on the Host Organization

Responses to this question were mixed. One third of the respondents were not sure or did not know. In reviewing the comments, some factors emerge which might account for the overall mixed reviews.

The positive factors include:

1. Improved outreach from the institutions to the community to examine issues of real consequence to all
2. Funding available at a time of significant cutbacks to universities
3. Development of a new generation of researchers
4. Offering of courses which could not be offered prior to ERP
5. Major steps forward in making cross-disciplinary research legitimate
6. Raised profile of the organization as result of a large number of doctoral theses, publications and web sites

Negative factors include:

1. The loss of momentum once funding stopped
2. Relatively small amount of funding compared to the size of the institution

"At the time of the program the impact was significant. It facilitated the successful completion of 29 students' graduate studies and encouraged a strong interdisciplinary exchange. Once the program funding ended, however, everyone went back to their own 'worlds' and much of the inter-disciplinary exchanges have been disbanded."

"I am not aware of how the ERP affected the university."

"The most important impact was on the students—a new generation of researchers exposed to and involved in multidisciplinary research: 13 theses, 2 at the doctorate level in geography and chemistry."

"Funding came at a time of funding reduction to universities, and kept them alive."

"As a Doctoral Scholarships recipient, it enabled me to focus on my research and achieve my research goal which I view as very significant, but I don't know how it affected the university."

"Though the ERP was a high profile program, it was fairly small potatoes for the University as a whole. I think it had a positive influence on the units that where involved. A number of the involved faculty have carried on with research initiated by the ERP and there have been a number of new research projects built as a result of the ERP that where able to leverage funds as a result of having been awarded the funds through the ERP."

"I would say it opened the door for Memorial University to both the government and the community. It offered a new opportunity to get into outreach. It was really a win-win situation for everyone. The ERP launched the concept of real interdisciplinary study and it got very positive support for the University."

"There was an Eco-Research fellowship created at Memorial as a result of the ERP and the very visible University support sent a signal to all the departments that interdisciplinary research was a good idea. Also, Environmental Studies is now a field of research and study at Memorial which did not exist prior to the ERP."

"Perhaps there was some impact here at the Centre Eau et Terre de l'environnement, of which I am part (and I do consider that getting the Eco-Research doctoral grant helped me get openings and money elsewhere, because it was a sign of excellence)"

"I am not sure that the multidisciplinary approach has been able to make any more gains since the Eco-Research funding was stopped in 1998."

"We were pleased to have the ERP but the work dissolved when the project was over. In my estimate the long term impact was low with no time or resources to continue it."

"The ERP program has fundamentally changed UVic in many significant ways."

"As a result of the ERP we offered courses that were not offered previously. The Bay Area Restoration Association relocated their offices to the university and they are still there today. It was easier to cross boundaries with the public and private sectors than within the university."

4.5 Impact on Knowledge Transfer/ Dissemination

The respondents indicated that the impact of ERP on knowledge transfer and dissemination of environmental science information was important. Some 75% of respondents indicated that information dissemination was a significant aspect of their Eco-Research project

Some examples of these mechanisms included:

- 150+ publications and books (e.g. "The Resilient Outport)
- Academic conferences related to the environment, health, the economy
- Development of new academic journals and websites
- Publications in existing journals: Canadian Journal of Botany, Journal of Environmental Management, Great Lakes Research Review, Aqua Safety Net
- Annual open houses, displays, presentations
- Briefings to municipal planners
- 100+ presentations at conferences and symposiums

4.5.1 Training of Environmental Specialists

The Eco-Research Program clearly contributed to the training of environmental researchers, according to 85% of respondents. Particularly noteworthy is the large numbers of professors, graduate students and undergraduate students who received training that could not have been achieved through conventional educational approaches.

The Eco-Research Program was a unique training ground for today's environmental researchers.

> *"As a part of this project we trained a lot of grad students. There was significant money put into graduate students. We had 9 postdoctoral students over the 3 years. In total there were 11 PhD students and 7 Masters students on this initiative. These students were from diverse disciplines and backgrounds. I had to fight for and got them their own spot on campus. I felt that it was important that all graduate students were in the same room. This brought them together physically as well as intellectually."*
>
> *"Given that there were 99 students involved in our ERP, there was a definite opportunity to train environmental specialists. I would say our students were the first ever environmental specialists that thought about the human side of their research as well as the material and physical side. It changed the discipline all together and as a result of our program many well trained and very talented environmental specialists were launched into the world."*
>
> *"There were more than two dozen professors and students who worked on this project and we not only learned research skills in our own disciplines, but also learned other disciplines' research approaches and created multi-disciplinary tools."*

4.5.2 Impact on Policy Development

Close to 60% of respondents indicated that they felt that the Eco-Research Program had a positive effect on public policy development.

Some of the ways in which it contributed include:

1. Increased community capacity through the involvement of community members in the research
2. Development and issuance of new regulations and guidelines in a variety of areas such as forest harvesting, waste management, land-use planning, and resource management
3. Movement of Eco-Research Program researchers into positions of influence in public policy
4. Development of land trust arrangements
5. Impact on new initiative for cities
6. Changes in water policy regulations
7. Creating increased awareness of environmental issues in the public at large, to pave the way for policy initiatives

Some respondents had difficulty identifying how their work directly affected policy making.

4.5.3 Impact on Environmental Science as a Field

More than half of the respondents stated that the Eco-Research Program contributed to the establishment of environmental science as a legitimate field of study. It provided a means for the disciplines of the physical and social sciences to transcend the barriers to interaction which still exist in many areas. However, a number of respondents argued that it is incorrect to call environmental science a discipline, as this can lead to a lack of focus. Rather, research is done in the traditional disciplines, but with an environmental focus or agenda.

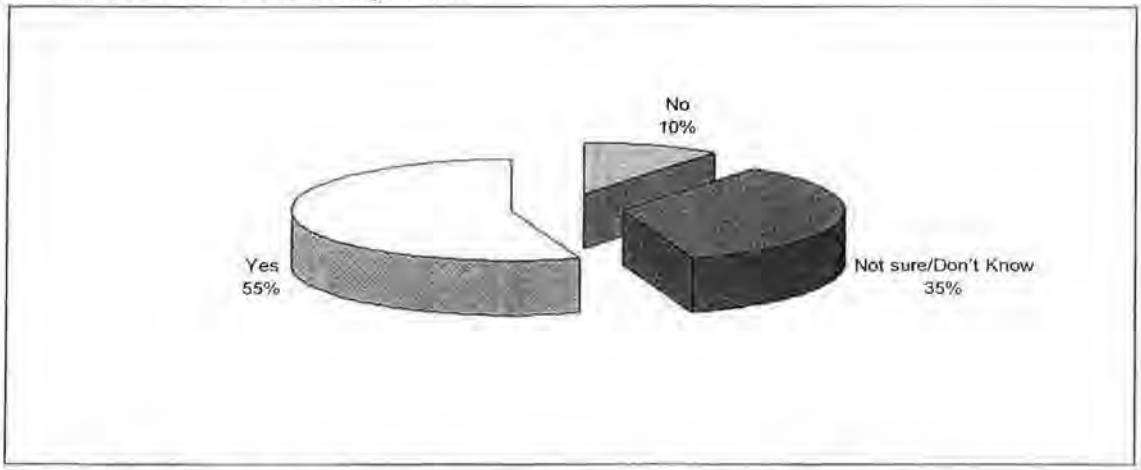

Figure 11. Contribution to Environmental Science as a Discipline

"The ERP has reshaped part of the environmental sciences. There is still a strong traditional presence, but there is now more openness to ideas from other disciplines."

"As an ERP doctoral scholarship recipient it is my opinion that the ability to conduct cross-disciplinary environmental research inevitably had an impact on environmental science as a discipline, though the actual impact is difficult to measure. My research also advanced a specific research technique which has been adopted and continues to be used today, but is exclusive to my particular area of study."

"ERP did have an impact on environmental science in the sense that it created a forum through which environmental science now includes the humanities and social sciences, which it did not prior to the ERP. I think it has made a significant impact in changing the perception that ecosystem research and environmental science need to include the humanities, and that there is a significant benefit to this paradigm shift in environmental research and study. Though there has been some significant movement forward, I still feel there is a long way to go."

"The ERP contributed to environmental studies and research as a whole, not specifically environmental science as a discipline. It broadened the definition. Environmental science is no longer bugs and chemicals (although it is still hard to convince Environment Canada of this)."

"SSHRC operates on the silo method. Environmental science can bridge the two worlds. We are all part of the natural world; we have created on top of that separate policy and social structures. We need to stop seeing the two as separate."

"My theoretical orientation in the discipline was fostered by ERP. I feel that the work has had an impact, but will have an even bigger impact in the future. I am beginning to move beyond environmental law towards ecological political economy."

4.6 Effect of Cross-Disciplinary Approach

4.6.1 Effect of Cross-Disciplinary Approach on Research Outcomes

A number of respondents felt they were already embarked on cross-disciplinary research, and the Eco-Research Program simply gave that approach more credibility. Some respondents cautioned that the choice of research mode should be driven by the demands of the particular research issue, and if the issues seem to require a multidisciplinary approach, then using such an approach will be beneficial to the research outcomes. However, if the approach is "cross-disciplinary for cross-disciplinarity's sake," then it is unlikely to succeed.

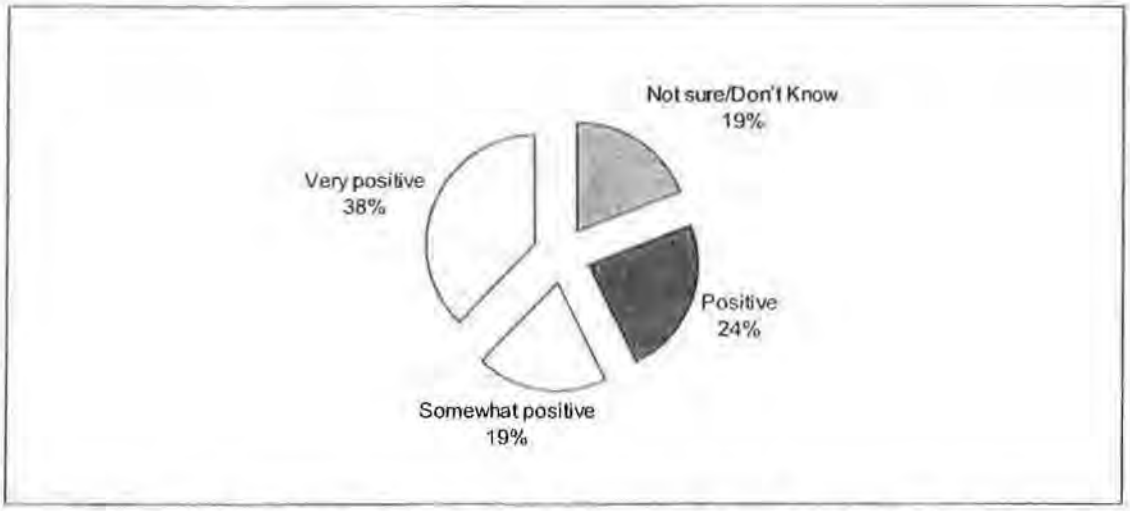

Figure 12. Effect of Cross-Disciplinary Approach on Research Outcomes

"The requirement of cross-disciplinarity brought an added dimension to the project because it prevented participants from working in isolation. The cross-disciplinary approach was very rewarding at the time of the ERP but it has not been sustained and lost its positive impact because the management of cross-disciplinary research became overwhelming."

"The nature of the doctoral research being conducted was already cross-disciplinary and was the path I was already on prior to being awarded the ERP. The requirements, though appropriate, did not change the nature or focus of my research, but it did promote what I was already doing giving more credibility to the cross-disciplinary approach in environmental science. I believe that all environmental science research should be cross-disciplinary and that there should be more programs like the ERP."

"It created the opportunity for people who would not have interacted with other disciplines to engage in debate. Traditionally it is very challenging to go outside of one's own discipline.

Within individual disciplines there is usually a 'language' and communication style that makes interacting outside of that discipline more complicated and frustrating."

"The entire premise of our program was that every aspect be interdisciplinary and I would not release funds unless the project demonstrated this. The research outcomes were completely impacted by the interdisciplinary approach. We did many surveys within the communities involved in our studies, for example, and every questionnaire was developed as a group effort, incorporating all the disciplines."

"My field of study by definition is multi-disciplinary (decision-making on garbage), but I am not at all sure that interdisciplinarity is making much progress in most university faculties, including my own (Public Affairs and Administration). Sometimes I think we are working to no avail."

"I am not a fan of interdisciplinary work the way that it is usually done. It is usually a forced and artificial fit. What I am interested in is the problem and then working towards bringing in the right cross-disciplinary people."

"I think that it is important to change the concept of collaboration where the cart is driving the horse—all research needs to be problem or issue driven. Otherwise cross-disciplinary work is just buzz words and politically correctness, and a waste of time and money."

In my experience social sciences are tagged on to projects and often the level of interaction is driven by personality. I wonder how do you build the capacity of the natural and applied scientists to work with social sciences? I feel that it is not getting systemically better, but there are individuals who can do it."

"We tracked and documented the increase in interaction and sharing among researchers. The ERP changed the dynamic of a number of different projects. The outcomes were not necessarily changed, but rather it was the way that the issues were approached and the research carried out that changed. There were certain negatives as the universities have yet to change anything in their approach to staffing and research, with faculties remaining focused on their narrowly defined disciplines, thus requiring multidisciplinary researchers to rewrite their work in an unidisciplinary way in order to be published and get credibility for tenure positions and advancement."

4.6.2 Effect of Cross-disciplinary Approach on Project Management

Many of the respondents found project management in a cross-disciplinary environment to be very challenging. The funding came with a requirement to employ a cross-disciplinary mode of research, so recipients had little choice in the matter. They were thus required to deal with a host of issues which conventional, unidisciplinary projects do not face, including multiple personal agendas and perspectives.

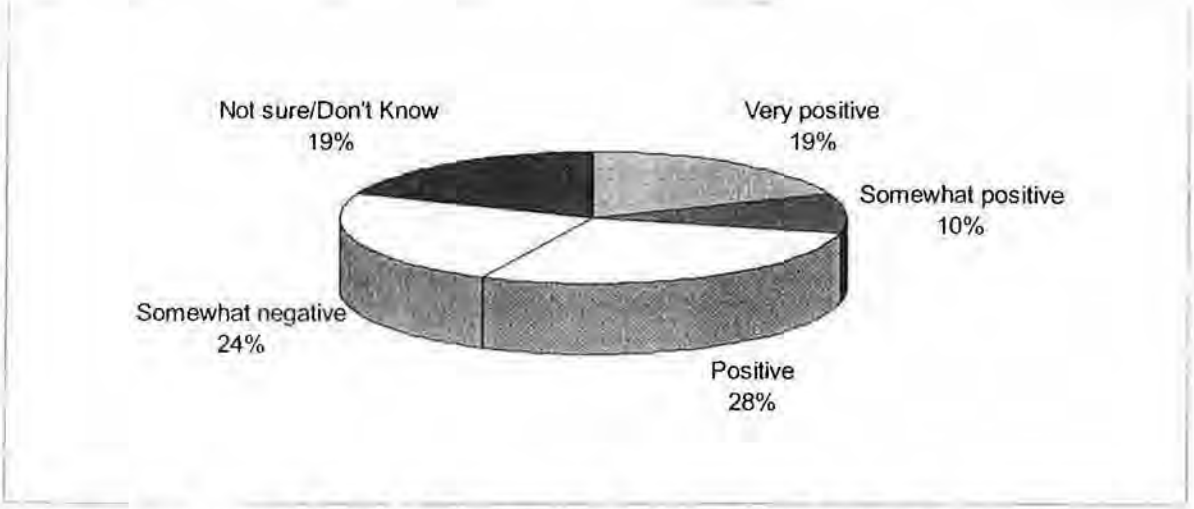

Figure 13. Impact of Cross-Disciplinary Research on Project Management

4.6.3 Sustainability of Cross-Disciplinary Research

Fully 90% of respondents indicated that cross-disciplinary research methods developed in the Eco-Research Program are still used today. Respondents have gone on to other projects, and used cross-disciplinary methods, or have employed graduates and trained them in cross-disciplinary methods.

The comments demonstrate a high level of commitment to the principles of cross-disciplinary research.

The degree to which cross-disciplinary research has been sustained within the organization, as opposed to the individual researcher, was less clear. A large number (over 50%) did not know because they had moved on from the original host organization and therefore were not in a position to judge. Of the remainder, 30% indicated yes, and 20% no. Some cited lack of funding for cross-disciplinary research as a reason for the failure to be sustainable, and others mentioned the conservative university culture.

"A cross-disciplinary approach has been sustained and expanded in my personal research and career path."

"In my research I have sustained a cross-disciplinary approach but I don't know about others in the project. Anything that I am involved with is cross-disciplinary, and brings in other people on campus."

"I am focused on building my own team of graduate students who I have trained to develop cross-disciplinary skills."

"As an individual the primary focus of my research and present work continues to be cross-disciplinary and would have been regardless of the ERP as it is fundamental to my research approach to this day."

4.7 Effect on Ability to Attract Further Funding

Sixty five percent of respondents indicated that ERP had a positive affect on their ability to attract further finding. Some of the reasons are identified in the comments received from recipients. In general, it had a significant positive impact on the legitimacy of research. funding as ERP awards were seen as prestigious and opened doors to other opportunities for a number of respondents.

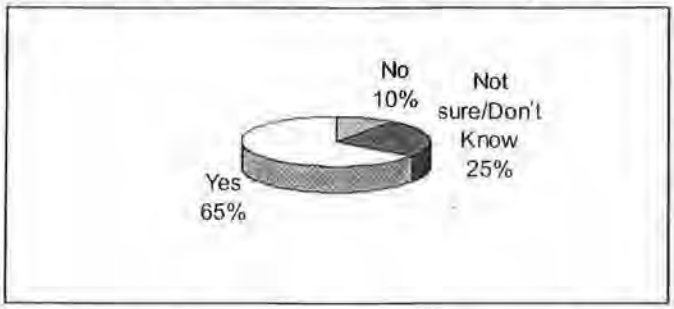

Figure 14. Effect on Ability to Attract Further Funding

"I did try to follow up from the ERP with other funding applications, but did not attain further interdisciplinary funds for the university. The University of Regina, however, was able to get SSHRC funds which I feel came as a result of having been granted the initial Eco-Research funding."

"The ERP was the first funding that emphasized an interdisciplinary approach. I learned how to communicate what I was doing in a cross-disciplinary forum. People doing applied research in environmental sciences are inherently interdisciplinary. This requires people to think out of the box. To be validated for thinking outside the box was a novel experience. It validated the existing approach."

"In this case just having the ERP on my resume has made an impact, especially on funding proposals. Having been awarded the ERP has given me more credibility when applying for other funds because the ERP is recognized as a prestigious award within the community. It did not, however, enhance my ability to apply for funding and I would recommend that there be programs created to assist PhD students with how to write a grant proposal and how to promote yourself when looking for a job, post PhD."

"The ERP at Memorial was a $1.25 million program. Today the Oceans Under Stress Program is a $6.2 million program, so yes I would say it is much easier to get funding in this area then it used to be. The primary issue is finding programs that will fund this type of research not our ability to get the funding."

"It helped get my post-doc in Austria and even getting into the Quebec government program that enables the universities to hire tenure-track positions."

"I feel that though I was not able to attain more funding, there were successful proposals made by the social sciences and health sciences participants that did receive funds likely as a result of having received ERP funding. Basically I feel that involvement in the ERP has had both a positive and negative effect on my ability to access research funding."

4.8 Changes to Institutional Barriers to Cross-Disciplinary Research

The most common response to the question of institutional barriers was that they did not know if ERP resulted in a reduction in institutional barriers to cross-disciplinary research. The Research Chairs in particular indicated that it had little effect.

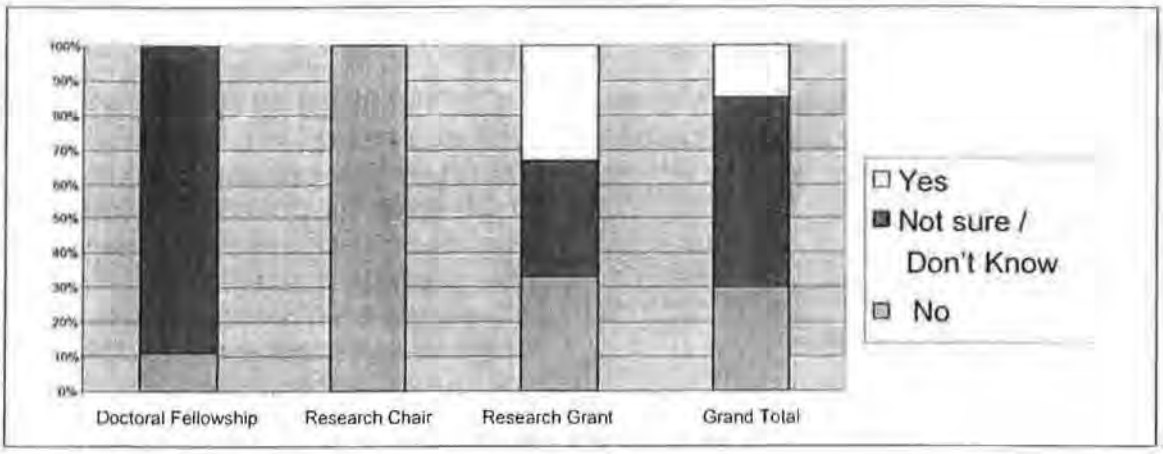

Figure 15. Barriers to Cross-Disciplinary Research

"I think cross-disciplinarity has been slow to catch on, and though it has been identified that the cross-disciplinary approach is important to strategic planning there is still a lot of opposition to it. I think it is acknowledged in public agencies that pay lip service to the idea, but do not practice it very well."

"The primary change I have seen is the opening up of the disciplines to cross-disciplinary graduate studies. The ERP demonstrated the effect of this at Memorial and UVic so there have certainly been barriers removed. Though there is still a lot that remains to be done in this area."

"I am not sure but yes, probably, because it has allowed young researchers to do multidisciplinary research that set them up professionally and academically. They now sit on research review boards, make presentations at conferences and thus influence multidisciplinary research to some extent. But I must also admit that I see no real opening of minds within the Canadian Association of Administrative Sciences in regard to multidisciplinary research."

"The ERP was not there long enough to result in any real deep change in the unidisciplinary focus of most research."

"There is a huge lack of understanding and receptivity within the natural sciences. The natural sciences are very individualistic with a general lack of interest in real life impact. For the natural sciences having an article in a refereed journal is assumed to be success, not policy impact."

"Barriers have not diminished despite the strong governmental support for multidisciplinary environmental research—the university faculties continue to be an obstacle to the development of young researchers. Faculties systematically refuse to grant tenured positions to excellent environmental researchers because they are not specialized enough in the 'home' discipline. I have stopped bringing young non-medical-doctor researchers into my faculty because they will never get a permanent position there."

4.9 Overall Impact of Program Components

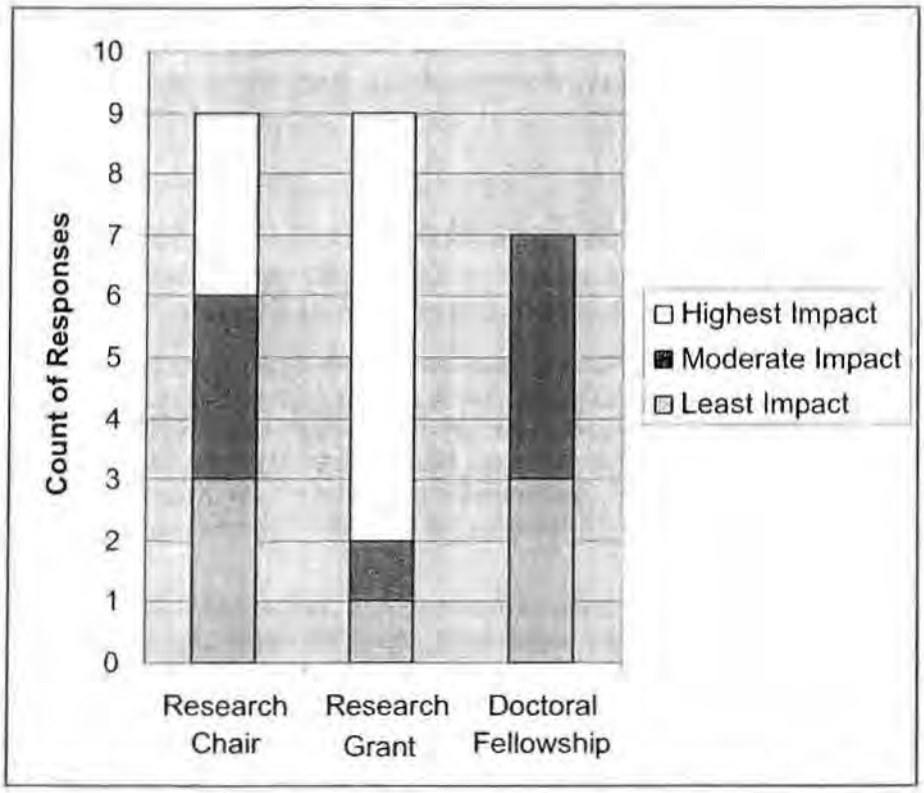

Figure 16. Overall Impact of Program Components

The chart above indicates that the respondents felt that the direct funding of a large research project provided the most positive impact on environmental research. Conversely, respondents felt that the doctoral fellowships had the least impact of all funding channels.

Some respondents pointed out that, if you want to make a significant change in the focus of an institution as a whole, then the Research Chair is unique in its potential to accomplish this goal. As well, the Chair provides a longer term approach and broader perspective. On the downside, some found the Chairs too political, detracting from the research focus.

However, if the goal is more and better research within the existing institutional structure, then the funding of research projects is regarded as the most effective method.

4.10 Future Directions

As a final question, the respondents were asked to provide advice as to how the government could support environmental research in the future. Much of the responses concerned funding, and the need to take a long-term view of research projects.

Long-Term Funding

Several interviewees stressed the need to provide long term funding for environmental research. They spoke about the complexity of the research and the fact that it could not be addressed in five-year funding cycles.

"Programs like the ERP should be continued and sustained for the long term. It seems to be the practice of Government to allocate funds to research projects and then pull the plug after a few years just when programs are getting established. Research is not a 'fiscal year end' thing and it happens time and time again that just as programs are getting a secure footing the funds and support from government go away. I feel the payback is huge if long term investments are made in research funding."

"Cutting the ERP and other environmental research funding has had a significant negative impact on environmental research. Some fundamental research (for example establishment the basic cycle of carbon when looking at carbon and climate change in the seas) is required for applied environmental research to be able to measure changes and solutions."

Dissemination / Knowledge Transfer

During the interviews there was broad agreement about the need to ensure that the research being conducted is relevant. Several people spoke about the need to be able to transfer the knowledge to policy and program development. This is particularly true for environmental research that has applicability to urban and rural spaces and human interface issues.

"Put more money in dissemination: create more scientific journals that will allow for greater dissemination of project results. Foster more non-academic dissemination, such as forum discussions in targeted communities or the private sector where new ideas about the environment can be exchanged."

"We need to extend the relationships between government science labs, the university labs, and the private labs in all disciplines. As a result of the ERP project there were people from Environment Canada, fisheries, agriculture, national defense, and natural resources working together. The researchers were able to have continuous interaction with all disciplines through horizontal linkages, not just within the government itself, but within the universities.

Support for Networks of Networks

There were a number of comments about the amount of environmental research that is being done without any mechanism to link researchers together. Several interviewees expressed the need for a network of networks

and mechanisms that would enable people to learn from one another and not duplicate effort—in particular in a climate where research funding is limited.

> *"Dollars are very persuasive for universities. There is still a hunger for research, which continues even without specific government funding. We need a national infrastructure that allows networks to talk with each other. There is inevitably a great deal of duplication of effort going on out there and we need to get people talking to each other face to face. Though the Internet is a useful tool it will never replace the benefits of forums and face to face interaction."*
>
> *"There is a desperate need to have a national body that brings all the ecosystem research and environmental organizations and agencies together under a universal umbrella to link our research together."*
>
> *"Encourage small teams and large networks; continue the Canadian Fund for Innovation, which supported the development of infrastructure such as instrumentation; also, more monies are needed for research assistants. As for research needs per se, there is in Canada a need to develop specific methodologies for multidisciplinary research on the environment."*

Support for the Development and Management of Cross-Disciplinary Research

Several respondents indicated that the key to cross-disciplinary research is to influence the universities as to its importance and efficacy. Most people described the challenges in working in such a way and the need to address those challenges in any new research program.

> *"More focus needs to be placed on cross-disciplinary work and there absolutely needs to be more funds allocated to facilitate cross-disciplinary work in the area of environmental research. There also needs to be a shift in focus to more broad based sustainable development and a greater social science perspective integrated into environmental science."*
>
> *"How do we bring together all the disciplines? There has to be some way to address policy and decision-making. Basic environmental sciences are solid; the gap is in the integrative work. We need a National Advisory mechanism with a 10 year mandate to look at complex environmental systems and develop a synthesis for earth science and life in the 21st Century. In Europe, they recognize the linkages between human health and the environment. Canadian universities and funding bodies are not equipped to look at it this way."*
>
> *"Programs that continue to promote cross-disciplinary research are fundamental to the enhancement and development of environmental sciences. Bringing people together in multi-disciplines has big advantages and we should encourage the re-birth of the ERP doctoral program."*

Role of Environment Canada

Several of the funding recipients and program administrators spoke about an increased role for Environment Canada should any new program be developed in the future. It was recognized that the peer review process was well managed by SSHRC. However there was some sense that the advisory role played by Environment Canada cut the program off from the policy and program issues it was meant to inform. In addition, several people spoke

about the need to take a more hands on role then the traditional role that SSHRC plays with academic research.

> *"Rebuild government science in Environment Canada. It was decimated at junior levels."*
>
> *"Environment Canada should take a lead role in the development and delivery of future programs like Eco-Research."*

Role of Partnerships

Partnerships were seen by many as effective mechanisms for research of this type. They bring in multiple players and their own networks and can be used effectively to disseminate results and build support for future research and policy options.

> *"In my experience the private sector enjoys and benefits from the involvement of partners. I bring in public and private sector partners as guest lecturers, which facilitates interaction. One of the things that happens when students leave the university is that their exposure to learning and research diminishes."*
>
> *"A cross-disciplinary, inter-sectoral approach allows the life-long learning philosophy to live. If researchers are isolated within institution they become distant to the real life, real working situations. By bringing the real world to institutions, everyone can tackle the issues in a mutually stimulating and beneficial manner. A cross-disciplinary, inter-sectoral approach also grounds the private and public sector in theory and research they may otherwise not have the opportunity to be enriched by."*

5 CONCLUSIONS AND LESSONS LEARNED

From the responses during the interviews, there can be little doubt that the Eco-Research Program had a significant effect on environmental research in Canada while it was in operation. Many of the residual effects, in terms of creating newly skilled researchers, and opening doors to the possibilities of new research partnerships and opportunities, were very significant.

However many of the issues that surfaced during the Workshop on Managing Cross-Disciplinary Research and during the Program Evaluation remain today and would need to be addressed in the design of any new program.

5.1 Conclusions

1. The need for a program, similar in design to the ERP continues to exist. The environmental problems that face Canada (and the world) are interlinked and will not be resolved without support to cross-disciplinary research.
2. The ERP had significant long-term impact on the careers of funding recipients, in particular the Chairs and the primary researchers of the research grants.
3. The ERP made a major contribution to the training of environmental researchers; many have gone on to careers in environmental research.
4. The ERP had a more limited impact on the field of study of environmental science, in particular because of its short time frame.
5. There were a number of partnerships and networks that emerged as a result of the ERP which continue today, most notably those that spanned disciplines. There were fewer successful partnerships with the private sector.
6. Cross-disciplinary research methods and approaches are viewed as important for environmental research. However, cross-disciplinarity must be used when the subject matter requires it and not as an end in itself. The cross-disciplinary research methods developed in the Eco- Research Program are still used today. Respondents have gone on to other projects, and used cross-disciplinary methods, or have employed graduates and trained them in cross-disciplinary methods.
7. Working across disciplines and teams presents considerable management challenges, which need to be taken into consideration when designing programs and grant applications.
8. The ERP had limited impact on host organizations with respect to support for cross-disciplinarity as opposed to unidisciplinarity.

5.2 Lessons Learned

Program Design

- Cross-disciplinary approaches to environmental research are important. However any follow-up program would need to clarify cross-disciplinarity as a means rather then an end.
- There is a need for a focused approach to the issues. One option might be to create an inventory of priority environmental research topics (after consultation with environmental leaders and researchers).

Knowledge Transfer and Dissemination Strategies

- The management of any successor to the ERP should pay particular attention to monitoring the actual research and its quality.
- A specific detailed strategy for knowledge management would need to be developed as a complement to any new funding. A portion of program funding should be devoted up front to the development of vehicles—web sites, journals, conferences, etc.—through which project results can be disseminated.
- The strategy would need to involve departments with policy and program mandates implicated in the funding.

Personnel and Capacity Building

- Support and better understanding of the challenges of the management of cross-disciplinarity approaches would need to be considered in the design of any follow-on program.
- The ERP provides some excellent experience in program design for cross-disciplinary research. This should be captured and made available to future funding recipients.

Partnerships and Networks

- More attention must be paid to supporting partnerships and networks and using them to disseminate results and communicate lessons learned.
- Specific outreach activities to the private sector promoting the benefits of partnering in research should be undertaken if partnering with the private sector is an aspect of a follow-up program.

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