Our Community, Our Health:

Dialogue Between Science and Community

International Joint Commission
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Dialogue Between Science and Community

A report on a workshop
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The concepts captured in this document reflect the views of workshop presenters and participants and do not necessarily represent the views of the International Joint Commission, the Science Advisory Board, or the Workgroup on Ecosystem Health.

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Summary and Recommendations

This report is based on a workshop sponsored by the Workgroup on Ecosystem Health, a committee of the **International Joint Commission's** Science Advisory Board. The workshop was called to explore ecosystem health issues from both the scientific and community points of view. Although the Workgroup on Ecosystem Health intends to broaden health concerns to the entire ecosystem, it recognized the necessity of beginning with human health so as to establish a fruitful interaction between community activists and cutting edge research scientists. Participants at the workshop included IJC Commissioners, scientists actively working in a range of environmental health areas, public health and other interested professionals, representatives of governments and industry, and representatives of environmental and community organizations actually engaged in participatory investigations.

Presentations at the workshop consisted of two plenary addresses, reports on community-based environmental health studies, and overviews of leading edge scientific research in the field. Participants also spent considerable time working in subgroups. The workshop closed with subgroup reports and plenary discussion.

Despite the apparently distinct subject matter, the subgroup reports overlapped significantly. This is an indication of both the interwoven nature of the issues and a high level of consensus on the problems. Despite significant value differences within subgroups, each ultimately was able to provide an uncompromising report, and discussion in plenary generally served to support and extend subgroup positions.

Given the degree of overlap and consensus, the following conclusions and recommendations are presented as workshop conclusions. Although a single set of conclusions and recommendations were not formally presented and accepted in plenary, the Ecosystem Workgroup believes the following to fairly represent areas of consensus.

Working together:

- We must support and promote the use of partnership processes for identifying problems, for finding and implementing solutions, and for evaluating effectiveness.
- Value positions must be in the open, acknowledged and respected for any multi-party process to work.
- Environmental decision making processes should accept and respect the concerns and experience of affected communities as valid.

The weight-of-evidence approach:

- The IJC's determination, in 1990 and 1992, using the weight-of-evidence approach, that persistent toxic substances should be virtually eliminated from the Great Lakes basin, is strongly supported.
- The weight-of-evidence concept needs clarification and development into a comprehensive, explicit process for environmental decision making.

The role of science:

- Scientists are encouraged to become involved in community-based health studies, in policy advisory committees, and in environmental advocacy.
- The IJC should facilitate the establishment of mechanisms by which "resource poor" organizations and interests can obtain scientific information on environmental health, referrals and direct assistance, particularly in dispute situations.
- Scientific education should include training in advocacy methods, cross-disciplinary and cross-sectoral teamwork, and a more holistic approach to data collection, analysis and interpretation.
- Environmental health studies should not be undertaken in a community without the community's explicit permission and involvement.
- Environmental health studies should encourage community participation and involve community members wherever possible in decision making.
- Environmental health studies should provide direct benefits to the community, including environmental health education, training, employment, quick feedback of study results, and assistance in developing strategies for community action to reduce or eliminate the effects of environmental stressors.
- The IJC should encourage harmonization in data collection so that data can be shared across broad spatial units.
- A binational inventory of data on the use, release and storage of hazardous substances in the basin should be developed.
- Pharmaceutical drug use patterns (eg. of antihistamines and asthma inhalers) should be investigated as potential bioindicators of community health status.

Inference across biological levels of organization:

- Our ability to draw inference from the very small (eg. molecular effects in individuals, and effects in single populations or communities), to the very large (clinical effects in individuals, and effects at the ecosystem level) needs further work.

- Of greatest importance are biological indicators of stress from hazardous substances which provide early warning of adverse effects. Research and development of these indicators needs to be supported, and regulatory criteria adjusted to the biomarker alarms rather than cancer deaths.
- We need to educate the general public about the importance, meaning and implications of biological indicators.
- Ecosystem-level indicators must be developed as well, to enable inference in the opposite direction, from the very large to the very small.

Communication:

- The recommendations of the IJC's Sixth Biennial Report (1992) are the substance of what needs to be communicated at this time.
- To be effective, the recommendations need target dates. Also, the IJC should encourage and facilitate communities, organizations and governments at all levels to review the Biennial Report, to excerpt, summarize, endorse and adopt the recommendations, as appropriate; and to communicate their endorsement to the two federal governments.
- While changes are needed at the individual lifestyle level for society to change course, these recommendations need to be communicated to and acted upon by legislators. Lifestyle changes alone cannot rectify the problems of polluted air, water, soil and food which require action at a community or governmental level.
- The IJC should take new initiatives to communicate its recommendations to a wider audience. This might involve presentations at major conferences and working more actively with the network of individuals and organizations already aware of the IJC's policy recommendations.

1. *Introduction*

1.1 Background

In 1990, the International Joint Commission (IJC or Commission) advised the American and Canadian federal governments that the health of children living in the Great Lakes basin, and the health of generations unborn, is threatened by exposure to persistent toxic substances.

Two years later, in its Sixth Biennial Report, the Commission repeated its warning, and recommended that the two governments adopt a "weight-of-evidence" approach to identify and virtually eliminate persistent toxic substances from the Great Lakes ecosystem.

The IJC was established in 1909 to provide principles and mechanisms for the resolution and prevention of disputes related to water along the entire U.S./Canadian border. Its most extensive responsibilities are under the terms of the Great Lakes Water Quality Agreement. Essentially, the Commission monitors and reports on progress made by the two governments as they try to implement their agreement.

Historically, the Commission has been guided by the scientific community. Working scientists are heavily represented on the Commission's Science Advisory Board, and it was scientific evidence that brought the Commission to its conclusion that human health in the Great Lakes basin is threatened by persistent toxic substances.

The first indicators of a threat to human health were numerous studies linking wildlife health problems to toxic substance exposure. Since humans are as much a part of the ecosystem as any other species, this conclusion was worrisome. Additional studies of small, high risk human groups people who eat a considerable quantity of Great Lakes fish, for example appeared to confirm these concerns. Taken separately, each study could be disputed. But taken together, the weight of evidence appeared indisputable.

The IJC's *formal* mandate is to pass on messages such as this to the Governments of the United States and Canada. But recently, the Commission has recognized that it also carries an informal mandate: to act as a locus for interventions from the public and activist groups who are concerned about health issues, particularly in the Great Lakes basin. Community groups are demanding that serious attention be paid to the impact of environmental factors on human health in their communities. They see the IJC as an advocate for health, both for themselves and for the ecosystem. They expect the IJC, science and government to respond with action.

And here there has been a double problem. Often, local communities have felt let down and even used by science. Some communities have been studied repeatedly, and despite evidence that the community feels is overwhelming an apparently high level of asthma among school children, for example science has generally found study results "inconclusive." Science, meanwhile, has study results from fish, bird and other wildlife populations, and from certain human populations as well, only to find that from a government and corporate viewpoint, their evidence is inconclusive or irrelevant to policymaking.

1.2 The Workshop

The workshop upon which this report is based was called to bridge the science-community gap. As Workgroup Co-chair Rosalie Bertell put it, "Science and community have different types of knowledge. If we put them together we will get much further than if we each work in an isolated way."

Specifically, the workshop had five goals:

1. To assist the Commissioners in advising the Parties regarding pertinent policies on ecosystem health;
2. To communicate the state of knowledge on ecosystem health, from both the scientific and community point of view, to the participants, to the Commissioners and to policy makers;
3. To bring leading edge developments in science to the non-scientist, community-based participants;
4. To bring the experience based expertise of community groups to the attention of research scientists; and,
5. To strengthen the IJC's informal mandate from the Great Lakes community.

> ***"This workshop puts us in touch with the cutting edge of scientific knowledge about ecosystem health, and with the practical knowledge of several human communities. In the past, science has often not listened well enough to community observations and concerns. We're trying here to set up linkages, not polarizations, linkages which help."***
>
> *Rosalie Bertell,*
> *Workgroup*
> *Co-chair*

The workshop opened with a series of presentations, summarized in the following chapter, from keynote speaker Pierre Béland, from community representatives, and from scientists. The presentations and associated discussions surfaced eleven critical issues. In discussion, the workshop participants determined which issues they would focus on, and grouped them under four themes:

- the problem of "proof" and the weight-of-evidence approach;
- the role of science;
- the problem of extrapolation and its obverse; that is, exploring implications of the very small (eg. molecular effects in individuals, and effects in single populations or communities), to the very large (clinical effects in individuals, and effects at the ecosystem level); and exploring the implications of observations at the ecosystem level for individuals, species, and communities; and,
- communications: How do we ensure that the message gets out and appropriate action is taken?

The participants then broke into four subgroups, each taking one of these broad issues. The subgroups worked for two hours on Day 1 of the workshop and continued their work on Day 2 after the second plenary presentation by John Jackson of Great Lakes United, a coalition of citizen and environmental groups. The workshop closed with an afternoon of subgroup reports and discussion.

Differences of opinion were apparent between scientists and community representatives, and over some issues among scientists. But as can be seen in the subgroup recommendations and discussion presented in Chapters 3 through 6, a remarkable level of consensus was achieved. To a degree, the subgroup reports overlapped, indicating that key concerns were shared. And when the reports were discussed in plenary, each was received and augmented in a manner consistent with each subgroup's intent.

"We have ignored the real contribution that an individual can make simply because he or she experiences the world directly through the senses. There is perhaps more truth in that than in all the scientific evidence we'll ever get."

Scientific participant

2. The Presentations

2.1 Keynote: Professor Pierre Béland

Pierre Béland is a biologist who for 20 years has studied the beluga whale population of the St. Lawrence estuary. His multi-disciplinary team has gradually moved from pathology to toxicology to population ecology, and finally to proactive public communications, in an attempt to get a substantive response from public authorities.

His presentation is a tale of plight, frustration and courage. Plight for the belugas, which his scientific studies have shown are sinks for virtually every compound used in the Great Lakes basin since the 1920s that is not biodegradable, and for the metabolites of some compounds that are. Frustration, that when science has shown clear links between contamination and health lesions, tumours, immune system effects, reproductive effects the sole response from government has been to mount an awareness program! And courage, for contravening the norms of the scientific world by going public.

The central lesson here is that science must go public, and that even so, results come hard. Béland's attempts to "build a public constituency" include writing public articles, bringing in TV networks from all over the world to cover the story, his own television series, lectures to students, a campaign asking people to adopt a specific whale, and the opening of a major interpretive centre:

> ***"At the basis of science is doubt. I think that is why we have such a problem getting our ideas across to the public. The public wants certainty. Scientists deal with hypotheses, doubt and "maybe." And science has no communications budget. The annual grants to university scientists in total is equivalent to a few minutes of prime time advertising."***
>
> *Pierre Béland*
> *St. Lawrence National*
> *Institute of Ecotoxicology*

"And after all that, ten years of science and ten years of public education, we find the public authorities running a public awareness program, which to us is unbelievable because everyone knows about the problem. The time now is for action."

Reflecting on his frustration, Béland makes a number of observations:

- Science is frequently first on the scene, but typically fails to get the message out.
- The bias in science has been toward experimental demonstration, but how could one ever put two groups of whales in captivity for 20 years, feeding one group contaminated food? Science must increase its acceptance of epidemiological evidence.

- Science, the public and policy makers must turn their concerns from the short term (for example, the cost of eliminating DDT) to the long term (persistent environmental costs).

Concluding, Béland made three general recommendations:

- Scientists must come forward, not only with what they know as scientists, but what they think as people with a great deal of experience: "In the sociopolitical arena, decision making is based as much on experience as knowledge. Scientists have a lot of experience, but generally they refrain from using it."
- To be effective, the scientist must broaden the picture, historically, spatially, and in every way possible. The beluga problem, for example, has been presented in a historic context: belugas have been documented as a part of native culture in the area for over 2,000 years, and are familiar in the daily life of Québec. As well, the beluga's problems have been systematically linked to contamination sources beyond the St. Lawrence estuary, to sources across the entire Great Lakes basin: "We must broaden not only how we look at things, but we must broaden our vision beyond our own little estuary, understanding that local conditions might be affected by things originating elsewhere."
- And finally, to be effective, when the scientist discovers a flag (in this case, the belugas), he or she must become a flag bearer: "An issue needs someone who goes upfront and sells the message. People want to relate their actions to someone, and scientists are not used to that. But someone has to do it."

Despite frustration, that is exactly what Pierre Béland has done. To the people of Québec, he is "Mr. Beluga."

A summary of the presentation by Professor Béland may be found in Appendix C-1.

"The evidence to us was overwhelming. We felt we should have no problem selling our message to those that make decisions. But no, we're still trying to convince the authorities that the problem is ubiquitous toxic contamination from the Great Lakes basin and the St. Lawrence River."

Pierre Béland
St. Lawrence National Institute of Ecotoxicology

2.2 *Plenary Address: John Jackson, Great Lakes United*

John Jackson's presentation, in large measure, is a plea for ethical behaviour. He calls for a vision of ecosystem health that goes beyond the physical, beyond our own species, and beyond the Great Lakes basin. He calls for a vision of ecosystem health that includes all life, the entire planet, and economic, social and spiritual well-being. And he calls for action.

Jackson emphasizes that the affluence of the advantaged may not be sustainable; that it may not be defensible, given that another third of the world lives in abject poverty; and that our "affluence" contains both a spiritual poverty and specific disadvantage for some individuals and communities.

And he decries "the end of nature." "Summer," he observes, "is extinct." And worse, we are beginning to accept each new encroachment on nature as normal.

Our society's illness is reflected in the illness of our climate. What is the source of that illness? Most significantly:

- our belief in endless growth, as a society, as an economy, and as individuals: "We believe our well-being is totally dependent on having more next year than we did last year";
- our belief that we are separate from nature; and,
- the breakdown of communities although Jackson notes that new communities, communities born of citizen group action, are emerging out of crisis.

"One of the fundamental things that must happen in this decade is the opening of corporate doors so that communities can participate in corporate decision making. And when business sits at the table, it must be willing to go beyond its own needs and think about the community's needs. I believe the community's needs should be paramount."

John Jackson
Great Lakes United

What do we need to do?

Jackson's first message here is the need for reorientation, for restructuring to ensure equity. This must be done in the economy, in our communities, and in decision making processes in government and industry. The latter, he suggests, may be the issue of the decade: "In this decade, we must encourage the private sector to open its doors. We now get more information, but the public must have input into fundamental corporate decisions."

Second, we must embrace restraint. Many chemicals should simply not be in production, and the vast quantities stored must be safely eliminated. As a society, and as individuals, we must embrace voluntary restraint. Consumer refusal to use certain products may have as great an impact as pressure to alter manufacturing processes and eliminate industrial releases.

> ***"I won't accept fish advisories and UV warnings as normal. My fear is that if we start talking about these things as normal, an even worse situation will become normal for future generations. The determination to keep these things from becoming normal is the driving force that will keep us all going and keep us working together."***
>
> *John Jackson*
> *Great Lakes United*

Third, the IJC and the science community must become active supporters of action in local communities: the IJC, scientists, activists and community residents must work together to heal our ecosystem. Such a partnership would be extremely effective in dealing with individual, concrete, ecosystem health problems. And it could push the agenda in new, creative directions. For example, we might work with several Remedial Action Plan communities, helping them do long-term planning and not just cleanup and prevention.

A summary of the address by John Jackson may be found in Appendix C-8.

2.3 East Toronto Health 2000 Participatory Health Study

Laura Jones, Toronto Board of Education
Karey Shinn, Safe Sewerage Committee Representative
Betty Vanderwater, South Riverdale Community Health Centre
Cathy Walshe, East End Health Centre

The residential community in the City of Toronto's east end is almost entirely ringed by non-residential development, including two expressways, a secondary lead smelter, a detergent factory, an experimental biomedical waste facility, large quantities of gasoline, oil and road salt, and up to 65 tonnes of chlorine stored for use at the nearby sewage treatment plant. Until recently the petroleum industry stored massive amounts of six dangerous products, and hundreds of chemicals are still used or stored in the area, including lead, mercury, asbestos, isocyanates and benzene. Efforts have been made to create new industries, but options are limited because the land is contaminated. To quote one presenter: "Our identity is more with expressways and industries than with anything else."

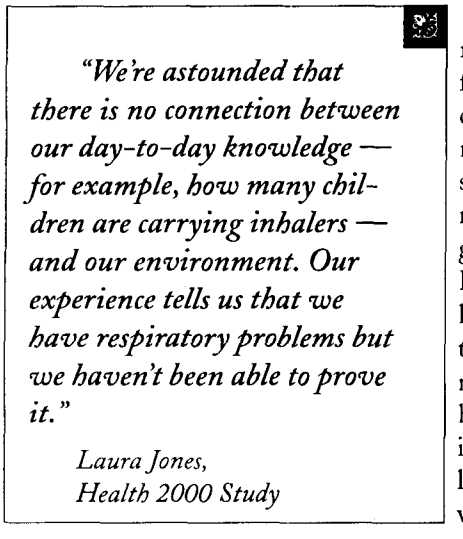
Over the years there have been fires, leaks and dumpings. In many places the soil is so contaminated it is considered to be at a low explosive level:

"Our problems are very complex. We have many different toxic substances in the air, water and soil. Few toxins are controlled by legislation, and we have had difficulty finding labs that can test for substances that worry us. There is little awareness of the impact of contaminated soil and house dust on our health... Recently there has been an increase in inspections and charges, but there is still a concern for health."

Health concerns go back well over a decade to public pressure over lead contamination: "It took us 15 years to get lead under control, and the reason we took on lead in the first place was that there was legislation for lead."

A major concern today is asthma, but this issue is more difficult because there are multiple sources of respiratory irritation. Past studies have been inconclusive, but to community workers the issue is evident in the unusual number of children carrying inhalers.

Environmental health problems have generated a high level of participation. Over a dozen environmental committees are working actively within the community, and community representatives have for ten years sat on a joint government/industry/community committee that deals monthly with complaints and spill reports.



"We're astounded that there is no connection between our day-to-day knowledge — for example, how many children are carrying inhalers — and our environment. Our experience tells us that we have respiratory problems but we haven't been able to prove it."

Laura Jones,
Health 2000 Study

The Health 2000 study emerged from a rejected request to the Minister of Health for health insurance data sorted by postal code. The objective was to develop a community health profile. The Minister responded that the existing data base could not provide that type of output, but suggested the community get in touch with Dr. Rosalie Bertell. Dr. Bertell's health survey had already been introduced in five countries, and appeared to meet the community's need to participate in planning for better health, while exploring better ways to intervene and promote health in the daily life of the community. One hopes the study will also be persuasive with policy makers.

In discussion following the presentation, Dr. Bertell emphasized that this is not an epidemiological study. Rather, it is more like a doctor's medical history prior to dealing with a complaint. It is a diagnostic tool for community health.

"We're trying to build an understanding of community health status. And also, this is a process. If we find the greatest community concern is respiratory disease, we can try to improve air quality and look for a reduction in the number of episodes... We're interested to see if we can improve health, rather than looking for problems after insult. We're saying, 'Let's improve this and see if we can improve health.' That's another way of seeing relationships. And we're interested in the community both entering into the decision of what's important and observing the improvement. That's how you modify behaviour."

To drive the study and maintain control, a steering committee was set up with representation from two local health centres, the local Member of Parliament's constituency office, Dr. Bertell's International Institute of Concern for Public Health, the school board, and an individual who is amember of or has contacts with a number of local environmental and residents' groups.

After a tremendous recruitment effort, including phone campaigns, mailings and door-to-door canvasing, 30 households were selected in each of three areas within the east end community. One area was a control, as far as possible from known hazards. A second was the area most subject to fallout from sewage sludge incineration. The third was exposed to contamination from multiple industrial sources. (Lead cleanup efforts have been undertaken repeatedly in this area.)

The criteria for family selection were a minimum five years' residency at the present address, parental age between 22 and 47, and one or more children five years of age or younger. These criteria proved hard to meet: "Young people move in, find out the local school has had the soil replaced several times, and they move out."

"We are a unique community, not because we live so close to industry, but because solving problems and community participation is so much a part of the neighbourhood."

Laura Jones
Health 2000 Study

Regardless, problems were overcome and data collection is almost complete. The next steps will be analysis of family data, soil testing, and feedback to participants and the community at a public meeting.

"The study will give us a very comprehensive picture of the quality of life within each household."

Cathy Walshe
Health 2000 Study

The questionnaire itself is completed by personal interview. It includes sections on demographics; medical, occupation, and residential history; lifestyle; male and female reproductive histories; birth histories (for each child); and individual child histories. In each section, a "tree" approach is used.

For example, if the respondent answered yes to heart disease, then the interviewer would move on to a detailed subsection on that subject.

Reflecting on the process so far, the speakers noted that the major difficulties have been the changing definition of contamination, high mobility, recruitment, and communications/trust problems arising out of language and culture differences.

On the other hand, it is now apparent that personal contact increases participation and the quality of information; participants were more comfortable if they knew the interviewer, if the interviewer was on staff at the community health centre, for example. In general, "The time required was enormous, but the disclosure by each family was equally enormous."

In discussion after the presentation, a scientist expressed some relief that the study will not be used to prove causality: "The study is too ambitious, it could easily be pulled apart. But I see now that it is not a traditional scientific study, but an aid to understanding the dynamics of a process. If you go in that direction, it will be a more powerful tool."

Nevertheless, one of the presenters emphasized the need for proof: "The authorities do say we need to prove we have problems." This speaks directly to both the weight-of-evidence approach, and the developments described in the subsequent scientific presentations.

> ***"The risk assessment process is set up for industry approval not community planning. The process includes test animals and human mortality statistics. This effectively eliminates living people as we are neither a test species nor are we yet dead."***
>
> *Karey Shinn*
> *Health 2000 Study*

> ***"As a nurse and non-resident, and coming from a rural community to assist with the study, I was struck by the number and severity of complex health problems. But I was not the only one who learned from the process. As a result of the study, the participants began to see their health in a more interconnected way, and in relation to the broader environment."***
>
> *Betty Vanderwater*
> *Health 2000 Study*

The First Environment Project
Katsi Cook

The Mohawk Nation at Akwesasne is located where the St. Lawrence River first meets the U.S./Canadian border, so as a community it has triple citizenship. Both projects described in this section are based in Akwesasne. The First Environment Project is American-funded; the Effects on Aboriginals from Great Lakes Environment (EAGLE) project described below is Canadian-funded.

The First Environment Project is now in its second year. But in fact, it is the latest in a series of studies conducted since the mid-1980s in response to mothers' concerns about the safety of their breastmilk. The first phase of the present project looked at breastmilk, cord and maternal blood, infant urine, and eating patterns. Over the next three years a second phase will look at men's blood.

In May of this year breastmilk study results were reported to a workshop for the first 167 sample providers, including controls. The research team was able to report to the mothers that the levels in breastmilk at Akwesasne are about the same and sometimes lower than the average in the Canadian/U.S. population in the Great Lakes basin. This was met with surprise and a measure of relief. Community members have been deeply concerned that environmental pollutants would rupture the intimate mother-child breastfeeding relationship: "At least we were able to reassure our mothers that it is safe to breastfeed, although to them any level in mothers' milk is unacceptable."

> ***"It is our relationships to the rest of the natural world that has kept our population as vigorous, strong and enduring as we've been over these past 500 years."***
>
> *Katsi Cook*
> *First Environment Project*

Akwesasne has been the centre of a storm of environmental health concern since the Cornell investigation of fluoride and mercury contamination in 1972. Repeated studies, and repeated advisories, have left the community concerned about their relationship with both wild foods and cultivated crops. This is a cultural issue. When the aboriginal link to the ecosystem is threatened, its culture is shaken to the roots. Fish, in particular, have been central to aboriginal culture: for example, fish and fish roe symbols often appear in prenatal dreams. And the research indicates that the only reason breastmilk levels are not higher is because traditional fish consumption has been greatly reduced.

But reduced fish consumption is not a satisfactory solution to a problem that is as much political and economic as it is nutritional. Other food sources are available at the supermarket but, to quote Katsi Cook, these "erode the sovereignty of our people, because it means a change in economic behaviour, going outside our community to earn the cash to buy other foods." And what is fish replaced with? High fat, high carbohydrate foods, since they are the least expensive.

The community's relationship to science has proven as problematic as diet change. Early studies were deeply disappointing, in part due to the limitations of science at the time. By the late '70s, the community realized it had to become more active in these issues:

"We were and continue to be frustrated by the limitations of the tools of science. But science changes very quickly, so we now have some hope."

Katsi Cook
First Environment Project

"But for me, involvement with authorities and scientists was a real risk. We've been the victims. To engage fully with science and the authorities to deal with serious issues has been difficult, although it has become easier over the years. So Maxine Caldwell and I and others are now working as interpreters between the scientific community and our own. It's a two way street. We're helping our community understand science, and we're also helping scientists have better respect and appreciation for our perspective."

Long range research plans include a retrospective examination of the older population, who have consumed large quantities of fish over their lifetimes; identification of indicators; and an effort to replicate a Massachusetts study suggesting a link between toxic material exposure and breast cancer.

The EAGLE Project
Maxine Caldwell

The EAGLE project, Effects on Aboriginals from the Great Lakes Environment, is also based in Akwesasne, but involves data collection in aboriginal communities throughout the Great Lakes. It is an environmental epidemiology study that takes a holistic approach to ecosystem and human health (as not only physical, but equally mental, emotional and spiritual); and in a very explicit way, it is a community-owned project.

The six-year project is a joint effort involving Health and Welfare Canada, the Assembly of First Nations, and First Nations communities, with funding provided by the Green Plan program. The project is now in its second year.

Phase 1 found that First Nations peoples in the basin are in a high exposure/high risk category. This conclusion was based on data from community members at open house meetings, at which community members spoke of their concerns and the impact that environmental contaminants have had on their lives. In the near future, additional meetings will be held to collect information of three types: information on community infrastructure, demographics, and political alliances, toward the preparation of community profiles; initial dietary information, toward preparation of detailed eating pattern profiles; and information on hunting, fishing, gathering and farming, toward a companion harvesting profile.

The EAGLE project arises out of the same rocky, community-science relationship described by Katsi Cook and the Health 2000 speakers. Maxine Caldwell emphasizes her people's frustration that science has been so limited. Questions abound. What happens to contaminants in sediment stirred up by Great Lakes shipping? What are we to make of increases in asthma, skin rashes after swimming, and decreases in wildlife and certain plant and tree species? Why is there no conclusive link between toxics and fish tumours, and why can't we make the link to human health?

People feel "studied to death," and they ask, "What's new about this one?" They have reacted negatively to invasive studies, and have been frustrated over delays in receiving feedback. As well, past scientific studies have suffered from lack of community input, cultural indifference on the part of the researchers, and the absence of a trust-building process between scientists and community.

The EAGLE project hopes to do better. It is an epidemiology project, but a holistic, community-controlled one. Perhaps because of those features, it has taken considerable time to build a science advisory committee for the project, and an appropriate epidemiologist has yet to be found. The traditional approach is not acceptable. An EAGLE epidemiology project will take the time needed to develop the project with the people involved, and this has been built into

> ***"Akwesasne means land where the partridge drum. The partridge don't drum there anymore. There aren't any. The species balance of fish has changed. There has been a decline in certain plant and tree species. People in the communities don't see why science can't make the link between environmental health and toxic contamination."***
>
> *Maxine Caldwell*
> *EAGLE Project*

the project's management structure. The science advisory committee brings recommendations to the project steering committee, which makes final decisions on project direction. The steering committee is comprised of First Nation chiefs and other First Nation people. All study data are community owned, and the steering committee determines who has access to that information.

The EAGLE project benefits from its long, six year time horizon, but Caldwell emphasized that time is needed to develop trust with the communities. Trust building may take many visits and considerable work by the four regional coordinators. Over the course of the project, the study team hopes to use and develop non-invasive data collection procedures (eg. the caffeine breath test), and better feedback methods so that communities are continuously updated.

Already, several lessons are apparent: all studies should provide continuous feedback; scientists must get out into the subject community and talk with many people, not just one contact person; and education is required to increase awareness at all levels: "With awareness will come knowledge that the environment does affect health."

In discussion following the two aboriginal presentations one scientist voiced strong support for efforts to develop good contact between the study community and scientists, as nothing less than "good science."

"Community partnership is the essence of this project. The communities are involved at all stages. They identify the problems, and it is the communities that will come up with the solutions. If the communities come up with the solutions they are more apt to participate in this or any other project."

Maxine Caldwell
EAGLE Project

Other issues raised in discussion are: how to set public policy and how to develop public risk communication in the face of uncertainty; whether the appropriate response to toxic contamination is protection at the individual/community level, or source control; and the value of community health studies as an organizing strategy. Each of these themes recurred later in the workshop, and will be discussed in subsequent chapters.

Following the community presentations, six brief talks provided a window on leading edge scientific research related to ecosystem health. Summaries prepared by the six presenters are included in Appendix C.

The six presentations deal with the following subjects:

- *Body burden measurement - Donald Tillitt, Ph.D.*
- *Fish and wildlife studies - Glen Fox*
- *Epidemiological considerations - John W. Frank, M.D.*
- *Reproductive effects - Sati Mazumdar, Ph.D.*
- *Developmental and Immunological effects - George Clark, Ph.D.*
- *Neurotoxicological effects - Brian Bush, Ph.D.*

Dr. Donald Tillitt opened with the observation that the concentration of many persistent organochlorine compounds in Great Lakes biota have declined exponentially since the 1960s, and that additional, substantial decreases are not expected for quite some time. However, many associated effects persist, suggesting that concentrations remain above the effect threshold for certain species, and that the classical monitoring approach, measuring chemical concentrations in the biota of interest, may be inadequate. Emerging techniques in biomonitoring (bioindicator methods) offer more promise.

Glen Fox followed with a discussion of the role of fish and wildlife species as early warning sentinels of population impacts and specific life-stage events. The molecular and cellular processes responsible for toxic manifestations are common to most species of vertebrates, including humans. In the past we have responded reactively to overt disease or disability; to be proactive, we must intervene early in the disability cycle by monitoring impairment of biochemical, physiological and behavioural responses. Fox also emphasized that although conditions are improving and gross manifestations of contaminant toxicity are observed infrequently, biochemical changes indicate sufficient amounts of contaminants such as PCBs in forage fish to influence the

> ***"The ultimate measure of our success in achieving the IJC's goal of the virtual elimination of persistent toxic contaminants will not be our attainment of some measured concentration calculated by a regulatory agency, but rather the absence of gross and subtle manifestations of toxicity and the restoration of a functionally healthy ecosystem."***
>
> *Glen Fox*
> *Canadian Wildlife Service*

physiology of herring gulls over much of the Great Lakes basin. Human beings, in general, appear more resistant to the effects of most chemical exposures and are less likely to be exposed than are most wildlife species. So indigenous fish and wildlife species under the greatest stress can serve as a worst-case scenarios for human health effects, and protection of the most sensitive indigenous species will protect human health as well.

Dr. John Frank then discussed the realities of classical epidemiology, outlining the appraisal criteria that must be met for an epidemiology study to conclusively infer an effect. He emphasized that classical epidemiology is "a very blunt tool" for use in exploring environmental health issues. For many reasons, such studies frequently generate "a very unconvincing demonstration of 'no effect'." Moreover, "The most tragic thing is that if you have a small group of people, epidemiology is tremendously hampered. Epidemiology is a prisoner of statistics." So if the traditional goal, inferring causation, remains the goal, classical epidemiology may have limited application in environmental health. If, on the other hand, the study goal is community empowerment, epidemiology studies may be valuable. The critical thing is that policy makers and the public, especially those involved in the study, know in advance the objectives, strengths and weaknesses of any proposed epidemiology study. Otherwise there will be disappointment.

In discussion following Dr. Frank's presentation, another epidemiologist added that epidemiology must be looked at with an ear to politics. For all the reasons Dr. Frank offered, negative study results are far the more common, and are often used to influence policy makers, who do not understand that a negative result is no test of safety. Also in this discussion, in response to a question from a participant regarding a paper he had written on eco-epidemiology, Glen Fox concurred that a single epidemiology study is not likely to be conclusive but by using traditional epidemiology criteria in a weight-of-evidence approach, it may be possible to infer causality. To this the questioner responded that, clearly, "there needs to be a better synthesis of the weight-of-evidence approach, traditional epidemiology and public health."

"Traditional epidemiology is a very blunt tool. Frequently, epidemiology will provide only a very unconvincing demonstration of 'no effect'... Policy makers and the public, especially those involved in the study, deserve to know in advance the objectives, strengths and weaknesses of any proposed epidemiology study. Otherwise, there will be disappointment."

John Frank,
Ontario Workers'
Compensation Institute

The following presentation, by Dr. Sati Mazumdar, outlined statistical research on reproductive success, identifying vulnerable sites for xenobiotic influence, and suggested

an approach for quantitative assessment of reproductive risks. Discussion following this presentation revolved around the ability of research to distinguish between the interruption of developmental chemistry by the toxicants, and the failure of conception.

This led directly to Dr. George Clark's presentation on developmental and immunological effects of exposure to 2,3,7,8-tetrachlorodibenzo-*p*-dioxin. His work suggests that the potency of dioxin and related compounds is strongly correlated with binding affinity to a protein, the Ah receptor. Effects include teratogenicity, carcinogenicity, immunotoxicity, and a variety of biochemical effects involving drug-metabolizing enzymes and growth factor pathways. Most if not all of these effects require binding to the Ah receptor. Experience indicates that there are great individual differences in human susceptibility to dioxin, and this may be due to variation in receptor number or receptor affinity. These individual differences may prove to be a significant confounder in epidemiology studies.

Dr. Brian Bush then discussed neurotoxicological effects of PCB exposure from an electrochemistry perspective. His in vitro toxicological studies implicate some PCB congeners as interferants with the important neurotransmitter, dopamine.

"The Ah receptor/PCB complex goes into the nucleus and binds with DNA. It actually causes different genes to be turned on and off. This is the mechanistic basis of how we get developmental effects."

George Clark
National Institute of Environmental Health Sciences

3. *Weight-of-evidence and the Problem of Proof*

The subgroup that took on this issue eventually redefined their task as *"Integrating Scientific Evidence, Community Testimony and Other Inputs into Environmental Policy Making."* While much of the subgroup's discussion did focus on technical problems with the weight-of-evidence approach, the discussion was at times emotional and difficult — as reflected in this new task definition, which clearly identifies the two quite different interests represented at the table.

Coming to agreement on recommendations took considerable time, and on reflection, the root challenge was reconciling divergent values. For example, "reverse onus" (onus to prove no harm) was a preeminent value for many of the community representatives at the table, while it presented problems for most of those with scientific training. The subgroup drew a general conclusion from this: value positions must be in the open, acknowledged and respected for any multi-party process to work. As can be seen in the recommendations, the subgroup's members did reach an accommodation even though differences remained, by openly discussing these value positions.

The core values issue in this subgroup was that the usual standard of proof in science often is not related to what communities think of as evidence; and while personal experience is considered valid at the community level, it has little weight as scientific evidence. This suggests that while it is admirable for the IJC to talk about the weight-of-evidence approach, the concept is not defined well enough and is handled differently by different people.

The subgroup also observed that the weight-of-evidence approach will have crucial implications for epidemiology. Studies that might otherwise be discounted as inconclusive or flawed may be viewed as disturbing when considered together with biological and ecological evidence. This situation is particularly evident in three areas of study:

- the study of developmental effects which appear early in life and then apparently disappear, but may be found later in some form with sufficient follow-up;
- the study of latent effects, effects that may take decades or generations to become evident;
- the study of persistent reservoirs of toxic contamination that are likely to have an impact not on this, but on future generations.

> ***"The weight-of-evidence approach needs work if it is to become an acceptable approach in the environmental field, or in any other field of policy."***
>
> *Subgroup presenter*

Subjects such as these appear to require a research approach that expands on epidemiology's limited ability to infer causation.

With these thoughts as preamble, the subgroup presented a set of formal recommendations, as follows:

Whereas the U.S. and Canadian governments have adopted an ecosystem approach to the Great Lakes basin, it is incumbent on the IJC to articulate a comprehensive and explicit framework for making policy decisions on environmental issues which

- accepts and respects the experience and concerns of affected communities as valid;
- encourages greater synthesis of scientific input by integrating biological, physical and social science, with ecological insights, in a clearly developed "weight-of-evidence" approach; and
- fosters social responsibility in science (eg. by providing accessible expert consultation to all interested parties).

In clarification of the first bullet above, the presenter emphasized that this is not merely a right to be heard but a fundamental respect for qualitative, community-based evidence. Social science acknowledges the validity of qualitative evidence, but this is rarely the case in environmental decision making at present.

With reference to the second bulleted item, examples of insights that should be considered include long-term consequences to various populations, human and non-human; and the consequences of ignoring equivocal evidence of a hazard that has persistence in the environment.

Discussion following the presentation raised the following points:

- One participant, a lawyer, pointed out that as used in law, weight-of-evidence is a *process* in which weights are assigned to different pieces and types of evidence, and then balanced on the scales of justice. *How* you assign weight is a provocative, but quite separate, discussion from this exploration of the weight-of-evidence process. The issue here is not what weight is assigned community evidence, or scientific evidence, but the simple fact that both are accepted as legitimate.

- Judgments as to the weight accorded depend to a great degree on the assessors' values. Community members at the work

"There is particular concern that expert scientists called to give testimony tend to synthesize evidence in ways that they may not make explicit. They, as all of us, are driven by their own values. We need to get those values laid out, get the assumptions and values up front, because they are always there, and they are critical in the way one synthesizes conflicting evidence."

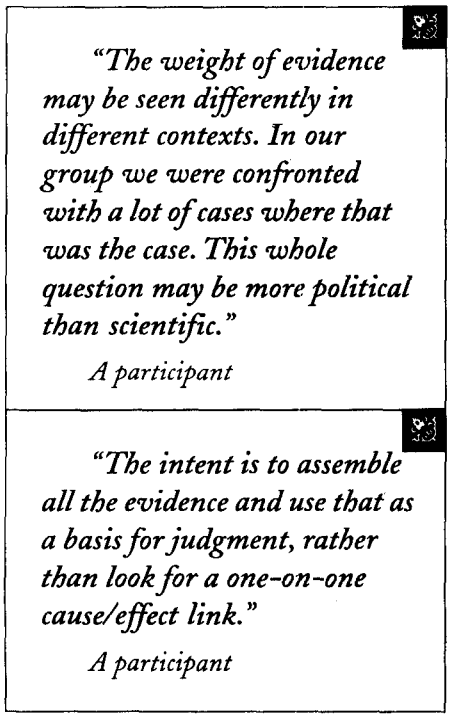
Subgroup presenter

shop provided numerous anecdotes illustrating how community evidence is effectively, albeit subtly, discounted perhaps as a case of NIMBY, unimportant because it is so predictable.

• Using weight-of-evidence as a process, a weight would be assigned to scientific, community, economic and any other information. The order in which different kinds of evidence are considered was discussed at length in the subgroup, without agreement, except that costs must be considered at some point for the process to be credible. In plenary discussion, one participant pointed out that we should think in terms of economics, not costs, because in the long view the economic implications of many decisions will be positive.

• Some participants noted also that the weight-of-evidence approach may involve making a judgment of total weight, without assigning any particular value to each separate piece; and that the weight-of-evidence approach can be used in the science sphere alone.

• In any case, it is evident that it is not easy to see what is going into each side of the scale, and how the scale balances. The balance may depend on context as well. For example, the weight-of-evidence may be seen differently in a neighbourhood's fight against an incinerator than it would in policy formulation.



"The weight of evidence may be seen differently in different contexts. In our group we were confronted with a lot of cases where that was the case. This whole question may be more political than scientific."

A participant

"The intent is to assemble all the evidence and use that as a basis for judgment, rather than look for a one-on-one cause/effect link."

A participant

• One participant suggested that the debate here is over synthesis, and that the understanding of synthesis is at the core of debates about "new science." In his view, "new science" moves beyond the traditional science of confirmation of proof (which, incidentally, is built into the legal system), to a more holistic approach which, not incidentally, is closer to the aboriginal perspective.

• This reference to the legal system prompted the observation that, for the most part, the weight-of-evidence approach lacks a forum: "We have legal, legislative, municipal, provincial and federal systems. In theory they provide opportunities to present your case. But in practice it doesn't work out that way."

4. The Role of Science

Recommendations from the role of science subgroup:

1. That scientists be more involved in technical advisory and science advisory committees addressing community and policy decisions;

2. That the IJC promote mechanisms for resolving disputes on environmental matters (eg. policies, issues, proposals), mechanisms that provide equal scientific opportunities and resources to each "side" to prepare its case;

3. That the IJC encourage the establishment of mechanisms through which "resource poor" organizations and interests can derive hypotheses and obtain the scientific resources to have them refined and tested;

4. That the IJC seek a diversity of scientific opinions from a diversity of scientific disciplines;
5. That scientific education include training in advocacy methods, team approaches, and the limitations of science generally, that scientists be more prepared to deal with issues in a larger way, in a new approach to science;

6. That community empowerment be promoted by the science/ research community, by:
   - providing assistance in identification of problems and hypotheses;
   - allowing and encouraging community participation; including community input to budget preparation, the communication of results, and the reporting/publishing of data; and by employing community members where possible in the actual study.

7. That scientists recognize community ownership of the epidemiologic, public health and ecological aspects of studies, and when possible provide immediate, direct and appropriate benefits, such as education, health, financial return and scientific training and that this concept be included formally in grants, contracts and Remedial Action Plans;

8. That the IJC assist the Parties to standardize (harmonize) data collection on ecological health so that data on key parameters can be shared across broad spatial units.

> ***"Community participation gives you better access to information and better results."***
>
> *Scientific participant*

Discussion

Values differences played a significant role in this subgroup as well, both between scientists and community representatives and among scientists. As the reporter put it, there were differences between "systems scientists and lay scientists and the hard line bench folks," particularly around the validity and bias of data. On another level, a subgroup member commented that she was "astounded how much people in this subgroup assumed that adversarial positions would be taken (when science and community interact), rather than assuming that the parties that could effect a solution would sit down together and try to work things out from stage one."

Plenary discussion following the presentation was dominated by the recommendation that "immediate, direct, and appropriate benefits" for communities be built into projects. A subgroup member clarified the recommendation by example: In a native setting, researchers might employ native people to collect data and recruit study participants, and community participants might be trained to do some lab work on-site.

Being compact, with a clear leadership structure and good cohesion, native communities tend to be easier to work with, but the subgroup recommendation was intended to apply to any community. This was supported in plenary. One participant took the south side of Chicago as an alternative example: "Do the people doing the study come in as outsiders with a subject-object relationship to the community, or are they adding resources to the community, are they educating the community and empowering it, in the process? Community participation gives you better access to information and better results."

"In practice, science comes in and says, 'This is what we're going to do.' There is no opportunity for the community to be, not only the subject, but also an active participant. And frequently, a native community doesn't have the strength to say 'Get lost'. It's over the barrel."

Community participant

Statements such as these prompted another participant to emphasize that science should not be in a community at all without the community's invitation and/or approval. A subgroup member responded that community permission was taken as a given. But aboriginal participants pointed out that however much it may be a given at the workshop, communities are frequently mistreated by scientists. As a result, scientists sometimes get poor results. By not listening, they can collect the wrong data (eg. testing wild food from locations not used) or spend large sums collecting data that would be more accurately and easily acquired with community assistance.

5. *Inference Across Levels of Biological Organization*

The issues facing this subgroup proved the most problematic of the four areas explored. How can inference be drawn from the very small (eg. molecular effects in individuals, and effects in single populations or communities), to the very large (clinical effects in individuals, and effects at the ecosystem level)? And conversely, how can observations at the ecosystem level be used to predict or explain effects at the community, individual or molecular level?

The subgroup prefaced its recommendations with several observations. First, the inference process will be facilitated by early problem definition, whether through community involvement or biological indicators. It is vital these both be recognized as valid indicators of stress. Second, solution development and implementation will be facilitated by partnerships involving all affected parties and a full sharing of information. And third, there needs to be some mechanism to evaluate inferences of this nature.

Recommendations:

1. Governments must officially recognize biological indicators of stress from hazardous substances which provide early warning of adverse effects on any component of the ecosystem.
2. Research and development for biological indicators must be supported. In particular, we must look for indicators of
   - specific modes of action (Since toxicology can tell us what sort of effects to expect given a certain mode of action, mode-of-action; indicators will be very useful in prediction.);
   - chemical specific indicators (These may be less useful, because we frequently are faced with mixtures, but many existing indicators of this type do work well with mixtures.);
   - indicators that tie early effects to community effects (This will require long-term studies.).
3. We need to educate the general public about the importance, meaning and implications of biological indicators.
4. We must promote understanding and adoption of a holistic concept of the ecosystem by the Parties; adoption of this concept is a prerequisite for any real action.
5. We must recognize community concerns as an indicator of ecosystem

"Governments must officially recognize biological indicators of stress which provide early warning of adverse effects on any component of the ecosystem."

Subgroup presenter

stress: "If the community is that upset, then we must acknowledge it as stressed."

6. We must support and promote full partnerships for the identification of problems, solution remediation, and evaluation of effectiveness. These include:
   - vertical partnerships (from senior governments down to the community);
   - horizontal partnerships (across communities);
   - more holistic, circular arrangements where everyone, particularly affected communities, is at the table from the start.
7. We must support and promote development of a binational inventory of data on the use, release and storage of hazardous substances. This is partially in place in the United States, and is being developed in Canada.

Discussion

Debate following this subgroup report centred on whether the effects of a toxic contaminant are typically felt first at the individual organism level, or whether effects may be manifested at the ecosystem level without first being evident among individual organisms. The subgroup presented the "individual organism first" perspective as the "general and common" wisdom, and suggested that toxic chemicals move through the system as follows:

- initial entry into an organism; possible identification in tissue by molecular chemist;
- physiological effect: primary biochemical effects related to the chemical's mode of action;
- cellular lesion, or other biological abnormality, leading to a health or reproductive effect and/or death, but still at the individual level;
- population effects (effects at this point transcend the individual);
- community effects, if enough populations are affected;
- ecosystem effects, if enough communities are affected.

"We have to find a way that the average person can relate the concept of biological indicators to his or her own life. For me it's like going to the doctor and getting a blood test. If we want to move beyond dead bodies and extinct species we need a widespread understanding of the indicators themselves."

Scientific participant

Two ecologists strongly questioned the assumption that effects are always seen in this order. One argued that his data show that ecosystem effects can be seen prior to effects in individuals. For example, he suggested that food web reorganization can be seen that has not yet affected the health of individuals directly, but is evidence that the food web is not as richly connected as it used to be.

Disagreeing, the presenter responded, "If we knew what early indicator to measure, we would have seen it... The stress will be reflected in some biological response in the individual before it ever gets to the ecosystem."

To which the dissenter responded with another example: The Oak Ridge Laboratory, he reports, has investigated effects near a lead smelter. The lab failed to see effects affecting the health of individuals, populations or communities, but they discovered that the system as a whole became nitrogen leaking.

Which prompted the comment, "If we had sensitive ecosystem measures I could accept that."

Clearly, the problem of inference in both directions across the levels of biological organization will be a major theme in ecosystem health for years to come.

"Since toxicology can tell us what sort of effects to expect given a certain mode of action, indicators of mode of action will be very useful in prediction."

Subgroup presenter

6. *Communication*

This subgroup began its work by listing all the issues its members felt needed to be communicated. After filling four sheets, someone observed that every point was contained in eight of the thirteen recommendations of the IJC's Sixth Biennial Report in 1992. A quick poll revealed that only a third of the subgroup were familiar with that report, and fewer had read it. Lack of familiarity with existing recommendations, and lack of action, thence became the focus of discussion.

The eight IJC recommendations referred to are as follows:

The Commission recommends that:

1. the parties adopt and apply a weight-of-evidence approach to the identification and virtual elimination of persistent toxic substances.
2. the Parties expand the definition of persistent toxic substances to encompass all toxic substances:
   - with a half-life in any medium water, air, sediment, soil or biota of greater than eight weeks, as well as
   - those toxic substances that bioaccumulate in the tissue of living organisms.
3. the Parties sunset PCBs and seek public acceptance of the means to effect their destruction.
4. the Parties sunset DDT, dieldrin, toxaphene, mirex and hexachlorobenzene and, in particular, seek an international ban on their production, use, storage and disposal.
5. the Parties, in consultation with industry and other affected interests, alter production processes and feedstock chemicals so that dioxin, furan and hexachlorobenzene no longer result as byproducts.
6. the Parties review the use and disposal practices for lead and mercury, and sunset their use wherever possible.
7. the Parties, in consultation with industry and other affected interests, develop timetables to sunset the use of chlorine and chlorine-containing compounds as industrial feedstocks and that the means of reducing or eliminating other uses be examined.

• • •

10. the Parties, in cooperation with Great Lakes jurisdictions, develop and implement educational programs that incorporate the Great Lakes and ecosystem considerations into existing curricula and educational programs at all age levels.

The communication subgroup observed that these recommendations are an excellent blueprint for action but that little has been done with them. The subgroup recommended wider distribution, and a concerted effort to secure endorsements from individuals, communities and governments. Also, the subgroup recommended that the IJC add target dates to these recommendations. In their view, both endorsements and a specific timetable are necessary if we are to see action.

"The recommendations in the IJC's Sixth Biennial Report are a blueprint for action. But they need target dates, and they need to be endorsed by communities, organizations and the various levels of government."

Subgroup reporter

The subgroup also made specific recommendations to the two federal governments, to science, and to the Workgroup on Ecosystem Health, as follows.

Recommendations to the two federal governments:

- The eight IJC recommendations should be incorporated into the public health planning process.
- While changes are needed at the individual lifestyle level for society to change course, these recommendations need to be communicated to and acted upon by legislators.
- The emphasis should be less on economic impact, and more on community health.

Recommendations to scientists:

- Scientists should become more involved and more willing to take on media exposure: "We need more Mr. Belugas."
- Scientists should define health issues more holistically.
- Scientists should work more closely with subject communities.
- Scientific expertise should be made more available to the public, in part by providing access to existing directories and networks.

"We need more Mr. Belugas. Science should be more visibly involved. It needs more media exposure."

Subgroup reporter

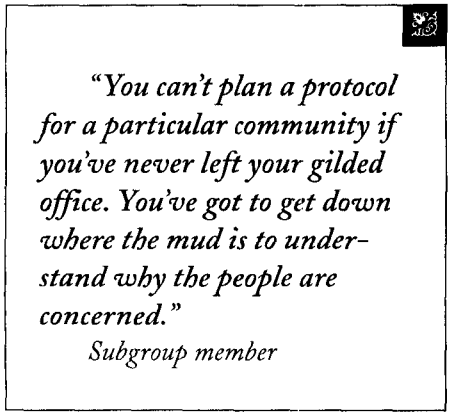
Recommendations to the IJC Workgroup on Ecosystem Health:

- The Workgroup should call on the SAB to seek endorsement of the IJC recommendations by key stakeholder communities, such as recent immigrants from cultures in which fish and fishing are important, native American communities, anglers, and parents.
- The Workgroup should encourage technological innovation by showing the cost of inaction; and by encouraging behavioural changes at the individual level which reduce demand for environmentally unfriendly products.

Discussion

This closing discussion of the workshop focused almost entirely on the role of the IJC in communications and promotion. While the IJC was heartily complimented for its quick response to requests for publications, the clear consensus was that too few people and institutions know about the IJC, its publications, and its recommendations. The result is that endorsements are not made and feedback is not received. As one participant put it, "I know the IJC is bound to give advice to the Parties, but somewhere in the process there needs to be a loop whereby the communities and the scientists involved in developing the recommendations have an opportunity to say something, both to the Parties telling them to get on with the process and to the IJC when the Parties aren't doing the job."

At this point a participant, medical doctor Robert Soderstrom, reported his work in securing endorsements of the Sixth Biennial Report Recommendations, first by his local medical association, the Genesee County Medical Society, and then by the Michigan State Medical Society. He encouraged the workshop's participants to review the report and to work with local groups and communities to endorse it, and to make those endorsements known.



"You can't plan a protocol for a particular community if you've never left your gilded office. You've got to get down where the mud is to understand why the people are concerned."

Subgroup member

IJC Commissioner Durnil then observed that Dr. Soderstrom won these endorsements in large measure by abstracting relevant material from the IJC report and putting it in physician's language. He encouraged other groups to take the same route: excerpt, abbreviate, and emphasize those portions they find most applicable to their own communities.

Three other recommendations were made in the ensuing discussion, methods by which the IJC can raise the visibility of, and secure endorsements for, its publications and recommendations:

- Make presentations at major, national conventions, such as the annual meeting of the American Public Health Association. By making contact with national associations, and by using conventions to speak directly to their membership, the IJC could reach a tremendous audience.
- Encourage the network of individuals and organizations already aware of the IJC (the IJC network) to activity participate in the distribution of publications, the securing of endorsements, and expansion of the network.
- Provide an IJC staffer as endorsement coordinator. The coordinator would promote the notion of endorsement and be a link between groups considering endorsements.

Just as discussion closed, questions about the public role of scientists resurfaced once again. As the reader will have observed, the notion that science should work with and in community, and that more scientists should be campaigning for action, was a common thread in many of the speakers' presentations, and in all of the subgroup reports. As the workshop closed, both enthusiasm and anxiety surfaced in bold relief.

One scientist wondered aloud, "Does community involvement compromise scientific objectivity? One reason scientists hide in their labs is not because they are shy, but because objectivity is really very fragile."

Another scientist added that it's not a question of getting out of the lab and really communicating with communities: "I don't think that is the issue. The issue is media exposure. If you are a media activist for the environmental side, your research is in question. The problem is remaining neutral so you are not perceived as being biased."

These clearly are profound professional concerns. But the weight of opinion at this workshop was clearly for movement toward public involvement. "Scientists as pop stars," one person mused. "Maybe Commissioners could be pop stars too!" On that note, the workshop adjourned.

"Scientists as pop stars? There is something very deep in the anxiety that communities have about what is happening. Are we asking scientists to act as secular priests calming community fears?"

Scientific participant

7. *Additional Issues*

This closing chapter focuses on issues, observations and suggestions that arose in presentations and discussions, often repeatedly, but seemed more appropriately presented in a separate chapter.

Source control vs. changes in personal behaviour:

This issue was brought up on at least five occasions, with voices on both sides of the issue. The example that ran through the workshop had to do with aluminum foil. In his keynote address, Dr. Béland mentioned that one toxic contaminant found in belugas is benzo(a)pyrene, and that the primary source quite certainly is Alcan's nearby aluminum plant. So do we convince or require Alcan to eliminate the compound from releases, or do we dramatically reduce demand for aluminum, in part by convincing individuals to stop using aluminum foil?

Another, more difficult example was provided by an aboriginal speaker. As a result of reduced fish consumption, mothers' breastmilk in Akwesasne is now considered safe. But the price is a cultural stress, reduced economic sovereignty (having to leave the community to earn cash for purchased substitutes), and nutritional problems as the low income community substitutes low cost, high fat/high carbohydrate foods. And as a scientist mentioned in discussion following a scientific presentation, he is not sure that more expensive domestic meats would be an improvement over wild food, given the chemical nature of agriculture.

So individual action may be of some value in the short term, but as a community participant from Toronto said, "You can't escape." Clearly, the pragmatic short-term tactic is both source control and individual behaviour change. But the IJC position, that the weight-of-evidence points to a policy of virtual elimination, appears the most reasonable long-term strategy.

> *"Perhaps putting a lot of energy into reducing point sources is less important than lifestyle changes to eliminate demand for undesirable products."*
>
> *A participant*

> *"The question should not be how to avoid the problem — what measures you can take as an individual. The question is how to get at the source."*
>
> *Another participant*

Proof in community health studies:

As was explained by epidemiologist John Frank, epidemiology is extremely limited in its ability to infer causation in small populations. Perhaps for this reason, two of the three community health studies reported are not epidemiology studies. They are health surveys which are attempting to identify possible sources of contamination, enabling individuals and the community to take action directly. Direct action might involve eating less fish, using bottled water, or finding an alternative site for a daycare centre.

This relates to the issue discussed above: these are expedient short term solutions. However, to drive external change, communities have found they need "hard proof." While health survey data may be enough to motivate action at the community level, quite a different type of proof is required for source controls to be put in place. The IJC's support for the weight-of-evidence approach notwithstanding, this is the present reality.

Drug use patterns as bioindicators:

So as one tactic, why not examine pharmacy and health plan records, looking for patterns in the use of inhalers and over-the-counter antihistamines? These may be useful as bioindicators of respiratory stress. This suggestion, made by a community representative from Toronto, prompted considerable supportive discussion.

Two American participants observed that drug use patterns might be derived from U.S. data. One suggested that another useful indicator might be L-dopa, prescribed for Parkinson's disease. The other noted that good data might be available from the Medicaid program (for the poor) and the Medicare program (for the elderly). These two groups, she added, may be early indicators since they are higher risk communities.

Another participant noted that a health study is being conducted in Ontario using random samples from every public health unit in the province. The data are now in and will be compiled in a publicly accessible data base. As well, she reported that several new atlases based on hospital discharge data are now available, and are accessible by postal code. In her view, "These are not on the mark yet, but they are bringing us closer to being able to indicate the health status of a population and zero in on places that have a higher incidence of asthma, cancer or congenital abnormalities."

"If we don't have a policy of zero discharge you have to prove harm. All our work is for nothing unless there is hard data to back up our experience. Analysis of drug distribution could give us that... We should know where asthma drugs are being used at unusual levels."

Community participant

A scientific resource and referral centre:

This idea arose in discussion following each of the community presentations. Both the East Toronto and aboriginal representatives spoke of problems with access to information, expertise, and testing facilities. One community representative added that business could use an environmentally oriented, scientific resource and referral centre as well in the design of more environmentally appropriate products.

Risk communication:

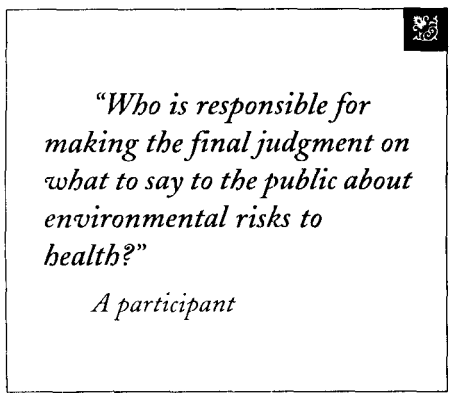
An interesting exchange following the Akwesasne presentations highlighted several subtle issues in risk communication. One person commented that mixed messages in public communication are often rooted in the ecosystem's very real complexity: "People want simple answers, but cause and effect are not clear."

Easy for science to say, said another, "but scientists too want certainty when they are affected personally."

This prompted a practical question (which was not answered), and a practical suggestion. The question is, simply, who is responsible for making the final judgment on what to say to the public? The suggestion was that perhaps we are mixing the specific with the general. The pharmacological approach is to provide general information and warnings to people with specific conditions. An analogous approach in environmental health would provide general advisories, augmented for local conditions as necessary.

Using eels as contaminant sinks:

Pierre Béland encouraged the workshop participants to take a broad view, to examine all possibilities, and by way of example, he talked about eels. His research team has found that fully half of the beluga population's contaminant load of mirex (and by inference, a substantial proportion of other toxic compounds) comes from eating migrating Great Lakes eels. In a two-week period once a year, the eels pass down the St. Lawrence estuary to the Atlantic and the whales eat them: "If eels are so effective at collecting toxic compounds, why don't we pay fishermen to catch them as a clean-up operation?"



"Who is responsible for making the final judgment on what to say to the public about environmental risks to health?"

A participant

Our Community, Our Health
A Dialogue Between Science and Community

An Ecosystem Health Workshop
Sheraton Inn, Ann Arbor, Michigan
September 14-15, 1992

Sponsored by the Workgroup on Ecosystem Health of the
International Joint Commission's Great Lakes Science Advisory Board

Workshop Goals

1. To assist the Commissioners in advising the Parties regarding pertinent policies on ecosystem health;

2. To communicate the state of knowledge on ecosystem health, from both the scientific and community point of view, to the participants, to the Commissioners and to policy makers;

3. To bring leading edge developments in science to the non-scientist, community-based participants;

4. To develop linkage between the scientific and local communities so that the two interests empower each other;

5. To strengthen the IJC's informal mandate from the Great Lakes community.

Monday, September 14, 1992

8:30 Rosalie Bertell, Ph.D., Moderator
Welcome and description of the International Joint Commission's formal and informal mandates - Gordon K. Durnil, Chairman, United States Section
8:40 Welcome and presentation of the role of the workshop and its sponsoring Workgroup -Dr. Bertell
9:00 Ecosystem Health Address - Professor Pierre Béland
9:30 Discussion
9:40 Break

10:00 June Fessenden MacDonald, Ph.D., Moderator
First Community Presentation:
The East Toronto Health 2000 Participatory Health Study -
Ms. Laura Jones, Ms. Karey Shinn, Ms. Betty Vanderwater and Ms. Kathe Walshe
10:30 Discussion
10:50 Second Community Presentation:
Akwesasne Mohawk Health Project -
Ms. Maxine Caldwell and Ms. Katsi Cook
11:20 Discussion
11:40 Lunch
1:00 George H. Lambert, M.D., Moderator
Science Panel
Body burden measurement - Donald Tillitt, Ph.D.
Fish and wildlife studies - Glen Fox
Epidemiological considerations - John W. Frank, M.D.
Reproductive effects - Sati Mazumdar, Ph.D.
Developmental and Immunological effects -
George Clark, Ph.D.
Neurotoxicological effects - Brian Bush, Ph.D.
2:40 Break
3:00 Mr. Jeff Solway, Facilitator
Discernment of four key issues and assignment into four breakout groups.
3:45 Subgroup meetings - Mr. Dave Best, Dr. Ross H. Hall, Ms. Laurie Montour and Dr. Milagros S. Simmons, Facilitators
6:00 Social hour and dinner
After dinner: Continuation of breakout group meetings, if necessary.

Tuesday, September 15, 1992

8:30 Timothy F.H. Allen, Ph.D., Moderator
Healing our Ecosystem - John Jackson, Great Lakes United
9:30 Discussion
10:00 Break
10:15 Continuation of subgroup work
12:00 Lunch
1:30 Mr. Anthony M. Friend, Moderator
Two subgroup reports with discussion
2:30 Break
2:45 Two subgroup reports with discussion
3:45 Mr. Friend, Moderator
Integrating discussion
4:30 Adjournment

Appendix B: Workshop Participants

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Appendix C: Presenters' Summaries

C-1: *Closing the Gap Between Science and Effective Ecosystem Protection*

Pierre Béland
St. Lawrence National Institute of Ecotoxicology
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There is generally a wide gap between science and environmental protection, as scientific facts and opinion on a given environmental issue are established long before they are translated into policy and action. This results in part from the very nature of the scientific process, and from the distance that exists between scientists and the "outside" world of interest groups, policy makers, the media and the public. The present sense of urgency regarding planetary ecosystems requires that scientists re-examine some basic methodological concepts, and attempt to close the communication gap.

The case of beluga whales in the St. Lawrence estuary will be used to illustrate some elements of this process. In ten years, this mammal population has moved from oblivion to the status of an international environmental symbol. This resulted from simultaneous efforts at carrying out a sound scientific study while making its results available to the community at large. Multidisciplinarity and the involvement of scientists from various institutions and regions were essential ingredients. They allowed linking local findings to the regional and continental picture, both important in forming a scientific opinion and in shaping a public awareness programme. Initial concerns regarding the presence of toxic compounds and severe lesions in the whale tissues were, in a step-by-step process, eventually linked to various other aspects of the biology of the species. This process allowed one to derive a broad picture of the status of the population, as well as to relate it to regional and continental concerns. It is this broad picture, and the translation of the scientific facts into a language that, while remaining true, is understood by the public and policy makers, that can make the difference.

However, the study has shown, as with many environmental issues, how elusive the definitive scientific proof can be, even in the face of exceptional findings. Reliance on a rigid scientific procedure has been used by governments and industry as their rationale for delaying action, with compounding effects from the innate reluctance of bureaucracies to move, and from the scope of the problem. Not unexpectedly, their recent response has been to initiate a public awareness programme, at a time when everyone else was already well aware of the problem. Science issues within government circles are necessarily tainted by the political process, and without a strong private sector in science to counter-

balance government science, scientists involved in environmental protection issues must ever keep pounding on with more facts and more communications to the public in order to build their own constituency.

C-2: *Contaminant Burdens in Great Lakes Biota*

Donald E. Tillitt, National Fisheries Contaminant Research Center
U.S. Fish and Wildlife Service, Columbia, Missouri

The concentrations of persistent organochlorine compounds in Great Lakes biota have declined since their peak in the 1960s. The decreases have followed an exponential decline and are near or at an asymptote, and therefore are not expected to decrease substantially for quite some time. The problem, however, is that many of the associated effects have persisted. This means that in certain species the concentrations of the contaminants are still above a threshold for effect. My discussion today will focus on both classical and new trends in biomonitoring efforts for environmental contaminants and their potential effects. The classical technique has been to measure chemical concentrations in the biota of interest. The new techniques in biomonitoring are directed at bioindicator methods which assess complex mixtures of contaminants, in place pollutants, and measures of ecological structure and function.

C-3: *The Value of Fish and Wildlife as Indicators of Ecosystem Health in the Great Lakes basin*

Glen A. Fox, Wildlife Toxicology and Surveys Branch
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As integrators of exposure, fish and wildlife species are extremely useful for providing us with information on the types, characteristics, and amounts of pollutants present in the environment. More importantly, they can indicate the effects of the broad range of chemicals in the environment on health, acting as early-warning sentinels of population impacts and specific life- stage events. Such an integrated response to environmental mixtures of chemicals is difficult to estimate from laboratory animal studies involving single chemicals.

The effects of contaminants on Great Lakes fish and wildlife populations are difficult to separate from the effects of habitat alteration, exploitation, introduction of exotic species, and changes in food supply, and most adverse population effects will be associated with multiple factors. To protect health we must protect the individual from those contributing factors we can identify.

Although there are interspecific differences in anatomy, metabolism and organ function, the molecular and cellular processes responsible for toxic pathophysiological manifestations are common to most species of vertebrates and are relevant to both wildlife and humans. Humans are at the top of the food web and accumulate the same spectrum of contaminants as wildlife species.

At least 14 species in the Great Lakes basin have experienced reproductive or other problems and/or population declines in the past 20 years that have been attributed to chemical contaminants. The list includes two mammals, nine species of birds, one reptile and at least two fish species.

In biological monitoring we assess stress, health (or homeostasis), and disease. Measures of impairment are more sensitive to contaminant effects than are measures of disability. In the past we have managed the Great Lakes ecosystem in a reactive fashion, responding to overt disease/disabilities such as mortality, population declines and extirpations, reproductive abnormalities, deformities, tumours and other gross manifestations of homeostatic failure in fish and wildlife. To be proactive, we must intervene early in the disability cycle. Monitoring impairment of biochemical, physiological and behavioural responses will clearly provide early warning of the onset of disabilities and provide a clearer understanding of the mechanisms by which health is impaired. The detection of such impairment will permit early, cost-effective and appropriate remedial action.

Manifestations of reproductive and developmental toxicity have been observed in 10 species of fish-eating birds, two mammals, the snapping turtle, and two fish. In birds, these manifestations have been most prevalent and have occurred in the most species in locations heavily contaminated with PCBs and related compounds, particularly Lake Ontario, Saginaw Bay and Green Bay. Young with crossed beaks and other malformations continue to be found.

Our pathophysiological studies suggest that although conditions are improving and gross manifestations of contaminant toxicity are observed infrequently, biochemical changes such as mixed function oxidase induction, deregulation of heme biosynthesis, disruption of retinoid homeostasis and hypothyroxinemia indicate the presence of sufficient amounts of contaminants such as PCBs in forage fish to influence the physiology of herring gulls over much of the Great Lakes basin.

Experience and logic suggest that human beings are, in general, more resistant to the effects of most chemical exposures and are less likely to be exposed to most chemicals of concern than are most wildlife species. Therefore indigenous fish and wildlife are the species under greatest stress in the Great Lakes basin and thus serve as a worst-case scenario for human health

effects. Protection of the most sensitive indigenous species will protect human health as well.

The driving force for cleaning up the Great Lakes is the need to eliminate all manifestations of toxicity. Toxicity is the integrated BIOLOGICAL response to exposure to the host of chemicals in an organism's environment and cannot be assessed by merely identifying and quantifying these chemicals in various environmental media. The ultimate measure of our success in achieving the IJC's goal of "virtual elimination" of persistent toxic contaminants will not be our attainment of some measured concentration calculated by a regulatory agency, but rather the absence of gross and subtle manifestations of toxicity and the restoration of a functionally healthy ecosystem.

The fish-eating wildlife of the Great Lakes basin will continue to be the sentinels and sensors whose response will critically monitor our progress.

Our past experiences with wildlife suggests that more emphasis should be placed on studying effects on biochemical processes, reproduction and embryonic development in humans who consume significant amounts of Great Lakes fish and wildlife. Current wildlife research is attempting to assess immune function, DNA damage, free radical-induced toxicity and evidence of contaminant-induced wasting and to adapt such methods as the caffeine breath test for use in bald eagles and other species. These studies will continue to provide direction and justification for studies of human populations at risk.

C-4: *Epidemiological Considerations*

John W. Frank, Director of Research,
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Epidemiology is the study of the distribution and determinants of ill health. In the present era, epidemiologists are frequently called upon to ascertain exactly what human health effects have been caused by exposure to environmental hazards. There appears to be a public perception that, if the appropriate studies are done by well-trained scientists, it should always be possible to determine with certainty whether or not adverse environmental health effects have occurred. In fact, however, epidemiology has significant limitations, particularly in its application to environmental health problems. This presentation will:

1. Briefly review the sorts of criteria that epidemiologists themselves would apply to a study of environmental health effects in order to determine whether it constitutes adequate evidence of the effect having been caused by exposure to environmental contaminants;

2. Give three brief examples, one in some detail, of published epidemiological studies that either did or did not find health effects from environmental exposures;

3. Demonstrate how all three of these studies have inherent flaws that make the findings inconclusive, (although it is not necessarily the case that the studies could have been done better, given the substantial constraints faced by the scientists who conducted them);

4. Offer some recommendations, particularly concerning the need for "fully informed consent" before communities participate in environmental epidemiological studies, in terms of participants' legitimate need to know the exact objectives, strengths and particularly **the limitations** of a proposed investigation prior to its inception.

C-5: *Reproductive Effects*

Sati Mazumdar and Donald R. Mattison, Graduate School of Public Health University of Pittsburgh, Pittsburgh, Pennsylvania

Reproductive success depends on male, female and couple-dependent factors and suggests conception at the appropriate time in the life cycle, normal embryonic and fetal growth and development, successful parturition and postnatal growth and development. This presentation will review statistics on reproductive success, identify vulnerable sites for xenobiotic influence and suggest an approach for quantitative assessment of reproductive risks.

Approximately 15% of couples are infertile, and recent data suggest that between 1965 and 1982, there has been a three-fold increase in infertility among younger couples. The causes of infertility are thought to be roughly one-third male, one-third female and one-third couple. Among the major factors of infertility, the male fecundity has been shown to be effected mainly by the sperm count, female fecundity and the spontaneous pregnancy loss are strongly influenced by age and the risk of spontaneous abortion is influenced by the prior reproductive history.

Chemicals affecting reproduction may elicit their effects at a number of sites in both the male and the female reproductive system. Interference by a xenobiotic at any level in either the male or the female reproductive system may ultimately impair hypothalamic or pituitary function. Spermatogenesis or oogenesis, ejaculation or ovulation, hormone production by Leydig or granulosa cells and the structure or function of the accessory reproductive structures also appear vulnerable to xenobiotics.

The couple based approach for reproductive risk assessment consists of modelling the reproductive risk of couples as a function of individual and couple-dependent biological markers for reproductive processes. There are both biological and statistical concerns regarding the functional forms of the reproductive risk models and the quantification of the parameters of the model. Biological concerns are mostly related to the identification of the biomarkers for different reproductive risk parameters such as time to pregnancy or cycle specific fertility rate. The statistical concerns are mostly related to the functional forms of the risk models, estimation of the parameters and the evaluation of the uncertainties in the risk estimation.

C-6: *Developmental and Immunological Effects of Exposure to TCDD and Related Compounds: Role of the Ah Receptor*

George C. Clark, National Institute of Environmental Health Sciences
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The Ah receptor is a cytosolic high affinity binding protein for 2,3,7,8-tetrachlorodibenzo-*p*- dioxin (TCDD). In addition to TCDD, a number of its structural analogs, such as the polychlorinated dibenzofurans (PCDFs) and the polychlorinated biphenyls (PCBs), also interact with the Ah receptor and produce the same spectrum of responses as TCDD in animal and cell models. The potency of these compounds is strongly correlated with binding affinity to the Ah receptor. These effects include teratogenicity, carcinogenicity, immunotoxicity and a variety of biochemical effects involving drug-metabolizing enzymes and growth factor pathways. It is generally accepted that most, if not all, of TCDD's effects require binding to the Ah receptor. Some of these effects have been observed in humans exposed accidentally or occupationally to TCDD, PCDFs or PCBs. However, there appears to be great interindividual variation in the response of humans and various animal species to TCDD. One possible explanation for this interindividual and interspecies variation in responsiveness could be differences in expression of the Ah receptor, the TCDD binding protein. If this was the case, Ah receptor levels could be used as a biomarker of susceptibility for TCDD exposure. Peripheral blood lymphocytes are a tissue which is readily available from humans and could be used for epidemiological studies. The Ah receptor is expressed in human blood lymphocytes when the cells are most actively dividing. Further studies will determine if receptor levels in exposed populations are predictive of adverse human health effects of exposure to dioxins and related compounds.

In addition to the toxic effects of TCDD, it produces a number of biochemical effects such as induction of the drug-metabolizing enzyme CYP1A1, down regulation of binding activity of the estrogen and epidermal

growth factor (EGF) receptors and changes in cytokine pathways. These effects suggest that the Ah receptor may play a role in cell cycle regulation and acts similar to a hormone in effecting cellular function. In human peripheral blood lymphocytes optimal expression of the receptor occurs at day 3 when the cells are most actively dividing. We are investigating further if there is a relationship of Ah receptor expression and progression through the cell cycle in lymphocytes. Binding of TCDD in human skin cells alters rates of proliferation and changes in differentiation of the cells which may be responsible for the development of chloracne. Altered gene regulation by activation of the Ah receptor by dioxins is the mechanistic basis for the various cellular effects of these compounds.

Humans have demonstrated large interindividual differences in their response to exposure to TCDD and its structural analogs from in vitro studies of CYP1A1 induction. Epidemiological evidence also suggests large interindividual differences in human responsiveness to dioxin exposure, in that some individuals exposed to equivalent levels of TCDD in the Seveso exposure incident (chemical plant explosion in Seveso, Italy) developed chloracne while other individuals did not. The reason for these interindividual differences in susceptibility may be due to variation in receptor number or receptor affinity if the receptor is the rate limiting event in the final biological response. We are currently investigating receptor expression in human populations that have been exposed to TCDD and other related compounds to determine if there is a relationship of receptor expression to biological responses observed in humans.

The Ah receptor has been suggested to effect cell proliferation and differentiation of a variety of cell types. Therefore, the developing organism appears to be uniquely sensitive to the toxic effects of TCDD and related compounds. Examples of developmental effects include the greater sensitivity of mice exposed in utero to the immunosuppressive effects of TCDD. Exposure during development also results in cleft palate in mice, altered sexual behaviour in rats, and in fish causes a syndrome similar to blue-sac disease. Human developmental effects have not been documented, but if humans are effected similarly to animal species, the developing fetus may be affected by exposure to TCDD and related compounds.

C-7: *Neurotoxicological Effects*

B. Bush, R.F. Seegal and W. Shain, School of Public Health
New York State Deptartment of Health, Albany, New York

In order to provide some quantitative basis for the ill-defined neurological complaints of electrical capacitor workers, we applied electrochemistry and HPLC to the determination of catecholamine neurotransmitters in sections of brain from animals exposed to PCBs. Changes were discerned in the rat, the monkey and in the sea slug *Aplesia californica.* At about the same time, two groups headed by Jacobson and by Rogan showed, independently, developmental problems in children born to mothers who had been exposed to PCBs and associated chlorinated pollutants. Behavioural effects have been demonstrated in several animal species but, as with epidemiological studies, mixtures of compounds were used and often the effects were poorly defined.

Again we have used chemical analysis in an attempt to discover relative potency of PCB congeners and other substances found in Great Lakes fish, using cells in culture as the indicator of effect on dopamine, norepinephrine and serotonin and their metabolites. Lake Ontario salmon shown to produce behavioural effects in rats by Helen Daly, has been analyzed for organic and inorganic xenobiotic chemicals, fractionated and the contaminants concentrated and applied to PC-12 cells in culture. PCBs are the only contaminants to produce an effect, a reduction in dopamine concentration; p,p'-DDE, mirex, chlordane derivatives, hexachlorobenzene and methyl mercury do not effect any of the parameters measured. These physicochemical studies implicate PCBs as an interferant with the important neurotransmitter, dopamine, which may account for the discerned behavioural and epidemiological effects. Further experiments *in vitro*, using brain slices, will allow mechanisms to be investigated.

C-8: *Healing Our Ecosystem*

John Jackson, Great Lakes United

It is not enough to define the problems in our ecosystem. We must find solutions to these problems and take action to heal the ecosystem. Scientists and community activists must work together to find the ways to make the transitions necessary to heal our ecosystem.

The Meaning of Ecosystem Health:

Ecosystem health has three vital aspects to it: 1) inclusion of all life, not just people; 2) inclusion of all humans, not just those in the Great Lakes basin (the ecosystem must ultimately include the planet); and 3) a concern with

economic, social and spiritual well-being as well as the traditional physical well-being.

The Present Condition of Our Ecosystem:

Most of our work in the Great Lakes has been on assessing the physical health of the ecosystem. The destruction of health by contaminants, the loss of wetlands and other forms of habitat — these and many other indicators show an ecosystem whose health is seriously threatened.

We have spent little time, however, assessing the other aspects of the health of our ecosystem. Our apparent economic affluence has not meant ecosystem well-being. Paul Wachtel in *The Poverty of Affluence* concludes:

> The growth approach to our national and personal problems has failed. It has failed to end the shame of poverty and homelessness in a nation of enormous wealth. It has failed to bring promised satisfaction and contentment. It has failed to bring us full employment and meaningful, challenging work. Most of all, it has failed to yield us a world we can live in safely and healthily.

We also have huge inequities in economic well-being within the Great Lakes basin as well as between the Great Lakes and the rest of the world. One-third of the world's people live the excessive consumer lifestyle. One-third live a reasonably sustainable lifestyle. The other third live in abject poverty. The United Nations tells us that 10 million people in the world are environmental refugees, driven from their homelands because of environmental and economic devastation.

The current conditions of the ecosystem pose a horrible legacy for future generations. Wayland Swain points out that the PCBs now in a mother's body will be passed on for five generations causing degradation of health — even if no more PCBs enter her and her daughters' bodies.

We are also threatening to remove the ability of future generations of living beings on this planet to ever live in a natural world again. In his book, *The End of Nature*, Bill McKibben says that "we make every spot on earth man-made and artificial." He says that because of our profound effects on nature, including the climate, we are changing the very meaning of sunshine, rain, and wind. We now fear the sunshine will give us skin cancer and cataracts. The rainfall brings acid rain and toxics. The wind blows away our precious soil.

We are also witnessing a social breakdown in our communities. We are afraid to walk in our cities or even in the countryside. A violent temperament arises, as communities break down.

The loss of nature is accompanied by a loss of our spiritual well-being. In *The Dream of the Earth*, the catholic theologian Thomas Berry says:

> We should be clear about what happens when we destroy the living forms of this planet. The first consequence is that we destroy modes of divine presence. If we have a wonderful sense of the divine, it is because we live amid such awesome magnificence. If we have refinement of emotion and sensitivity, it is because of the delicacy, the fragrance, and indescribable beauty of song and music and rhythmic movement in the world about us. If we grow in our life vigor, it is because the earthly community challenges us, forces us to struggle to survive, but in the end reveals itself as a benign providence.

Sources of the Illness:

1) Our Belief in the Need for Endless Growth: We believe that our well-being is totally dependent on having more next year than we did last year — more income, more consumption, higher profits, more production. In *Beyond the Limits*, Meadows points out that this endless growth inevitably leads to economic and ecosystem collapse. We must change our criteria for success and accept physical limits.
2) Separation from Nature and the World: Every day we should be in contact with the natural and the wild. Nature shouldn't be something that we go to visit on a reserve somewhere, but should be just outside our door. Unfortunately, we believe that we can survive better by separating ourselves from nature. The current "biosphere" experiment is a prime example of this idiocy — believing that we can build an ecosystem in an enclosure to escape the destruction that we have wreaked on this ecosystem.
3) Breakdown of Community: Work and home and family are no longer usually in the same place. Intergenerational community has broken down even more so as we have become such a mobile society. Citizens' groups are forming new communities.

Healing our Ecosystem:

I don't have the answers to how to heal the ecosystem. We need to explore together to find those solutions. I do know, however, that the healing process means:

1) restructuring our economies to make sure everyone's needs are served;
2) restructuring our communities to provide happy, satisfying lives and to be integrated with nature;
3) restructuring decision-making of government and private business. During this decade private business decision-making will have to be opened up to the public to ensure that companies are acting responsibly towards workers and community residents. Community decision-making will have to be developed, where industries are expected to act morally;

4) focusing on reducing and in some cases eliminating the use of toxic chemicals. We must shift from our focus on releases of contaminants to the use of toxic substances;
5) reducing our consumption. This means changing our lifestyles to reduce consumption while simultaneously increasing our happiness and spiritual well-being.

Scientists, activists and community residents must work together to heal our ecosystem. As community activists, we ask scientists to continue to help us understand the problems and understand where and when we must exercise constraint to protect the ecosystem. We need more emphasis by scientists on social and economic studies to help us better understand the nature of the problems. We also need scientists to work with us to find solutions to the problems that they are helping to define. Finally we need scientists to help us deal with specific local issues; for example, to come in and provide their technical expertise to a citizens' groups fighting contamination in their community.

The Science Advisory Board and the IJC have played a unique role in pulling together the community of scientists, politicians and citizen activists in the Great Lakes basin.

We ask for three changes to further the contribution of the IJC in contributing to the healing of the ecosystem:
1) Put the Great Lakes basin into the context of the world. What is sustainable here may not be sustainable worldwide — indeed it may only be sustainable here because we are intruding upon the limited resources of the other parts of the world.
2) Provide more economic and social research.
3) Be more creative in searching for solutions to help us heal the ecosystem. This needs to be done by working in an experimental way with the local communities confronting the problems. Perhaps, as a beginning experiment, we could choose a couple of RAP areas to do this in.

Scientists and community activists are united by our determination to not let the present state of ill health of this ecosystem become the normal way of life. By working together we can find the ways to heal the ecosystem.