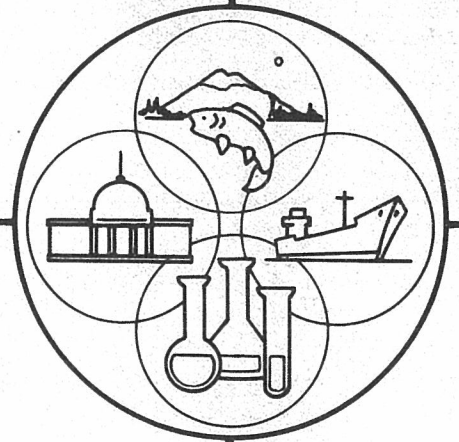


Proceedings

Puget Sound Water Quality Conference

Sept. 30, Oct. 1, 1983

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PROCEEDINGS

PUGET SOUND WATER QUALITY CONFERENCE

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PREFACE

The Puget Sound Water Quality Conference was held in Seattle, Washington, on September 30 and October 1, 1983. It included prominent speakers from the Puget Sound region, other parts of the United States, and Canada. Balanced support from 26 sponsoring organizations represented the research community, regulatory agencies, the private sector, and environmental groups. Concurrent roundtable sessions came between an opening series of major addresses and a reporting and synthesis session involving two rapporteurs with distinctive backgrounds in both environmental law and the business community. In addition, the interactive format encouraged questions and comments from a very broad audience.

These Proceedings will enable the participants to reflect on the many insights and points raised by their colleagues and the general public, and will be welcome by a wide audience in the Puget Sound region. This continuing work toward a more coherent sense of direction regarding the future of Puget Sound is the primary goal of the Conference. The comments of Commissioner Bill Mahan, Vice President of the convening Puget Sound Council of Governments, are recommended as an able introduction to the Conference. He suggests five criteria for evaluating the Conference--that it be credible, honest, interesting, balanced, and civil. These might be reflected upon as our collective work continues in the coming years.

Without imposing a premature summary on the Puget Sound question, we can again briefly ask: "What do we really know about Puget Sound, and what does it mean?"

While the Federal Clean Water Act concentrates on biological wastes and treatment plant and industrial discharges, the new generation of issues is perhaps more threatening and difficult to correct. These include toxicants, particularly metals and synthetics, and a variety of pollutants from airborne and other diffuse sources. In the Puget Sound region, we know the sources of many pollutants and are beginning to learn about their relative contributions. We also know, however, that only a few toxicants are actually monitored. We know very little about possible synergistic or cumulative effects. However, there may be evidence that metal desposition rates for Puget Sound as a whole are no longer increasing, and in many instances are in decline. Other improvements are also identified.

We are now aware of the limited flushing capacity, and have a general understanding of recirculation patterns of Puget Sound. Due to the complex geography, our attention is drawn to atypical sedimentation rates in sensitive embayments, particularly in urban areas. Dr. Donald C. Malins reports on fish diseases in urban and industrial embayments, relating these to levels of contamination. We do not know what level of present or future risk might exist for human consumers of non-commercial species found to be affected.

While the Conference deals with a specific geographic unit, it also enjoys a wider interest by casting this region as a focal point for more universal concerns relating the setting of environmental policy to short and long-term research findings. Direct similarities and differences were also indicated with other semi-enclosed marine systems, such as Chesapeake Bay, San Francisco Bay, and Kaneoke Bay, Hawaii.

A key institutional issue highlighted throughout this Conference is the need (difficulty) for individual decision-makers to recognize "technical" analysis as properly leading policy decisions, rather than following, and the prior need, therefore, for researchers to focus their work in a manner which is informative to others. In a separate step not reserved to any single agency or group of experts we must also assess the actual significance or insignificance of the physical evidence. I believe that it is this sense of multiple and expanding areas of knowledge which must be kept in sync with each other by a separate act of "assessment" or judgment, which often challenged and united diverse the Conference participants. Too often specialization sharpens our minds by narrowing them.

Another recurring and related theme was the need for someone to accept the challenge of mediator, or translator, between the technical research arena and the policy decision arena. The Puget Sound Council of Governments, convener of the Conference, was suggested as having a possible role. Dr. John Vandermeulen speaks thoughtfully and eloquently in his concluding remarks on the "end points" which are the basic positions taken by different parties. How far should one go in tracking and correcting ecological effects in one direction and multiple causes in the other?

One identified end point is budget limitations, which serve as a practical "translator" between the research arena and the political arena. This "assimilation capacity" is as real as that of the Puget Sound resource. The practical issue is one of identifying the greater environmental risks, many of which present us with exponentially rising cleanup costs, and then allocating limited budgets to the major sources of these risks. We must avoid spending ninety percent of limited resources on ten percent of the problem. This will require an increased ability, as Dr. Bish suggests in his remarks, to make trade-offs across agency turfs. Also, the timing of the Conference still allows for preventive as well as corrective policies in Puget Sound.

We often find that increasing knowledge also increases our uncertainties ("advocacy science") rather than producing consensus, by overturning basic assumptions, (for a delightful handling of this human element, see Dr. James Warren's reference to the early settler, Dr. Henry A. Smith). Cast adrift the all too human temptation is to defend positions with casual metaphors and analogies, and selective use of facts. The contribution of this Conference was, at this point, to assemble the parties and present some of the data in a manner which invited an overall context for future work, and which fostered constructive reflection and mutual critique. Missing from these Proceedings, and not easily captured after the fact, is the marvelous sense of congeniality and mutual respect which resulted.

To help draw a frame around the warning signals and other material presented at the Conference, three initial follow-up steps might be considered by the sponsors:

1. A more thorough review of all the data as several research efforts are completed, particularly through a series of workshops on specific issues (e.g., a Puget Sound mass transport model), each of which would present technical data, and second, examination of policy findings through panel review. This format would provide a scientific dialogue, rather than consultant reports only. Implications on existing programs would be evaluated in item 2, below. The workshop series would:
 - (A) Relate biological effects, midrange and overall capacity and resilience of the Sound (considering such factors as available flushing) and long-term trends;
 - (B) Rank problems and pollution sources within the above framework, based on more extensive monitoring and modeling, and risk assessments; and
 - (C) Develop more systematic comparisons between Puget Sound and other semi-enclosed marine water bodies, for our mutual benefit.
2. Internal review by each agency of its program priorities so that these independent but interrelated programs, when viewed together, will give evidence of an increasingly coherent strategy toward the Puget Sound resource, reflecting the results of well selected research.
3. Recalling the five criteria governing the Conference, a persevering effort at synthesis by the community basing policy decisions on an assessment(s) of all that is actually known (and not known), rather than on selectively chosen "facts" as we often do in complex situations.

Continued cooperation and action should proceed alongside the investigations of the newly appointed Puget Sound Water Quality Authority, rather than awaiting Authority findings. The Authority might even be a catalyst for accomplishing some of the above steps. Beyond these initial steps, the need for balanced judgements, as distinguished from fleeting political consensus per se, is the goal of political institutions, and increasingly must consider esoteric technical data. This is a recurring theme. Mr. A. Henry Schilling, Battelle Human Affairs Research Centers, offers several provocative points with regard to environmental institutions in this period of transition from the activism and optimism of the 1960's and 1970's.

Responding to Dr. Robert Bish's observation on the dispersal of authority within "government," the Puget Sound "forum," initiated by the sponsors of this Conference, should continue as a series of workshop sessions, and then a subsequent Conference, to be attended by the Authority members as they develop their final recommendations to the Legislature and the Governor in 1987. Based on the very encouraging results of the recent Conference, the Puget Sound Council of Governments intends to remain at the service of the Puget Sound community as a participant and possible convener of those who are experts and in charting a course for the future.

Peter D. Beaulieu, Ph.D.
Editor

Seattle, Washington
December, 1983

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JOAN THOMAS, DOE

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WELCOMING REMARKS

RANDY REVELLE
King County Executive

Good morning, it is a pleasure to be here. A pleasure, in fact, to be here and live here in the Puget Sound area. On behalf of the 1.4 million residents of King County, I appreciate the opportunity to welcome you to the Puget Sound Water Quality Conference.

I would first like to congratulate the Steering Committee and the many regional organizations sponsoring this conference on your efforts to initiate communication about the water quality of Puget Sound.

My personal concerns about the future of Puget Sound water quality are rooted in my larger concern that we here in the Pacific Northwest anticipate the impacts of growth to preserve the quality of life we prize so highly. I'm particularly interested in the Sound because I have been fortunate enough, while living in Seattle, to have a family summer home in Kitsap County right on Puget Sound. We have dealt for a number of years with problems of water quality and what irresponsible growth and development can do that marvelous body of water.

Responsible growth is necessary to a vital economy and to community improvements as well as to provide the resources we need to make choices about our quality of life. Today we face the challenge, in my judgment, of making critical growth decisions focusing on where we want to grow, in what ways, how much, and how fast. All the time we think about what we want to preserve for our children and future generations.

The preservation of water quality is an important element of two King County program initiatives that will be receiving quite a bit of attention in the coming months. First we are in the process of revising King County's Comprehensive Land Use and Development Plan, known affectionately as the General Development Guide or GDG. Policies to address urban drainage problems and to preserve the amenities of our natural ecosystems, such as the Puget Sound, will be included in the proposed draft guide that will be submitted to the King County Council by the end of this year.

Another major initiative of our administration has been the completion of a Surface Water Management Utility Study recommending, in affect, that King County establish a SWM utility and levy a service charge in the beginning in 1986 to finance a comprehensive surface water management program. If we don't move soon to establish a comprehensive SWM program to address the surface water run-off problems associated with urban development, we will loose the chance to preserve for future generations the rivers, streams, lakes, and wetlands that make up an important part of our environmental heritage in this area.

Puget Sound water quality is an issue that should and apparently does concern all of us. If we recognize that Puget Sound

is one of the major reasons that we like living in this area, we also know that the future of Puget Sound rests with actions we will take or not take that directly impact water quality. The broad scope of human activities that we are engaged in here on dry land determine the future water quality of Puget Sound. It is important that we recognize the Sound as a valuable resource to be managed responsibly and realize that our day-to-day activities effect the benefits and uses we will derive from this outstanding resource.

This Conference, in my judgment, provides an excellent opportunity and an excellent forum to discuss the available data and to begin identify the long term prognosis and alternative outcomes facing us and Puget Sound. You embark upon a very serious Conference today, one directed at helping us preserve a very valuable resource. For those of you who are not from this area, I hope that you have some time after the Conference to enjoy the water quality of Puget Sound first hand. We certainly have marvelous weather for the occasion.

While there is a lot, of course, to see and do in the city of Seattle, I can't help advertising that there is also a lot to see and do out in King County. We encourage you to take the ferry boat across Puget Sound to rural Vashon Island, to enjoy the spectacular Snoqualmie Falls and Snoqualmie Pass, and to ride through the farmlands of the Sammamish Valley, the mountainous countryside of Snoqualmie Valley, and the horse country around Enumclaw.

For those of you who are from out of town, we encourage you to come here, enjoy yourselves, spend lots of money, don't pollute our Sound, and then go back home! We are confident that the weather and the residents of King County will do their best to help you enjoy your stay.

Thank you very much for this opportunity to join you. Good luck on an enjoyable and productive Conference. Thank you very much.

PERSPECTIVE

BILL MAHAN

Kitsap County Commissioner
Vice-President, Puget Sound Council of Governments

One of the purposes of the Puget Sound Council of Governments is to provide a forum on different public issues in the region. We find it especially rewarding and challenging to work with the many sponsors and interests present here today. On behalf of the Council and twenty-six sponsors, I welcome all of you to the Puget Sound Water Quality Conference.

Before we enter further into the Conference program, I would like to provide you with a perspective on the questions we face in this Conference and in our continuing work. What are the goals of the Puget Sound Water Quality Conference, the first of its kind since the 1972 Puget Sound Symposium, and what is the format developed to achieve those goals?

May I begin with one short quotation:

Practical men, who believe themselves to be quite exempt from any intellectual influences, are usually the slaves of some defunct economist. Madmen in authority, who hear voices in the air, are distilling their frenzy from some academic scribbler of a few years back. I am sure that the power of vested interests is vastly exaggerated compared with the gradual encroachment of ideas.

This, from perhaps the most influential economist of the past half century, John Maynard Keynes.

We are here to challenge ideas, the ideas of each other, and of ourselves. We have 30 speakers. We will also have comments from you. The forthcoming sessions allow for exchange with the "audience." This means a lot of ideas...and a lot of listening.

The logo designed for the Conference captures one of the major themes we hope to foster over the next two days and afterward. Four different and sometimes competing groups are symbolized. These are (a) the regulatory agencies, (b) the research community, (c) the private and business interests, and (d) the environmental groups. The sponsors come from these four corners of what we are confident will be a Roundtable event this weekend. They share with all of us the goal of furthering a continuing communication within and among all of these parties for the benefit of the entire Puget Sound community, now and in the future.

I invite you to enter into the program with the idea that this is not simply another conference. The diversity of sponsors and registrants, the very broad list of speakers, particularly on the roundtables later this afternoon and tomorrow, and the opportunity for questions and answers with the audience, all point to a significant event. One of our objectives is to bridge the gap between specialists who usually talk to each other, and what is becoming a very informed

and sophisticated general public. This Conference can mark a significant beginning in a very broad effort to better understand the Puget Sound resource, and based on this understanding, to better understand each other.

Looking for a moment beyond even Puget Sound, we hope to show that as we all face increasingly complex public policy issues, we can fix our attention on public and private actions and their actual consequences. We hope to use this understanding to guide future decisions. We need the depth perception supplied by several points of view. We must consider Puget Sound as both a commodity and a resource to be managed.

We hope to answer the following kinds of questions: Is Puget Sound healthy or not? What is the long-term prospect, based on the scattered but improving evidence? If Puget Sound is healthy, then how do we keep it this way? If not, then how can this be specifically corrected? Will the possible evidence of long-term trends of deterioration remain inconclusive until these trends are irreversible? How does one avoid the "Seafirsting" of Puget Sound, if in fact this is a real threat? Do the trends move in different directions, some improving, others not?

These kinds of questions, and others of your own, fit within the format you find in the Conference program. I have referred to the Roundtables, for example, and now would like to spend a few minutes giving a quick overview of the sequence outlined in the program.

In a few minutes I will introduce the first three speakers of this opening plenary session. The first presentation will deal with Puget Sound as a very broad economic and environmental resource. This is followed by a treatment of environmental impacts which some uses of Puget Sound have on other uses, and users. The third presentation will then look at the institutional setting. The broad range of sponsors, governmental, private, commercial, and research, can all be considered institutions.

After the luncheon we will hear from four panelists who will address a sequence of specific pollution questions. The first two are familiar. These are toxics in urban areas, and second, a smorgasbord of many other water quality concerns, ranging from oil spills to red tide.

The third panelist will comment on the long-term picture suggested by research being done on Puget Sound and experiences in other areas. The fourth panelist will return to the institutional setting. Here especially the "encroachment" of fresh ideas mentioned by Mr. Keynes, will be welcome, based on growing research and a maturing from the crash programs of the 1970's.

One of the major objectives of the Conference, again, is to make that difficult connection between state and federal laws for example, and the actual logic of the impacted ecosystem which manifests its own laws. What we hope for is some precision of long-term problem statements, and solutions, this before actions are taken, rather than after incorrect or ineffective but costly actions have begun.

The opening session and panel presentations set the stage for the concurrent Roundtable discussions. Each of these deals with one of the four panel topics. The panelists will each be joined by a broad group of respondents--you have their names in your program packet--and will also be available for extended questions and answers with the respective Roundtable audiences. The Roundtables are your opportunity to provide whatever balance you think has been overlooked, and to dig further into some of the points raised, or not raised in the presentations.

A few words on Roundtable protocol...each of the four Roundtables will be led by a discussion leader, someone other than the speakers, who will govern the sessions and receive your comments. Because the full assembly here will be looking forward to hearing from each of the Roundtables late tomorrow morning in the concluding session, as a courtesy we should respect the guidelines.

Basically these are: (a) to work within the goals and subject matter of the Conference--extended discussion on specific public works projects, and so forth, would be distracting; (b) to be concise and not repeat points already made; and something which is inherently difficult; (c) to try to work toward a synthesis of views--not necessarily consensus--which can be reported to the full assembly late Saturday morning by the discussion leaders. The reports will take place here--in Grand Ballroom A--and will be received by two well-qualified rapporteurs selected for their ability and differing backgrounds.

To enable each of you to attend two of the four Roundtables, the respondents have agreed to repeat the Roundtables on Saturday morning. We ask that you not attend the same Roundtable twice, and that you try to spread yourselves smoothly among the four concurrent sessions.

I am informed that the Steering Committee very early discovered the modest goal of having a Conference which is: "interesting...balanced...honest...and credible." We have already noted the attempt at balance, represented by the four symbols on the logo, and your broad participation.

Interesting? and Credible? We hope that interest and credibility will continue to grow. A videotape and proceedings will be prepared to help continue the work which you will begin here, but will never really complete.

Honesty? Our purposes here are to identify what we actually know about Puget Sound and what we do not know. We are looking for good news as well as bad news. By the balance of interests we have maintained, we hope to avoid a preconceived notion about things. Let's move all of our most comfortable mental furniture aside--those encroaching ideas--for the next two days. I am reminded of Adlai Stevenson's little witticism: "If they will stop lying about me, I will stop telling the truth about them." We hope that new information will dispel whatever false anxieties are out there. The real issues might be even more exciting.

Interesting, balanced, honest, and credible. This is a high order. To best bring these qualities out, one other ingredient might

help. This is identified, I think, by Douglas Frazer, long time president of the United Auto Workers, and first labor leader to sit on the board of a major corporation, Chrysler Corporation. In a television interview he was recently asked, "what is the thing most absent and needed in this country today." Recall that environmental mediation is often patterned after labor-management negotiations. His answer was not more data, or more money, or power, or even resources, or law, or institutional change. His answer was "civility."

Each of us should be looking for understanding rather than ammunition. With this institution of civility, if I may call it an institution, we might serve as a microcosm of how to deal maturely with environmental issues in general, and perhaps other issues long overlooked.

The timing of the Conference is excellent. A considerable amount of research is well underway or being completed, including the toxicant studies of Metro--Metro began this work when the topic was not yet fashionable--and other research by the National Oceanic and Atmospheric Administration, DOE and EPA to determine what kind of long-term and coordinated research is yet needed. In addition to environmental concerns, the economy of the region is at a juncture of sorts. So too is the legislative phase of the environmental movement.

Our special appreciation to all of you, to the sponsors, and especially to those who have made financial contributions covering over half of the total Conference costs, and to the several of our speakers who are celebrating birthdays by being here this weekend.

Timing might have been better. On the other hand, this Conference has been timed to avoid conflicts with a different "conference"--the Pacific 10. This scheduling feat was settled six months in advance. Now in terms of this Conference--our goal is to look even further ahead, six years and even sixty years.

The one special interest we all hold in common is Puget Sound--over the long term. It is both an economic and an environmental endowment. And in addition, Puget Sound is also a trust, a trust held by all of us, not for ourselves but for those who come after...for our children and their children. With all of these thoughts in mind the 26 sponsors welcome you to the Puget Sound Water Quality Conference.

Thank you.

PUGET SOUND AS A RESOURCE

DONALD W. MOOS, Director
Washington State Department of Ecology

Twenty years ago, a major effort was undertaken in the State of Washington to clean up Puget Sound and its embayments. This effort was a result of a symposium, much like the one that we are convening here today. Citizens, government representatives, and experts came together to discuss the future of Puget Sound.

The result was indeed a major clean up. Industries and citizens accepted the responsibility, the cost, and the effort to install treatment works where needed. The results are evident today. Water quality improvements at Port Angeles, Port Townsend, and Oakland Bay near Shelton have resulted, certainly, in more fish and shellfish in those areas.

Twelve years ago, the Shorelines Management Act was enacted by the people of the State of Washington who recognized the unique value of Washington's shorelines. In Eastern Washington, the centerpiece of the act was Lake Chelan; in Western Washington, the centerpiece was Puget Sound, in particular Hood Canal. Over the years, the Shorelines Management Act has fostered access to shorelines, reserved shorelines for water-dependent, water-related uses, and placed manageable limits on the use of our shorelines.

Not quite one year ago, the United States Senate Committee on the Environment held a hearing in Seattle to learn more about the toxic chemical pollution in Puget Sound.

This came on the heels of NOAA's report indicating the presence of toxic substances in the sediment and abnormalities in bottom fish in the Everett Harbor area. Those testifying at the hearing noted that Puget Sound is a valuable resource and still is a quality resource. Without exception, witnesses recognized that we are on the threshold of better understanding the dynamics that determine the quality of Puget Sound.

Puget Sound is treasured for its beauty, coveted for its recreational value, and admired for its commercial and industrial significance.

In 1980, 33 million pounds of salmon were harvested from the Sound, 33 million pounds of shellfish were taken, and 99 million pounds of other marine fish were harvested commercially. In 1980, 8,000 commercial boats were licensed in Washington. People took 1.8 million fishing trips and caught more than 750,000 salmon.

Our State Department of Fisheries has counted over 400,000 clam digging trips in Puget Sound alone, yielding over 1 1/3 million pounds of clams. Commercial shellfish production exceeds 13 million pounds per year and the industry employs 800 or more people during peak periods and contributes better than \$10 million to our state's economy.

In the Puget Sound area, there are about 30 ports serving commercial navigation--seven of which serve major deep water export traffic.

Puget Sound and the Straights of Juan de Fuca will undoubtedly continue to be the target for new water-dependent industry and port development. Its deep, sheltered water ways are accessible to growing and developing economies in the Asia-rim countries. State and national policy support an increase in exports and the Pacific Northwest is a growing market requiring more activity to serve its needs. In 1980, a report of demand prepared by the Public Ports Association estimated a need for 26 new berths over the next 20 years.

In a recent study done by the League of Women Voters, it was found that nearly one-half of the state's population visits shoreline areas several times each year. Of those who visit shorelines for recreational activity, 40 percent visit the ocean or Puget Sound beaches. Recreational boating in the Puget Sound region has grown in leaps and bounds over the last 10 to 15 years and the estimates place the ownership of recreational boats in Puget Sound at better than twice the national average.

People living in Puget Sound love it. A recent survey on attitudes toward Puget Sound show that 77 percent of the Sound's residents who have lived in other parts of the country believe that living in Puget Sound is better than living elsewhere. Sixty-one percent would not leave the area, even to make \$5,000 more a year. Sixty three percent would rather take a worse job in the Puget Sound area than relocate elsewhere.

According to a survey by the Economic Development Council of Puget Sound, top priorities for Puget Sound are: clean water, clean air, unspoiled natural beauty, hiking, fishing, and not too much overcrowding.

Puget Sound has absorbed much of my career in different but compatible ways. As Director of Agriculture, I was intrigued by the interdependence between agriculture in Eastern Washington and warehousing, marketing, and shipping in Puget Sound. Believe me, the commodity producers east of the Cascades are dependent upon and interested in a thriving, healthy, commercial, navigation center here in Puget Sound.

Later, as Deputy Regional Administrator of the Environmental Protection Agency in Seattle, my attention was focused on the water quality concerns of Puget Sound. The young Environmental Protection Agency was fortunate to have a state like Washington to take a lead role in protecting the quality of Puget Sound waters. We were able to merge the new thrust of the Federal Water Pollution Control Act with the efforts of the state and implement both state and federal laws to control and prevent the discharge of pollutants to the Sound.

Several years later as Director of the Washington Department of Fisheries, I was absorbed in the business of managing a fisheries resource. At that time, most of you will recall we were quite involved in Judge Boldt's court and the questions of allocating and managing the fisheries between Indians and Non-Indians. At the heart of that problem was the need to maintain a quality environment in

which enough fish could be produced to maintain fishing as a commercial enterprise in Puget Sound for Indian and Non-Indian citizens.

Clearly, the potential for the Sound has barely been tapped. Aquaculture, for example, is still a young emerging industry. It faces many technological and marketing hurdles. It will grow only if a healthy and compatible environment for growing oysters, clams, mussels, seaweed, and other marine products can be maintained.

In 1981, my selection by Governor John Spellman to be the Director of Ecology, came at a culmination of a career which combined experiences in agriculture and with the EPA and the Department of Fisheries. But, the Department of Ecology is responsible for managing the resources of our state and maintaining a quality environment that people prize so highly. The Department of Ecology is charged with fostering the use of our natural resources while maintaining and protecting a quality environment.

Now we are confronted with new information, new concerns, and new decisions to be made about protecting Puget Sound. Information is emerging daily on the levels of toxic substances found in urban embayments and deep sediments. This is not a sudden realization. It is the result of improved technology to detect these substances at very, very low levels of concentration and the ability to analyze the cause and effect relationship of those substances with biological problems found in some organisms in the Sound. We must now ask "What about the cumulative effects of discharging waste to Puget Sound? Can the environment assimilate these wastes in a way that they will not become a problem in later years?" The critical questions are "What are the risks involved? Have the levels of toxicity reached proportions that demand immediate removal of these wastes? Or, are there other ways of managing the risks?"

We have undertaken several new programs to deal with these concerns. In Commencement Bay, funded by the Superfund program, the state will determine the degree of toxic contamination in the sediments, the source of toxic contamination, and alternatives for removing and controlling contaminated sediments. At the heart of these investigations, is a crucial effort to develop criteria for a future clean up.

In another but related effort, the Environmental Protection Agency and the Department of Ecology have joined together in a program called the Puget Sound Management Program. This program will assess the availability of data and the need for additional studies to better understand the cumulative effects of waste discharges into Puget Sound. In addition, we will concentrate on urban embayments to learn more about toxic contamination and biological abnormalities. Above all, however, this Puget Sound Management Program will bring diverse interests, particularly in the research community, together to examine Puget Sound in depth. We have too few resources and too little time to allow a lack of coordination and duplication to work to thwart the gathering and assessment of information related to the quality of these waters.

In this regard, I was pleased that Governor Spellman, this week, announced the appointment of twenty-one members to the new Puget

Sound Water Quality Authority. This noon, I will introduce the members to you. This body will provide a means for citizens, business, and government to advise the Department of Ecology and the Environmental Protection Agency on studies and policies affecting Puget Sound.

Within the last year, millions of dollars have been made available through Superfund and state legislation to clean up the Sound. These laws were enacted in recognition of the environmental and public health threat posed by the contamination of our environment by toxic substances. They were also passed because the public is demanding the control and removal of these toxic wastes.

Our job is to manage the problems posed by toxic contamination. The decisions we will make will ultimately be based on the judgment of experts. But in the end, the responsibility rests with the Department of Ecology and the Environmental Protection Agency.

I invite all of you to begin again with us, as we did nearly twenty years ago, to assess the quality of Puget Sound. Help us determine how best to control the discharge of the wastes into the Sound, protect against the accumulation of wastes that will destroy the Sound, and remove the contaminants that are not good for Puget Sound.

Thank you.

WATER QUALITY IMPACTS

ERNESTA BARNES

Regional Administrator

Region X, United States Environmental Protection Agency

Needless to say, I'm not going to make a technical speech to you this morning. I'm not a scientist. I don't have a background in environmental work. In the three months that I have had an opportunity to accept the challenge which Don so correctly says is possessed by the EPA and the DOE, I have depended heavily on my staff to learn some of the things that I'm going to talk to you about today. Some of those staff members are here today and I want to thank them personally for being patient with me as I attempt to understand an issue as complex as Puget Sound.

As I sat in my living room last night and attempted to collect my thoughts and prepare myself for this opportunity to speak to you, I looked around the room for help and found it on the wall. Among the other things that we have in our living room is a very beautiful Japanese playbill. It is a wood-cut, and is the artwork from the theatre playbill posted outside of the theatre in which the play, which was being announced, was to take place. I wish I could have seen the play. The name of the play in rough English translation is the "Battle of the Good Luck Charms."

The playbill is a very charming depiction of these three warriors who are dressed to represent three good luck charms which are, I gather, the Japanese cultural equivalent of our four-leaf clovers. They have a pine, a lotus, and a water lilly as equivalent. We are stuck with only a four-leaf clover.

This particular playbill shows each one dressed up in wonderful traditional Japanese warrior garb, with their swords--one with a knife between his teeth. They are battling, apparently, in the play for the right to bring good luck to their patrons. The play is supposed to be a comedy. But, there is something ironic about that playbill and terribly indicative of where we are today.

Probably the fighting among themselves will not do much on the short-run for their patron good luck.

I thought, as I approached you today, of the three Japanese warriors and that we are in somewhat the same situation here, assembling not just before groups whose characters are represented by the logo on the front of your program, but many, many others here to talk about Puget Sound with the clear hope that we can bring some good luck to the future of that body of water.

However, in learning about our past efforts to cooperate together, I find that we are not unlike the three warriors and that in fact we have traditionally challenged one another's science, we have challenged one another's jurisdictions, we have challenged one another's methodology. This is unfortunate. The history of Puget Sound and its jurisdictional controls as well as its science has been as difficult for me to understand as the United States Federal

Government Interagency Telephone System. I still find it easier to dial 9-1, go outside and pay for the call, than to try to figure out how to do it correctly.

Occasionally, as today, we get together, we bury our hatchets, and we attempt once more to cooperate on behalf of this magnificent body of water. As I would have reminded the Japanese warriors in the 19th century--that their primary mission was their patron's good luck--I remind us, once more, as we begin today that our primary mission is water quality and the maintenance of a healthy environment for everything that uses the Sound, not just man.

I want to share some thoughts with you, before your technical speakers and your roundtables and your workshops, that I hope will help you focus your efforts, which I know to be primarily scientific and technical--my thoughts are not. My first thoughts are about science, and I share them with you as a non-scientist and one who has had to grapple with your terminology and your concepts. Most of you are scientists, which I think at least today, is probably a disadvantage to you in considering the strengths and the weaknesses of science in helping to deal with the complex management problems which Puget Sound possesses. Don and I are in the unfortunate situation, which he has accurately described, as being the persons burdened with the management solutions which your technical expertise is intended to help us secure. Unlike nature, I have learned that scientists adore a vacuum and that nothing would please any of you more than to be personally responsible for a magnificent breakthrough of a barrier of knowledge which would open vast new areas of ignorance into which you could spend the next years and months and decades exploring and charting. This is not comforting to me.

I am responsible for permitting or denying uses of Puget Sound and the other bodies of water which are tributary to it today. Often I'm under court order to do that at a pace and a rate which you tell me is impossible because I can't wait until tomorrow to find out what I need to know. It will be five years before your bio-assays have proven beyond a shadow of a doubt that the sea fleas can in fact endure this new assault to their environment.

Another thought I have about science is that the laboratory scientists--the chemists, the toxicologists--appear to be unable to produce results which correlate with what the biologists find in the field. The environmental result never duplicates what the laboratory indications suggest that they should. This is also not comforting to me. When I'm advised of what the lethal dose-50 is, and when I finally understand how you find out what a lethal dose-50 is, and when I come to terms with the dead ducks that have been sacrificed to determine what the lethal dose-50 is, I am then told that in nature the ducks survive with apparent impunity in an arsenic-laced setting. They are smart enough not to eat it.

What does this tell me about the apparent presence of toxic materials in Puget Sound? Don correctly suggested that the "so called" conventional pollutants are going to look like a picnic compared with what we are going to try to tolerate as we begin to learn more and more about the toxic materials which are present.

In understanding the history of Puget Sound, one of the most amusing stories that was shared with me, which I'm sure many of you have heard and in fact many of you witnessed, was the representative from the pulp mill who boldly drank the liter of sulfite liquor and challenged the last Puget Sound Symposium to figure out whether or not there were any environmental health effects. The thing that is amusing about that story is not just the image of the man standing in front of group drinking the liquor when the scientist whom he wanted to impress had in fact already left the room. But, the fact that at that time sulfite liquor in its totality was considered a pollutant. There was apparently no consideration of what the components of that were, and little ability to distinguish and measure among and between them.

There appears to be very little epidemiological support for some of the conclusive laboratory findings of these modern pollutants. Nothing as compelling and satisfying as the epidemiological results of having fecal coliforms present in drinking water.

My final thought about science is that your techniques for analysis have far outstripped our ability to manage or even comprehend the results. You are far ahead of us, the decision-makers or managers, in feeling great confidence when you tell me that you have discovered a pollutant to one part per million, or one part per billion, or even worse, one part per trillion in the water, or in the air, or where ever it is you found it.

Some of you have already heard how I have come to terms with those numbers, and I'll repeat again. I asked some members of my staff to give me a feel--to give in terms that I could understand--what was one part per million, or one part per billion, or per trillion. One part per million, I understood, to be an ounce of vermouth in an 8,000 gallon tank of gin. That wasn't very helpful. Even less helpful was the one part per trillion, which was the width of the human hair when laid against the entire width of the United States of America.

You here bravely are developing spectographs and chromatographs and I sat dumbly watching them do there thing and had a technician or scientist gleefully tell me "A'hah! One part per trillion. Now what are you going to do about it?"

We have no predictive health data to give us comfort in managing an environmental assault at the one part per trillion level. What human data we have, as you well know, derives from exposure levels which far exceed one part per trillion. We are unsure how to extrapolate or interpolate, depending on which part of the graph you are moving towards, and make any kind of a satisfactory public statement about what might happen at exposure levels of that type in our environment. Our discipline, taught to us by you, is to assume a straight line relationship, even at miniscule levels.

Many of the decision-makers have stomach instinct which tells them differently. Many of them assume, as they have to, that there is some level at which some of these things can be tolerated with some degree of safety. But where is it? And, when you have as little confidence, as I do, that one per trillion is anything it is hard to let even my stomach rule my head.

My next group of thoughts is about civics. In the last decade, we have seen a major change in the concept in this country of representative government. Some of you here today, I assume, are elected officials. Think about what your burden and responsibility is as a representative governor fundamental to our democracy which we defend and seem to defend increasing in all corners of the world. It is our right and our responsibility as individuals to elect and then to be represented by these public officials.

A companion right, defended by Thomas Jefferson very eloquently, was our right to be informed, and in fact, ever since we have spent quite a bit of time defending newspapers on the theory that they did inform the public, and mandating that public officials not ignore an apparently ignorant public, but take the time to inform them so that they can be apprised of what was going on. There has been a change in this decade in what we assume the public's right to be is. The right to be informed has been expanded to the right to be involved.

Now, I invite you to spend a little time thinking about what the word involved actually means. One illustrative piece of help that I can provide for you is an analogy that was shared with me about having a breakfast of ham and eggs. In considering the ham and the eggs you might consider that the pig has been committed but the chicken is involved. When we become committed to those who elected us, then we'll be into a whole new era of civics.

Right now, I want to talk to you for a minute about what is in fact contemplated by involving citizens in decisions which hitherto had been the purview, and almost the exclusive purview of people who were elected to represent them and to inform them. Some people have equated this new era of public involvement with a New England town meeting, which would be not unlike the forum we are assembled in here today, except we would be discussing whether to increase taxes, or whether to fire the public safety chief, or something else and we would all invite one another to take a vote when the debate was over. I contend that public involvement is not at all like a New England town meeting because in a New England town meeting the decision-makers in the forum of the meeting, were in fact, the citizens who were present, and a vote of the majority was binding and the decision was made by a group.

So far none of us in public office have considered that public involvement mandates a plebiscite. The press has interpreted some of my recent efforts to improve public involvement at the EPA, as exactly that, a call for a vote. My personal belief is that public involvement at its best should be advisory to decision-makers. It is totally different, however, from public information. The test of good information is the quality of the material which has been used to inform the public. The test of good public involvement is a measure of the dynamics which follows the exchange of ideas. If we are to take this seriously, we must change our minds about how we are going to change our minds.

In the past, those of us with technical expertise and those of us with the responsibility to act have changed our minds in private and we have usually changed our minds prior to informing people that that is what we have done. If we are to take public involvement

seriously, then we must assume that the public has not only a right to be informed, but they have a capability to form opinions of their own and to advise of what they are. We must change our decision-making process so that not only does the fat lady have an opportunity to sing before the opera is over but if she chooses she has an opportunity to change the tune.

My final thoughts are about the future. Good behavioral psychologists would admonish us that there is no past and there is no future and we should focus all of our psychic energy on the here and now. Fortunately, this is not a conference on behavioral psychology, but is a conference about Puget Sound and about its health and about its integrity and about its future.

We approach this Conference with the assumption that Puget Sound possesses management problems which Don and I and the others who must grapple with them will find solutions to. The problems that we are dealing with today have planning horizons which match construction schedules which are derived from the depreciation allowances for the major capital equipment involved.

I think you mentioned a planning horizons of six to sixty years. Some of us will be here sixty years from now, but in any event, these are very short-term horizons to me when contemplating Puget Sound. Most of us here today probably assume that the future will bring even more sophistication and even more technology and even more precision to the management techniques which I might have an option to apply.

The new buzz word is "cradle to grave" control of hazardous chemicals. We envision the recycling of the expensive synthetics. We envision reuse of liquid waste. We basically envision advanced treatment of everything. But I encourage you to have a different vision as you go through this meeting for the next two days. I encourage you to be concerned about nuclear war or even to be concerned about what science fiction poses for our futures. Or, if you wish to raise your levels of concern to a theological plain and to have a different vision of the future, you might envision life forms which are simpler than ourselves. You might envision air which will no longer support lungs. You might in fact envision instinct replacing logic. If that would be your vision, then you might envision us returning to the sea from which we are supposed to have come.

In whatever form we may evolve to when that happens, I for one, would be significantly comforted to know that that sea, represented for us today by Puget Sound, has been maintained in an environment which is hospitable to whatever form of life it is that I have assumed, so when I go back there it will take me in again.

Thank you.

INSTITUTIONAL ISSUES

DR. ROBERT L. BISH
Professor of Public Administration
University of Victoria

I am going to discuss general issues and ideas about institutional arrangements. The ideas I have worked with over time are very old. They come from the design of the constitutional structure of the United States and the design of the Washington State Constitution and provide insights to management problems that are sometimes overlooked when we think of modern management technology.

Human Trade-offs -- Not Pure Science

While I'm not a scientist in a physical science sense, my main interest is in looking at legal structures, constitutional design and institutional arrangements of various kinds, to identify the incentive system that is inherent in those legal structures, and then to predict the consequences that are likely to flow as human beings like ourselves work in the various roles that are specified by those structures.

Ernesta Barnes has talked about the problems of prediction in the physical sciences and the biological sciences and we have to be aware of those difficulties because there is sometimes a tendency to think of them as very precise. If you think about the problems of prediction in the social sciences, where we are dealing with human beings who can think, and learn, and alter their strategies, the predictions are even more difficult to make because at least when we predict the behaviors of ducks, the duck doesn't read your prediction and go change his behavior. When we try to predict outcomes from institutions, people who feel disadvantaged from the predicted outcome may change their behavior. So that the originally predicted consequence does not result. That, in fact, is a major problem in designing rules and institutions because we are dealing with people and there is no way to get around that.

When we look at the nature of the water quality problem, we know the science is technical and diverse. Different technical scientists disagree. There is simply no consensus on the impacts of many pollutants. Some scientists are more optimistic than others of resolving those differences quickly. But, if you look at the history of disputes in science, such as whether the sun goes around the earth or vice versa or even more modern disputes, they do not always get resolved quickly. It is not because of any particular vested interest, it is because scientists do try to do their best, but have different views of the world, set up experiments differently and do give some different answers.

Our dilemma though, while we need good science, is related to the variety of uses we make of Puget Sound. Those uses may not only be interdependent with one another in the sense that if commercial fisherman catch salmon, there are fewer salmon for sport fisherman--at least in the short run. Or, the water quality may damage oyster farmers like myself. Each one of those uses is also highly interdependent with the rest of the economy and the society. So, when

we think about fishing regulations we may also want to look at the social and economic impacts on small towns throughout the Puget Sound region where a change in regulations may change the optimum size of a fishing boat which may change where a boat is located, and thus have a major impact on the social structure of a small community.

When we look at the role of ports, we look at the changes in technology and we have to recognize that this is interrelated to what goes on in Portland, or San Francisco, or Vancouver, and also with what happens in railroads as we try to ship materials back and forth, as with containerized cargo, or as we begin to use trains for coal. These may also have impacts elsewhere that people need to consider.

All of our resources here are so connected through the society and through the economy that we try to deal with them through political structures as well as through markets. It is not easy. It does mean, very clearly, that there aren't any technical solutions. The trade-offs are among people, they are social, they are economic, they are made through political and market processes. We can't just think of them as scientific. These decisions will be made by human beings in a variety of forums. They will not always look only at science because the physical sciences are basically inadequate to determine many of the decisions we would like to make.

Institutional Complexity

The problem of making decisions in the face of uncertainty, the problems of dealing with diverse perspectives, diverse points of view, diverse values, are debated in the Federalist Papers which underly the Constitution of the United States. They look at the problems of fallibility and with the capacity for learning which is a characteristic they attribute to people.

We do make mistakes. But, we can also learn. We need forums where we can bring diverse points of view to bear, we need to treat these issues in more than one forum to be sure that no single forum develops a systematic bias, and we have to look at the world as a positive sum game--a positive sum game being where there is a potential for net gains. Because if we begin to look at the world as a zero sum game--a situation where when one person wins another person loses--we don't get very many resolutions to disputes. We simply end up in conflict situations where people don't tend to be very happy with the outcomes.

Looking for mutual net gains is a mind set, but it is a very important one and it is necessary for our system of separated powers and multiple agencies to function effectively. Multiplicity also forces scrutiny of problems from several perspectives and this is why we have some separation between Executive, Legislative and Courts. If we look more closely at the design of the Washington State Constitution, we not only have separation between Legislature and Executive, but we have nine different independently elected executive officials, and those State Departments that aren't headed by an elected official tend to have a commission which advises them on their policies.

We are dealing with a constitutional structure that follows very specifically from arguments about differences in values,

differences in perceptions, and uncertain information. We have to get use to working within the structure, understand its properties and how it works, rather than have a tendency to say, "well, somebody must be in charge." No one is in charge of the whole system, and although we have different assignments of authority for different perspectives, most interesting problems cross organization boundaries and require concurrent agreement to achieve change.

Within this system, we do challenge one another. Challenge is normal. I think the research comparing British Columbia and Washington State, for instance, is going to show that the division of fisheries authority between the federal councils off-shore, the Indian fisheries, and the state--and which necessitates that the people involved in each organization justify their biological forecasting models and improve those models--is in fact leading to an improvement in forecasting related to fish runs that is not occurring up in British Columbia where you have a single monopolistic agency that has never really been challenged on the basis of its forecasts and the decisions it makes about them. Thus, we don't want to view duplication and challenges as undesirable. They can often produce new information and stimulate people who have gotten very comfortable in their day-to-day situation.

Kinds of Coordination

I want to enumerate some of the ways we see the organizations interacting here. I have not tried to count up the number of formal organizations involved in important water quality decision-making here on Puget Sound, ranging from the formal government agencies that are directly responsible through organizations like fisheries which are affected and also responsible in terms of, say, hydraulic permits.

On the Fraser River we identified fifty-four organizations, with some 800 systematic kinds of agreements among them with some very systematic properties. We are getting less afraid of these complex systems and a little better able to understand how they work.

The dilemma for an outsider is that people who work in the system tend to always know it better than any outsider does, they tend to know that they work in relation to people in other agencies. It is always more difficult for an outsider to draw observations but some of the insights we gain may be useful for the people who are involved in the system here on Puget Sound to think about more systematically.

First of all on the most formal level, we do find a lot of contracts and joint agreements. These are agreements where two organizations have gone together to jointly administer something. For instance, we do have agreements between the EPA and the Department of Ecology and the Department of Agriculture, etc. We also see a lot of agreements where one agency provides something for another agency. For instance, if one agency has a particularly good group of laboratory scientists it will simply contract to do research for other agencies. While that looks like a rather simple market transaction, it does improve the level of communication across the different agencies when scientists from different agencies communicate, when administrators communicate, and becomes less isolated. The use of the those quid pro quo arrangements is very extensive.

At a slightly less formalized level are the systems of referrals that have been set up. If you apply for almost any kind of permit in this state, you have an organization that will try to coordinate the dissemination of that permit application to the agencies that may be effected. In general, 80 to 90 percent of the permit applications that have no major impact on an agency's area of concerns are processed very quickly. It also serves as a means to flag down those projects which someone may have overlooked as not too important, but are important to your agency. Using that flag, you can get that information and go ahead with analysis.

The biggest problem, of course, with referrals is that they begin to get up in the thousands per year and it takes a lot of time and effort to look at them. In spite of the attempts to accumulate base line data in many parts of Puget Sound or the San Juan Islands, the base line data are often inadequate, and there simply is not the budget in an agency to send field people out. We hope the scientists who make these decisions as these applications cross their desk do well under difficult conditions. But, the referral process is probably the most comprehensive process in the Puget Sound region to disseminate information among different agencies.

Another process that is widely used here are standing committees that get together on a regular basis. When I was here on the U.W. faculty, I would occasionally sit in for another faculty member at the Department of Natural Resources. A proposal for something that was going to involve a major lease decision would come in and representatives of the different agencies--like Fisheries and Game--would talk about it and see if there were going to be major problems. If there were going to be major problems and they looked to be unsolvable, the applicant would be told at the beginning of the process. There were a lot of proposals for developments on Puget Sound that simply never went forward because the range of problems could be indicated in an early stage by a group of high level officials meeting regularly to look them over.

Standing committees depend upon mutual benefits for the departments involved. Many of the times, even though you have a statutory requirement to send a representative, if you feel your agency is strong enough you don't really contribute very well, or participate very well. Standing committees require a high level of mutual respect among the participants and people who are looking to solve problems. They depend on the personalities of the people involved to a large extent. Because of the net benefits by getting resolutions to problems early you also don't end up as the last person in line for an approval process where everyone else has approved the project, and your agency is taking all the heat at the end when there are really serious problems with the proposal.

Another kind of committee is the ad hoc committee. Whenever we find a special problem, an ad hoc committee is constituted. Some of them work and some of them don't. But, they are a way of dealing with unusual problems. For instance, there are not as many formal relationships as one might desire between, say, the Department of Health and Social Services in dealing with shellfish problems and County people who enforce planning and zoning codes where you get some pollutants, say, from non-point source developments. There is not a lot of formal linkage there. If you get a problem on a particular

bay, the rational thing to do is have an ad hoc committee to see if you can improve the inspection processes and perhaps do simple things, like convince contractors to wash off the big trucks before they leave a building site so they don't haul a lot of mud and so on out in the streets which inevitably ends up silting streams and going down on the beaches and into the Sound. Ad hoc committees do have uses. We use them all the time.

Finally, you get working agreements which are simply between different people and different agencies. They say, "well I'll handle this and someone else won't have to." They can be very informal. Probably Game and Fisheries are the best examples here, where the division by sport and commercial leaves them with overlapping responsibilities in many areas so they have working agreements and joint efforts to deal with the problems they have to deal with.

And, finally, and the most difficult for a researcher to identify, what we call tacit agreements. These are informal and difficult to identify because we never observe the agreement. Tacit agreements are reflected by taking other's interest into account such as when you know that you shouldn't do this because someone else will be harmed by it, or because someone else will object so you don't do it, but there is no formal interaction. In much of our life, we engage in this sort of tacit agreement to do or not to do things. We come to depend upon it. It becomes very important.

Citizen Participation

The dilemma with all of these coordinating approaches is rather straight forward. They exist primarily within administrative structures and they only occasionally involve elected officials. But, face it, the system is largely run by appointed officials--by employees--rather than by elected officials. The operation of the system becomes very difficult for citizen groups or outsiders to understand. Some citizens would like to have access to what is going on. This poses a particular dilemma in Washington State because I would advance the thesis from my work in Washington State that citizen participation here is certainly anything but new. Washington has one of the most populist-oriented State Constitutions of the fifty states. We have used initiatives and referendums for such things as creating the Department of Game when sports fisherman were unhappy with the activities of the Department of Fisheries. We used initiatives to get rid of fish traps when they were being viewed as taking too many salmon, although they were used primarily to take Fraser River rather than Puget Sound salmon. We used the initiative process to give the legislature a good hard kick on the Shoreline Management Act when after two legislative sessions elected officials could not reach an agreement.

The processes are very open here, and it's an area where citizens have always felt they had the right to participate. We also have strict adjudication indicating that elected and public officials have to treat citizens fairly. The Appearance of Fairness doctrine is a very strong doctrine here. In fact, we have a very active citizenry who are really quite sophisticated on most issues of environmental management, of water use, and so on, that flows from a system of very decentralized state and local government. Port districts, for example, are run by special districts of elected port commissioners

rather than by state governments or city governments. There is a tradition of local water districts, local sewer districts, etc. Problems of multiple governments are something citizens are use to.

It is interesting that with all this diversity, Washington is one of the states where when we look at the preferences and the attitudes of elected officials, they match very closely with the preferences and attitudes of citizens--much more so than in 42 or 43 of the other 50 states. It is a state where elected officials do tend to represent citizens to a very high degree.

We do not know, or at least the research hasn't been done on how we can get citizen participation into administrative structures (which begin to make the major policy decisions) throughout the referral processes, the committee processes, and so on. Most of these processes are not legislated. They are instead developed by administrators who face problems of getting some coordinated output in a reasonable amount of time where they have to deal with fisheries, or water quality, or shellfish, or public health, or ports, or shipping, or any industrial users. It is a response that is necessary but one we have not thought much about.

Advocacy and Negotiating Forums

Historically, Washington State has had departments that are very constituency-oriented. We know what the purpose of the Department of Game is, we know what the purpose of the Department of Fisheries is, we know what the purpose of the Interagency Commission on Outdoor Recreation is, and the State Parks and Recreation Commission. We have got some agencies, though, that have always had a more difficult mission and they include the Department of Ecology. In the Federal Government, they do include EPA. In some senses, Ecology and EPA are set up to be advocates for a cleaner environment, but also, they are set up to be the arena where you balance competing uses in decisionmaking. You in fact have an organization set up that is partly an adjudicator to make the decisions and yet at the same time, partly an advocate or a player in the game as well as the judge.

The dual advocate and judge role puts these agencies in a very difficult position when their staff of scientists, which are supposed to be "doing the best scientific research," differ from scientists from a port district, or from the Department of Game. What do you do? Are you the advocate or are you the arbitrator?

Good administrative systems have both constituent-oriented agencies and forums for adjudication once we think about organizations being constituent-oriented, then we recognize the need to create forums for fair adjudication and fair decisions or coordination to create a positive sum game. Perhaps DOE and EPA should be advocates for clean water, the same as the Department of Game is an advocate for fish, wildlife, and sportsmen's councils, and so on. But, when we look at the overall structure here, DOE and EPA roles are unclear and there is a potential role for a new organization to fulfill a disinterested mediator role more effectively.

I was involved in major studies of Puget Sound disputes sometime ago, including a study of the proposal by Boise Cascade to put in a new town on Hood Canal and a marina at Anderson Cove. The

proposed marina seemed to have too many problems associated with it, so it was dropped from the proposal at a very early stage. But, in the case on Hood Canal, the County planners and the County Commissioners held hearings in which they took the initiative to encourage testimony from representatives of all of the state agencies that would later have to give permits, from different scientists, from different points of view and they didn't really ever decide whether the new town could go ahead or not--What they did is decide a set of, I believe, 33 different conditions that were important and then said you can go ahead when you have satisfied these conditions. They then left the decision to the organization--Boise Cascade--knowing that interests of other parties were protected.

Many kinds of problems were brought out in the hearing process. They were adjudicated fairly in the sense that one looked at and decided, for example, that you did need a small sewage treatment plant rather than relying on septic tanks. A whole list of things was gone through. The interesting thing about that decision is that people regarded it as fair even though the company that was involved in it recognized that the conditions raised costs so that it didn't go ahead with the investment in the declining market at that time. But, most important, it was a fair process, one in which the variety of interests were heard and where people were basically satisfied that they had gotten a fair hearing.

That is the kind of process you like to see, where you really get information produced, where people look at the information and make decisions and when you are all done everyone agrees it was a fair process. That seems to be more important than such values as economic efficiency. We recognize when people's values are different, but we have no way of observing exactly what they are, instead we must rely on good processes. If you can bring your variety of people together in a forum, in a human setting--where people come away with decisions they think are fair--you are making a lot of progress in institutions.

Questions for Puget Sound Institutions

Let me pose the kind of questions that I would want to ask about our institutional arrangements for water quality management on Puget Sound. I emphasize, I am not an expert in water quality management. I do research on institutional arrangements anywhere from urban environments to Roman cities. We are discussing here just one set of institutional arrangements dealing with one of the most difficult problems we face.

These are the kind of questions we find useful. Does the institutional structure provide relevant information for all concerned individuals and groups to make their preferences for the use of Puget Sound's resources known and considered? Is the political system open enough that people don't feel continually left out, that other people have access and dominate the system. I think on Puget Sound, we have one of the more open political systems in the United States.

A second very important question in this whole system of committees, referrals and potential for legislation is, does the institutional structure provide the means to take into account a wide range of alternative courses of action in response to citizen's preferences and to compare and choose among trade-offs inherent in

each? This is one of the really difficult questions. When we have a governmental structure that is divided by function, can we make trade-offs across those functions? A good historical example here in Washington State was some very early requirements that if you wanted to build dams on rivers you had to put up the money to build the fish hatcheries to replace the declining stock of fish that would result from the dam. That is the kind of trade off that is important in the long run. The ability to make those trade-offs is critical. That depends on things that are hard to legislate. It depends on a lot of discretion to administrators, who are themselves constrained by their own constituencies, but they have to be able to include a wide range of consequences and actions in their alternatives.

A third thing that is very important and I think is as important in water quality as any place else, is does the decision process produce an awareness of the consequences from a multiplicity of perspectives? When we look at fishing regulations I do want to know the impacts on small villages. I want to know that just the same as I want to the impacts on the stock of fish in the escapement. For instance, we have had proposals for changing the fisheries management scheme in British Columbia which would literally eliminate all of the small fishermen and concentrate the industry into a relatively small number of very large boats. That may have, especially in the short run, what many would regard as unacceptable social consequences in wiping out the economic base of many of the villages up the coast.

You need a variety of perspectives and that is hard for any single agency to provide. After all, agencies have constituencies. The people who feel comfortable working in an agency, feel comfortable there because they usually have some agreement with the constituency they're looking out for. People are not empty-headed organisms, they have preferences, they feel more comfortable in some environments than others. Just our own selective perception depends upon what we are trained in and what our attitudes are, and what our attitudes are leads us to look at different implications of policies. We need forums where when we are going to make a major change in law we include people who know something about different kinds of consequences. This is a continuing task.

Finally, there are two other criteria. One that is very important--if you have a system that functions well--participants in it develop common mutual expectations. They know what to anticipate from other agencies, they know what the trends are. To the extent you can create common understandings as to what the future is going to look like, or what you would like it to look like, and other people agree, conflict is greatly reduced. Interagency interaction, including conferences such as this one on Puget Sound, help increase the level of awareness and help create common expectations. Thus, we tend to run into fewer conflicts because people don't tend to then advance project proposals for things that simply don't fit those expectations.

The other question--probably the bottom line in one sense--is for those of us who care more about outcomes than processes: do our processes lead to maintaining the natural environment at a high quality? This is a different kind of question, but is one that you ultimately have to ask. If processes are going along smoothly, you still want to know what the bottom line is in outcomes. That means some people would prefer pristine environment, others feel as long as

you can move a ship through the water--that's okay. There is a variety here, but we are interested in the base line--are we eliminating living organisms through pollution, especially toxic chemicals? This is a different kind of question because it is a question on an impact on something that is non-human where my biases are to ask the questions from the point of view of impact on human beings. We have to ask occasionally what our impact on the world around us is and whether cumulative impacts give us a warning where we may want to readjust our expectations and look at the long-run more closely than we might have otherwise.

I think that when we look at some of our hearing processes sometimes we are disappointed. If you look at the details on the Northern Tier hearings, they were expensive, they were long, but the frustrating thing is it is not clear that we have a lot more information when we finished than we had when we started. When we look at the votes of the members on the Commission, they seem to reflect their constituencies at the end pretty much as they did in the beginning.

On the other hand, we occasionally get into a hearing like Skagit Nuclear Power Plant where new information does change minds. The geological information on earthquake faults, at least wasn't publicly known early in the hearings and when it became known it appears to have weighed heavily against approval. You never know in some of these processes that do take a long time whether something important is going to occur later. As people become emotionally involved they do look harder, they do engage in advocacy science, but this kind of science often does produce new information. There is no clear answer as to what trade-offs we give to the time and cost of decisionmaking, the delays that are introduced, the uncertainties that are introduced for investment planning and for the emotional involvement--which if you have been involved in these disputes--can be strong.

We just finished, I'm pleased to say, winning a major court case in British Columbia where a lumber company tried to put two acre waterfront lots in an area zoned for ten acres and was able to bargain with government officials to get permission. We on our island had to raise \$9,000 and knock them back by having a judge say the approving officer did not have that discretion. For the people on Cortes Island who bore the brunt of that effort there was emotional involvement for about two years in a way that was disruptive personally to their other activities.

Conclusions

I am sorry I can't offer any answers to these dilemmas. I analyze questions. We are getting some pretty good comparative data on what is going on here compared to what is going on in British Columbia. British Columbia has a really simply governmental system compared to here. The idea of parliamentary sovereignty where someone is always in charge makes things a lot simpler, but that simplicity doesn't make things better. In fact, in almost every area we have looked at, this messy system in Washington State seems to provide a higher level of performance. These are things that go beyond water quality and include areas like ports where the competitive port structure here on Puget Sound is bringing in over half the general

container cargo that goes to Western Canada because it is so much more efficiently run than Vancouver which is run by the national government. Of course I think that if Washington, D.C. ran the Port of Seattle, then containers would probably go into the Gulf of California and Mexico. Our system is messy, but it does have a logic behind it. It is a logic we often forget when we look at management models, but it is a logic that was developed very fully in the design of the constitutional structure of the United States. It is a logic that underlies the design of the Washington State Constitution. It is a logic that doesn't separate politics and administration. And, because of the multiplicity of agencies, we must have these different kinds of relationships among agencies and we have to learn better how they work and which ones don't work and how we can, where necessary, add citizens to those processes where there are some weaknesses.

Thank you.

LUNCHEON ADDRESS

MR. BROCK EVANS

Vice President for Natinal Issues
National Audubon Society
Attorney, University of Michigan
Past Director of Sierra Club, Washington, D.C. Office

I am very, very glad to be back in my own city again, back in what I very much feel is my own land, especially away from Washington, D.C. and I want you to know that even in the years that I have been forced to live back in Washington, D.C. I have kept a promise. I made a promise to some of you in the audience when I left that whenever I talked about Washington back there, I would always say what a terrible place it was, and how rainy, and that it was cold all the time. But I want you to know that when I go back, and it will be very hard, I will keep my promise. I am going back tomorrow.

I do feel very honored to be here, because I think that this is a very significant Conference. It comes at I believe an important and I believe crucial juncture in the history of Puget Sound. That long and tense, and sometimes loving and sometimes harsh, but always passionate story of our role and our relationship with our beautiful sea and our forest. I like that term, one early writer described Puget Sound that way and even though we don't have the same forest, I think it is very, very apt to describe this unique resource we have here in Puget Sound.

Well, I think we all know this. We all feel it instinctively. We all sense somehow that now in our time perhaps, this is the most important part of this history, and that is why we are here today. Because we know that the final course and direction of our inland sea is not yet set. It's final destiny is not yet sealed. We sense and somehow know that there is much we can do if we so choose to shape its future course, to start a dynamic and benign and truly lasting balance between the needs of the human population around it and that complex web of natural processes that is it, that is Puget Sound. We can do this once and for all, I think, in our time, in the right way. If we have the will to act, and act soon. I believe this to be a crucial time because it seems that we are perhaps in a transition phase or stage right now. Between one era and the other, the other era, the one to come, a new and still uncertain future which can be better or worse as we decide, as we act, or as we do not act as Randy Revelle said this morning.

The era of unrestrained industry location and large scale wetland fills and waste dumping, and the era of massive forest elimination and fishing, is now behind us pretty much because in the past two decades we have created a framework of laws and institutions to slow down the worked assaults on these natural processes and systems, and to bring that first era under control, to move towards that balance. We have clean water laws, fisheries management, toxic waste controls, zoning, the Shorelines Act, and the institutions to enforce them in varying degrees now. All this we have done, and we have reason to feel good, I think that we have accomplished something. What we have tried to do and have done is not nothing. We need only

to ask ourselves, what would the character and quality of our inland sea be like if we had not cared, if we had not made these laws. It doesn't take much imagination to visualize the blight and poisoned environment that our Sound would be now. And yet, I think we all know that it is not enough, not yet. We have a ways to go.

With increasing frequency these days, we heard this morning too, the new studies and reports seem to be coming in. More revelations about fish kills, clam beds, increased accumulation of toxics and sediments, advisories not to eat certain fish caught in certain places. Maybe we are doing better to keep the water column up to standard, but there is doubt about that too, but those accumulations in the sediments keep on growing. What does that mean? We know it can't mean much of any good.

And with just as much frequency we read or more likely we take part in the struggles between competing interests who want to use the Sound for different purposes. There are more sewage outfalls in King County filling in wetlands around Bellingham, the prospect of oil spills from the northern tier pipeline, all these battles and the countless others from Nisqually to Lummi, from Port Angeles to Point Defiance, are symbols as well as real struggles, aren't they. Symbols of both the ongoing effort to find a balance between the natural and human needs, and also the passion and intense feeling of people who care about this unique place. We all feel that, I think.

That passion has always been there. It is a vital component of the equation of Puget Sound, I think, and we should never forget it. Too often we tend to measure the quotient of these battles and these debates in terms of coliform counts and parts per million, recreation man days, and tons of cargo, and barrels and catches of harvest. We make more complex what I think is actually quite simple. And, that is two basic facts.

First, that this inland sea of ours is a unique and priceless treasure. It is what sets off our region from any where else in our country and perhaps all but a few other places in the world. Second, that we love it and will fight for it. We know from the public opinion polls how people feel about it. We know from the battles already that they will sacrifice much for it. We know it is probably the single most important feature in our daily lives. Even more so than Mount Rainier, which after all we can only see on clear days. We see the Sound all the time.

I know that for myself I can never forget its impact, its emotional impact on me when I first came here to see the World's Fair and I couldn't believe that such an incredible place existed. This great body of salt water between two mountain ranges, and that had a lot to do with my decision to come here and make this my home. So I think that we should never forget the emotional impact of the Sound and its importance to our daily lives for all of us. This too is a vital part of the equation as we now decide how to move forward and discuss what to do.

I have always believed that in order to look into the future, we have to first understand the past and so as we talk about going ahead it doesn't hurt us to take at least a brief look into the past

of the Puget Sound. What did it mean to others and what did they do to it, how did they treat it?

Well, the emotional impact of Puget Sound goes way back, and is as recorded by the first European to pass through it, George Vancouver when he came through here in May of 1792. I have often thought of that first voyage of his here and tried to imagine what an Eden it was then. What it must have been like. Perfect time of the year, the forest of huge trees coming right down to the rich clam and oyster beaches. The fish swimming in the great pure rivers. And as he voyaged down the Sound right near here you could see the magnificent backdrop chain of great snowcapped peaks in either direction.

If what is left of all this now still enchants us, can you imagine what it would have been like then? But let's hear from Vancouver in his own words, let's hear what he said about the land, and also his prophecy for the future. He said this,

"To describe the beauties of this region will on some future occasion be a very grateful task to the pen of the skilled poet. The serenity of the climate, the innumerable pleasing landscapes and the abundant fertility that unassisted nature puts forth, require only to be enriched by the industry of man with villages, mansions, and other buildings to render it the most lovely country that can be imagined. Whilst the labor of the inhabitants will be deeply rewarded in the bounties which nature seems ready to bestow on civilization."

Well, that was the passion that the Sound evoked, and it is the same for all of us, each reacting in his own way. Fishing in it, walking on its beaches, clamming, living on its shores, crossing on the ferries, earning our livelihood from it. It affects us all deeply, and maybe so profoundly that we don't often think about it all the time. It is just there.

Well, we also know how Vancouver's hopes for civilization were realized. It is a lovely and fruitful land, but I suspect the changes were far more sudden and drastic when they occurred than he could have possibly imagined. The first permanent European settlers came 50 years later. And, in much less than a century after that the great forests were extinct, gone like the grass at mowing time. The great salmon runs became things of the past, a shadow of what used to be. Great new cities and ports sprang up. There are 25 active ports now. Puget Sound became one of the great hubs of world commerce and a major trading region for the Pacific Rim. Thousands, then tens of thousands, and then finally millions flocked to its shores, made their lives, and grew and established schools and factories and highways and airports; a whole infrastructure of a complex civilization that Vancouver could have hardly imagined. And they are still coming, aren't they.

And they are going to come in the years to come: 1.9 million in 1970, 2.3 million in 1980, 2.7 by 1990 and 3.1 by 2000. And we know what the impact of this has already been with the present population and the demands on the resources. The toxic sediments, the fish we are afraid to eat, the contaminated shellfish, the masses of sediments pouring down the tributary rivers and unwise logging and farming

practices, the oil and chemical laden runoffs from the great paved over urban complexes. We know what this is like now, and we wonder what will it be like when we have 500,000 more people in the next 15 years.

We know, for example, that in an average day the Metro treatment plants in King County alone discharge about 150 million gallons of effluent into the channel. What will it be like with 20% more people? And, will the Sound be able to absorb, and continue to absorb, not just that but all the daily and chronic accumulations week after week, month after month, year after year. Heavy metals, toxic sediments, hydrocarbons. Without drastically changing its character and its value to us as one of the prime amenities of our lives.

Well, we don't know exactly, all the evidence certainly isn't in yet. But many of us fear what it means, and rightly so, I think.

As I have already noted, we have made efforts and good effort to do something about it. We do have water pollution laws, we do have zoning and shoreline laws. But still the pollution buildup seems to be greater in some quarters. And still we have a multiplicity of jurisdictions. Over 300 of them. Many of them designated some basic authority under the Shorelines Act to regulate most development activities. And all of them in one way or another making decisions which affect the Sound in one form or another. Here even with the best intentions in the world, each separate jurisdiction is naturally going to act first in its own specific interests, and not necessarily think of the Sound as one whole entity. The one single rich treasure whose unique parts are all part of one process. One varied and beautiful whole. But it is only natural that the many jurisdictions would act on their single piece of it, just as that is all they are required to do. We have hardly any control, now, over what is happening in the upland areas that drain into it. And so, that is what is happening too, isn't it.

The Sound, and its shorelines and waters, they're not being assaulted by a large frontal attack that we can easily see or resist or take care of obviously. It's being rather I would venture, attacked piecemeal, bit by bit, piece by piece, month after month it goes on. Puget Sound could be dying the death of a thousand cuts. No one fatal, but added all together the consequences could be just as tragic and just as final.

Well, none of us want this to happen. We tried to make it not so. But I think we can do better. In fact, we must do better and must do better now. I think we can, and I know you think we can too. So let's look ahead at what we can do and where do we go. And, perhaps the time has come to dream, to reach out to what ought to be.

Dream only large dreams because only they have the power to stir people's souls, said a favorite writer of mine once. So let us dream. Let us dream now of the Puget Sound restored. A Puget Sound whose beaches don't ever have to be closed. Let us dream of a Puget Sound whose rivers run clear forever. Whose rivers no longer bring in overloads of waste and sediment. Let us dream of a Puget Sound which supports a large and healthy fish population, and a Puget Sound which supports a large and healthy human population. We have the means and the knowhow to do this.

Let's dream of a Puget Sound which is a center for commerce and industry and as it always has been, a focal point for our pleasures, fishing, walking and boating, just looking across it at the mountains on the other side. And, let us dream of a Puget Sound where all of the jurisdictions, and cities and towns, states, tribes and all the others, all agree that it is one great inland sea. It is not just several hundred parts of one, each to be carved up according to the politics of the particular area or jurisdiction. Let's dream of a Puget Sound as different human parts work together and depend on each other, just as all the natural parts work together and depend on each other.

Well, let us dream about these things. We can make them happen, I think. And, let's build on the good work of the past. Build on the beginning efforts. The Clean Water Act, the zoning laws and the Shoreline Act, and the Water Quality Authority are excellent starts. Excellent for us right now. And then let's take on our dreams and take a quantum leap into the future. I think we can do it.

Let's finally then create a new human institution. We might call it something like Puget Sound Conservation and Development Commission, composed of all the interests affected, but also more than its disparate parts. Representing all of its human parts and institutions but having more power than all of them separately. Having real power first with the participation of all interests to make a real comprehensive plan for future growth and protection of the Puget Sound we know and love. A plan which recognizes that it is one unit, one Sound, one inland sea. And then, having the power to do it, to enforce it. The vital power to say yes or no to what could be done or what could not be done. Well, this is what should be done, I think, and many others think so too. But, it is not a new idea at all. There is a precedent south of here.

Another inland sea, not quite as spectacular or rich or nice as ours perhaps, but important nevertheless to them. San Francisco Bay. I think we might benefit a little bit here by taking a quick look at our neighbors to the south and see what they did with their Bay Conservation and Development Commission, how it came about, and what they did. Take a look at it and see if there is anything pertinent or similar for them then that may be useful for us here and now. I think there is much there and it could be a model for us.

Twenty years ago San Francisco Bay was the greatest single geographical feature and focal point of that region. A source of vital commerce and equally vital amenities, just the same as our Puget Sound is for us today. Twenty years ago those amenities and values were under attack from all sides. Even more direct challenges than perhaps our own situation here, mainly from backing and filling the extensive wetlands around it. It was estimated that 25% of the bay that existed a century before had been diked off or filled in, and those lands continued to be lost at the rate of 3-1/2 square miles per year. There were many other kinds of developments and much pollution and many different jurisdictions, each one jealously guarding its own interests. And many in their own ways, ignoring or placing recreation, environmental and amenity values a far distant second down the line when it came to decisions about the future of their particular part of the Bay.

Well a lot of citizens seeing certain loss of many of the valleys of the Bay, not to mention much of the physical Bay itself, realized that something had to be done, and done fast in the mid-1960's. The Bay needed to be treated as one unit. Its natural mechanisms and processes needed to be understood and respected. And, most importantly to accomplish a real balance between needed growth and development and the other values, new institutional arrangements were required. Only a new vehicle with the power to plan and enforce could perform this balance in the interest of the Bay as a whole and its human population all around it. To do this, of course, wouldn't be easy. There was fierce opposition. No jurisdiction, naturally, wanted to give up its authority and many economic interests were afraid that their concerns would be submerged. Well, it was a long and tense struggle in the State legislature but it was finally all done in about 7 or 8 years in three stages.

First, there was a study commission appointed by the governor and the two houses of the legislature. It included conservationists, local officials, developers, and by the way this is a feature throughout. All vital and rival interests were included in the various authority and policy making bodies at every stage. It is absolutely essential, I think, there or here, for success. All interests have to have their part in shaping the final plan and policy.

The commission held public hearings around the Bay and issued a report which recommended three things. First, there should be a much more detailed study. Second, that the results of the study be used to prepare a plan for intelligent conservation and development. And third, that in the interim the Bay should be protected from further filling, which was their main concern.

Well, the second step occurred at the next session of the legislature. The second step was to set up a temporary commission in spite of strong opposition from development interests. It passed due in large part to one of the strongest drafted citizen efforts ever to descend on the legislature. The commission was set up and it was a large commission. It had 27 members, and they came from all levels of government and the public. Some thought it was too large to be efficient, but the initial decision was that it was better to have representation of all interests, than it was to sacrifice that for the presumed efficiency of a smaller agency. This political decision to represent all the interests proved to be correct. It proved to be a tremendous asset for the commission to have liaison with the different interests that had to agree to the final plan.

And contrary to expectations, conservation and development oriented members did not form separate blocks. But they did work somehow together, much better than they expected. Most importantly the commission prepared a plan, it took four years to do. The staff prepared 27 separate reports in technical and non-technical form covering every aspect of the Bay and its problems. The whole process was carried out in public in a fishbowl, with many hearings, and most important of all, citizen needs and suggestions were heeded and included in the final plan when it was done. And thus, the stage was set for a permanent agency for the Bay Conservation and Development Commission to implement the plan. There was, of course, another struggle in the legislature. But finally, what was created was in

effect a multi-purpose limited regional government to consider the plan for the Bay as a whole and to regulate, under the Plan, activities that affected the Bay.

The Plan was not to be static, but to be continually revised and updated. And the Commission did have the authority to enforce it. It was in the end a regulatory (not an advisory) body which was and is its great strength.

Now I am not an expert on the BCDC, of course, as many of you are, but the main elements of relevance to our situation, I think, are these. First, that it is a comprehensive regional proposal. Second, that it was an effort to balance conservation and development to control pollution and land use as these affected the Bay through the device of a plan agreed to by all interests and continually updated. Third, that the commission had the authority to enforce the plan by denying development permits for activities incompatible with the Plan. And, fourth, it worked.

Sure there were ups and downs, but its still there and its still functioning. Most important, the Bay is still there. It is still a vital living resource, a center of commerce and focus of amenities, and it is a pleasure to be witness to the great human population around it.

The bottom line, I think, is that the Bay is much better off because of this new human institution that the citizens created. So there is much to learn from this. It doesn't fit our own situation exactly, of course, but a lot sounds familiar. We also have a crisis or a sense that something is needed. People place an immensely high value on all of our natural resources. People don't want to lose the Sound and its fisheries, water quality, its views, its magnificent and dramatic shorelines. They will make the effort to protect all these critical parts of Puget Sound.

The evidence is that present institutional arrangements are probably not enough to accomplish all this and handle the proliferation of individual land use decisions. The cumulative impact must be addressed.

Therefore, I believe in a large regional mechanism, that Puget Sound is one unit. And, I believe we cannot separate the pollution and water quality problems from the land use problem, these are closely and integrally related. The urban and rural runoff and so on. These all need to be evaluated and considered at the same time.

It's time for me to close. And it's time for us to dream of a Sound whose water is clean forever. It is time for us to dream of a Sound whose fishing is abundant and whose other amenities are beautiful forever. It's time for us to dream of a dynamic and healthy balance between the needs of the growing economy and the needs of this vital natural process, of the supporting resource. It is time for us to build on the good work of the past, and it is time for us to look forward to the future. I believe that a real regional authority can help us accomplish these goals, a regional authority representing all the interests, that can enforce its decisions, and serve us all. I believe that if we dream of these things, whatever we set out to do, we can do. It is a beautiful resource in a beautiful state. I am encouraged by the Conference and wish you well.

Thank you.

TOXIC CHEMICALS IN URBAN EMBAYMENTS:
EFFECTS ON MARINE LIFE AND THE CONSUMER

DR. DONALD C. MALINS, DIRECTOR
Environmental Conservation Division
Northwest and Alaska Fisheries Center
National Marine Fisheries Service
National Oceanic and Atmospheric Administration (NOAA)
Seattle, Washington

I very much appreciate and sympathize with Brock Evans' comments at lunch today, speaking as he did in an up-beat way about the future of Puget Sound. I think that is marvelous, and I very much share those thoughts.

One of the problems researchers such as myself face is to try to understand pollutant fates and effects in Puget Sound--what is the nature of the chemical pollutants in the marine environment, and what relationship pollutants may have to diseases of marine life?

In about 1974, a close colleague of mine, Dr. Bruce McCain, and his associates showed that diseases were present in bottom-dwelling marine life, such as English sole (*Parophrys vetulus*), from the Duwamish estuary. McCain and his associates were able to show that quite a number of English sole had liver tumors. At the time they were unaware of the significance of that observation. Subsequent studies clearly indicated that there were indeed serious health problems, including liver tumors, among marine fish from waters adjacent to a number of industrialized areas of the Sound and the possible relationship of health problems to pollution was viewed with keen interest.

These kinds of problems set the stage for my talk here today. Specifically, the topic with which I want to deal concerns the attempt to understand the nature and distribution of toxic chemicals in Puget Sound; how the chemicals get into marine organisms; what the chemicals do to marine organisms; and what the implications are to the human consumer. There are many variables and unknowns concerning these matters. Often we're dealing with the shallowest of evidence.

The starting point for our consideration is: "How do these toxic chemicals get into the marine environment"? Some of the ways are depicted in Figure 1 and include entry via runoff from agricultural lands (e.g., in the case of pesticides); via rivers into Puget Sound; and from runoff from streets and paved areas, which is extensive and which may contribute high levels of compounds like fossil fuel hydrocarbons. Waste discharges and input from the atmosphere clearly contribute. The chemicals enter the water where they frequently bind to tiny suspended particles, which then settle to the bottom. In such a process, bottom sediments build up and concentrate a wide variety of chemicals arising from various sources. The sediments are the home of many fish and shellfish--that is, these organisms live in or on these sediments.

HOW CONTAMINANTS GET INTO FISH

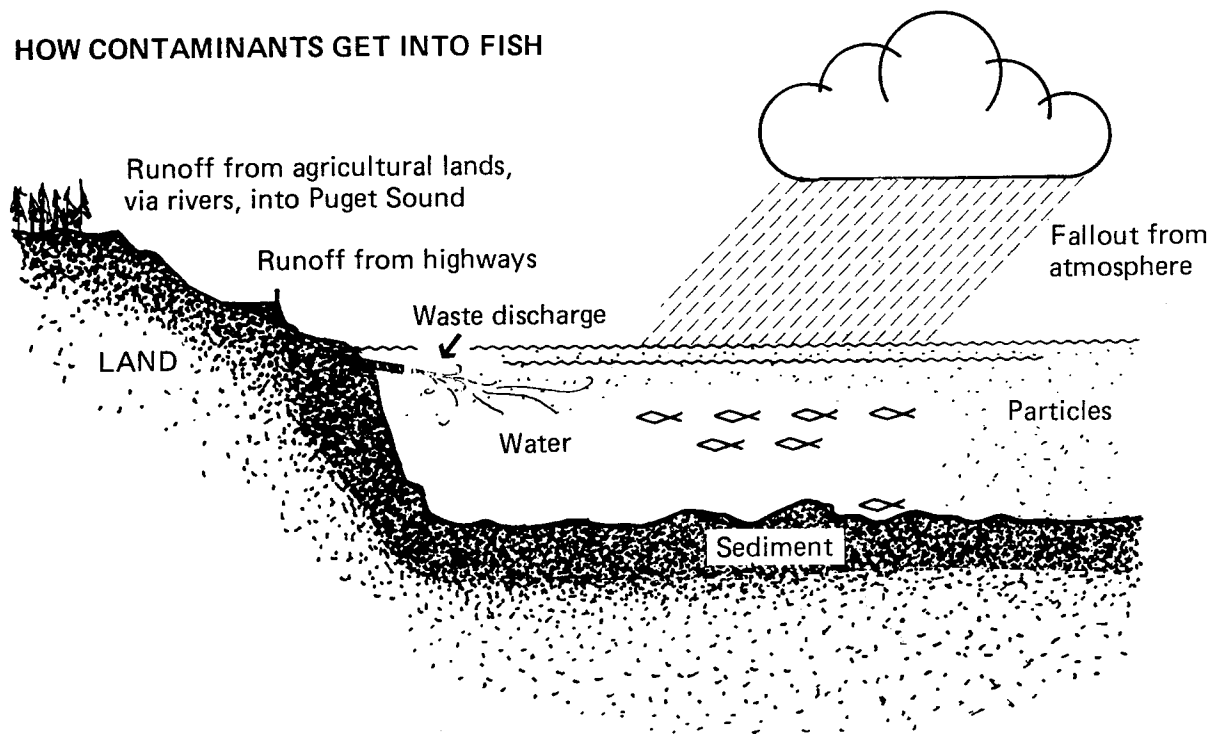


FIGURE 1

METALS IN A SEDIMENT SAMPLE from Puget Sound (Old Tacoma)

Aluminum	Chromium	Nickel
Antimony	Cobalt	Phosphorous
Arsenic	Copper	Selenium
Barium	Iron	Silver
Beryllium	Lead	Strontium
Bismuth	Lithium	Tin
Boron	Manganese	Zinc
Cadmium	Mercury	

FIGURE 2

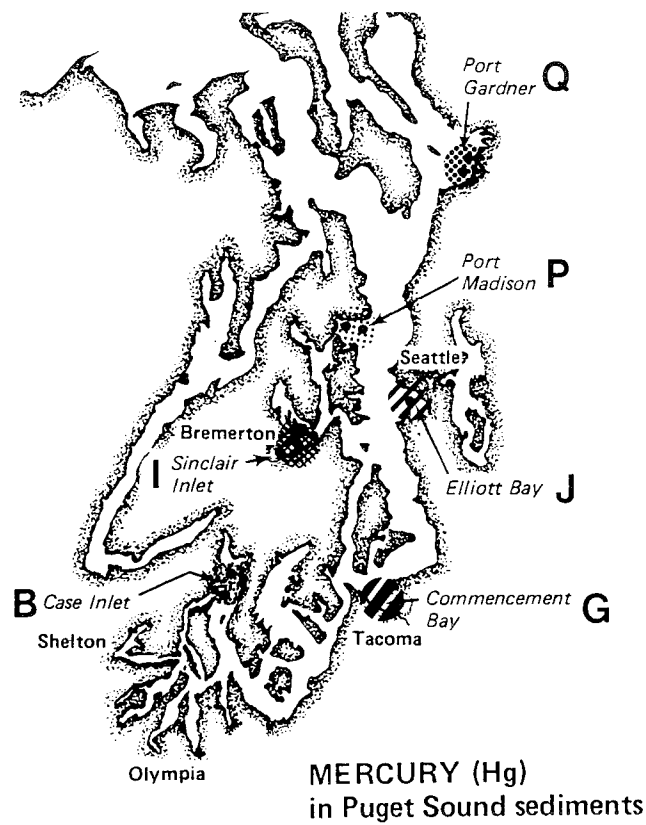
Let's consider the nature of the chemicals. In Figure 2 there is an example of some of the metals which we find in Puget Sound. I'm not going to belabor the issue, but compounds such as lead are a problem, as are cadmium and mercury. Another group of perhaps more insidious and highly troublesome compounds is the very complex mixtures and varieties of organic compounds which often have considerable toxicity for animals. Some of these compounds are mutagens and carcinogens. Dr. William MacLeod, Donald Brown and their colleagues at NOAA's National Analytical Facility in Seattle are continually analyzing for such complex suites of chemicals which are found in polluted Puget Sound sediments. For example, approximately 360 aromatic hydrocarbons, 430 or more chlorinated hydrocarbons, as well as, brominated, sulphur-containing, nitrogen-containing, and oxygen-containing compounds have been detected in sediments from Old Tacoma. The actual fact is that we are dealing with hundreds, perhaps thousands of chemical structures which have entered Puget Sound over the years--probably starting close to the turn of the century.

Next, I want to point out to you the distribution of some of these chemicals in Puget Sound. The distribution of mercury in the sediments is depicted in Figure 3. As an example, mercury tends to be located in the heavily industrialized areas around the Everett Harbor (Q), Commencement Bay (G), Seattle waterfront (L) and, to a considerable extent, over by Sinclair Inlet (I) in the Bremerton area. But when you consider our reference sites (e.g., Case Inlet (B) and Port Madison (P)), which are relatively removed from these highly industrialized areas, you begin to see substantially lower concentrations.

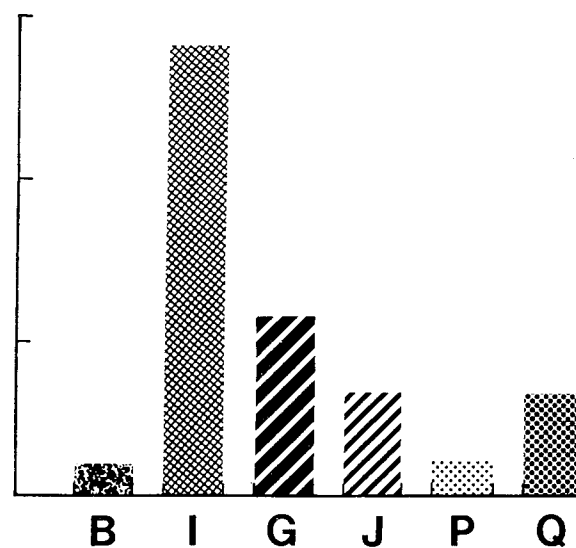
If we now look at lead, another toxicant and generally bad actor among chemicals, and consider one example, the Elliott Bay region (Fig. 4), we get the sense that lead is associated with the highly industrialized area of the Duwamish River (J) and, to a considerable extent, with Seattle's waterfront (L). But, as one moves away from these highly industrialized, highly populated areas of Elliott Bay, say over to the non-industrial area of Alki Point (M), one gets very substantially reduced levels. So, the story the metals tell us is that pollution in the Sound is particularly associated with areas of considerable industrial activity, as well as urban areas of high population density.

If we now consider the polychlorinated biphenyls (PCB's) (Fig. 5), and thus focus on organic chemicals, you will notice very definitely that the highest concentrations of PCB's tend to be found near industrial activity in the Sound. These chemicals are associated, for example, with places such as the Duwamish River (J), the Commencement Bay area (G), and even Sinclair Inlet (I), as well as to some degree, with the Everett area (Q). But, when we look at Case Inlet (B) again, or at Port Madison (P) (the non-urban reference areas), we see very small amounts of PCB's by comparison.

Another group of organic chemicals known as chlorinated butadienes, are, like the PCB's, known carcinogens and mutagens. And, again, if you look at their distribution in Puget Sound sediments you recognize that the highest concentrations tend to be associated with the heavily industrialized or highly populated areas. It turns out, presumably because of historical activity in Commencement Bay, that

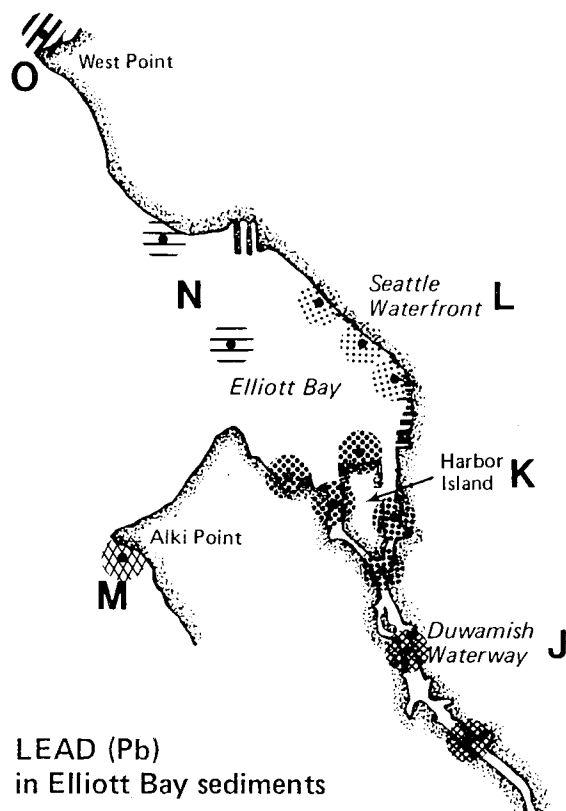


1200 ppb

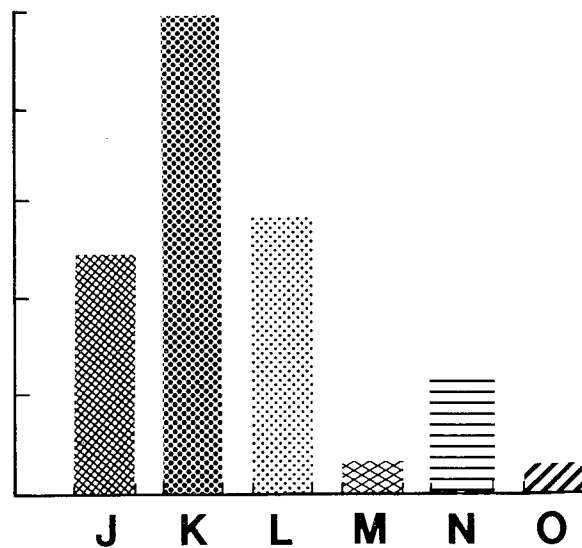


From: Malins, D.C.; McCain, B.B.; Brown, D.W.; Sparks, A.K.;
Hodgins, H.O.; Chan S.-L. *NOAA Tech. Memo. 1982,*
OMPA-19.

FIGURE 3



250,000 ppb



From: Malins, D.C.; McCain, B.B.; Brown, D.W.; Sparks, A.K.;
Hodgins, H.O.; Chan S.-L. *NOAA Tech. Memo. 1982,*
OMPA-19.

FIGURE 4

some of the highest concentrations of these mutagens and carcinogens are located in that area. However, Bremerton and Everett also contain these toxic compounds in significant concentrations.

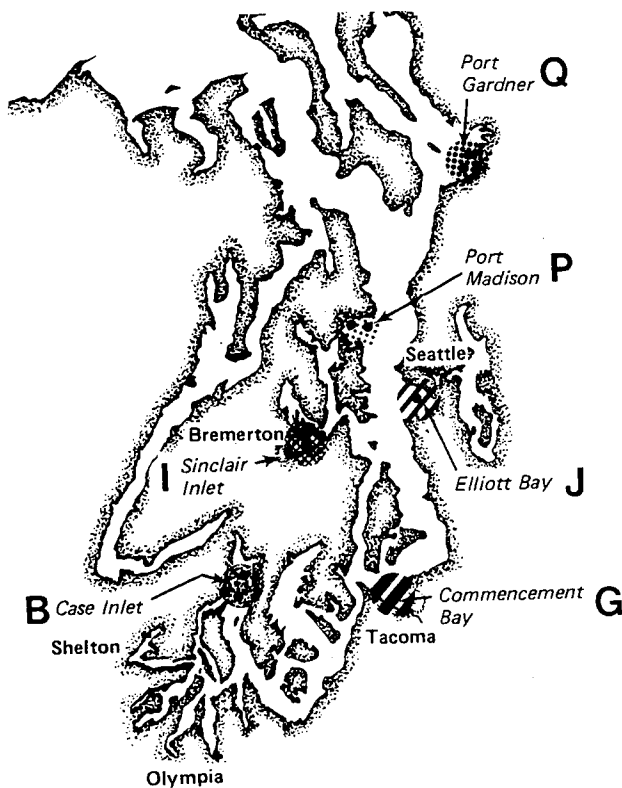
So, the story which evolves (although, as we will see later, it has some cracks in it) is that the pollution problems are characteristic of the industrial, highly populated regions of the Sound.

There is another group of organic chemicals, the aromatic hydrocarbons, which come from fossil fuels, automobile exhausts and spills of petroleum. In this instance, you can't completely attribute these compounds to industry. As a case in point, I'm probably partly responsible for polluting Puget Sound with aromatic hydrocarbons when I drive a car or when I run a boat. These hydrocarbons enter the atmosphere, but particularly they enter urban estuaries from land runoff. And, again, the perspective I am giving you of pollution in the Sound is consistent in that there are very high concentrations of aromatic hydrocarbons in the highly industrialized and highly populated areas and very low concentrations over by the relatively clean and fairly well flushed area of Alki Point. So, as indicated, the data then solidly give us the impression that the problems are pretty much localized, at least in their most severe forms.

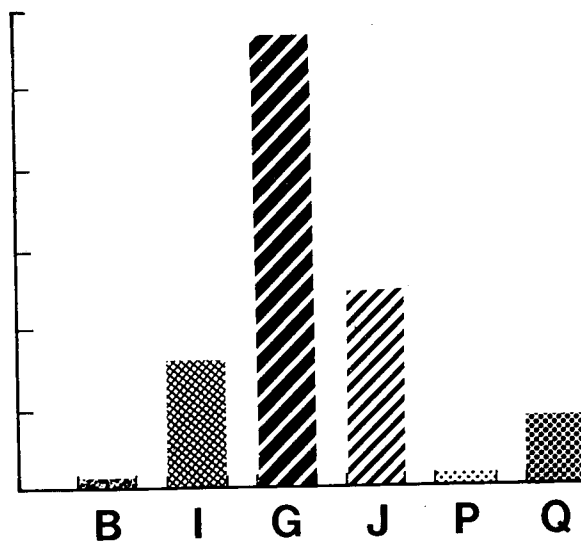
Now, I have to tell you something which my good friend and fellow speaker Dr. John Vandermeulen, teases me about--that is my long-term concern with the conversion of these chemicals to other potentially toxic substances, both by environmental processes and inside animals through the action of enzymes. The fact of the matter is that when many of the toxic chemicals enter an organism, such as a starry flounder (*Platichthys stellatus*), they undergo a number of biochemical transformations. So, one toxic compound can become, in effect, ten or fifteen "new" potentially toxic compounds. And my colleague, Dr. Usha Varanasi, and her associates have done a very nice job of illustrating what happens to toxic chemicals when they enter fish. To give one example, the carcinogenic aromatic hydrocarbon benzo(a)pyrene (found in polluted Puget Sound sediments) is absorbed in various ways into fish, such as English sole or starry flounder. It undergoes conversion in these fish to maybe ten or more metabolites. Some of the metabolites are excreted. But some, such as those viewed as ultimate carcinogens, interact with DNA (i.e., with one type of genetic material of the cell). This interaction is thought to be one of the key steps in the formation of tumors. Many of these chemicals can build up in the liver and, as a result, a lot of damaging effects can occur, possibly to include tumors.

Now when we examine the livers of fish, such as those from cod and sole from Commencement Bay--from the polluted areas, that is--we find that the liver indeed does a very nice job of accumulating PCB's. These carcinogenic compounds are ubiquitous. Fish also do a fairly good job--particularly sole--of accumulating other potentially harmful compounds such as the carcinogens hexachlorobenzene and the chlorinated butadienes.

The point I want to make is that the livers of many fish species readily accumulate these compounds from the environment. Moreover, animals such as sole, which live in intimate contact with



600 ppb



From: Malins, D.C.; McCain, B.B.; Brown, D.W.; Sparks, A.K.; Hodgins, H.O.; Chan S.-L. *NOAA Tech. Memo. 1982, OMPA-19.*

POLYCHLORINATED BIPHENYLS (PCBs) in Puget Sound sediments

FIGURE 5

polluted sediments, are good examples of fish that actively accumulate these toxicants in their livers. But, I also want to point out, at least based on the small amount of evidence we have, that salmon pick up substantially lower amounts in their livers by comparison.

Now the next question is, if these compounds can go into the livers of fish from polluted areas, what about the edible portion of the animal? Well, when we examine fish from Commencement Bay, we certainly get the impression that English sole living in highly polluted environments readily pick up the PCB's, for example, and deposit them in edible muscle. The concentrations go up to 900 parts-per-billion. A number of other chlorinated compounds also build up to significant levels in sole muscle. The benzo(a)pyrene concentration in the muscle of most fish is usually very low, but we can't, strictly speaking, place too much confidence in that reading in terms of environmental pollution. The reason is that we know that benzo(a)pyrene is metabolized, as I have previously stated. Moreover, we know that we can't detect by routine chemical analysis, the metabolites that are formed. Overall then, we recognize that the benzo(a)pyrene is changed into a number of derivative compounds which may be harmful to the fish, and which may persist in fish tissues, presumably including muscle.

Generally, the point that I want to make is that you get high concentrations of various toxic compounds in the livers of animals exposed in polluted environments; however, you often find a much lower concentration of a number of these compounds in the edible muscle. But, I have to tell you that our analytical capabilities are still very limited and we actually can't know about all of the possible chemicals that may build up in any of the fish tissues.

Because we find accumulations of chemicals in various aquatic species from polluted areas, an important question is "how far are they transported up through the food chain"? Well, the fact is that if you have animals such as small polychaete worms, which are exposed in sediment to pollutants, they will take some of the pollutants into their bodies and pass them up the food chain. There is every expectation that the chemicals can go all the way to predator fish, to birds, to marine mammals, and the evidence indicates that they have the potential to go from marine organisms into the human consumer (Fig. 6).

Now, we come to a point where we ask the question: "If there are accumulations of chemicals in the sediment (and they also exist in the water and in the suspended particles as Dr. Robert Riley of Battelle Northwest has shown), and, if certain chemicals do accumulate in organisms and are metabolized to potentially deleterious compounds in the liver, what are the consequences to the health and survival of exposed animals"?

Well, of course we are not able to examine all of the possible adverse biological effects. A great deal of evidence has focused on those rather dramatic changes known as tumors, however, and on other degenerative diseases of the liver--the types of diseases which Bruce McCain, Ken Pierce, and Sefton Wellings originally found in fish

TRANSFER OF TOXIC CHEMICALS THROUGH THE FOOD CHAIN

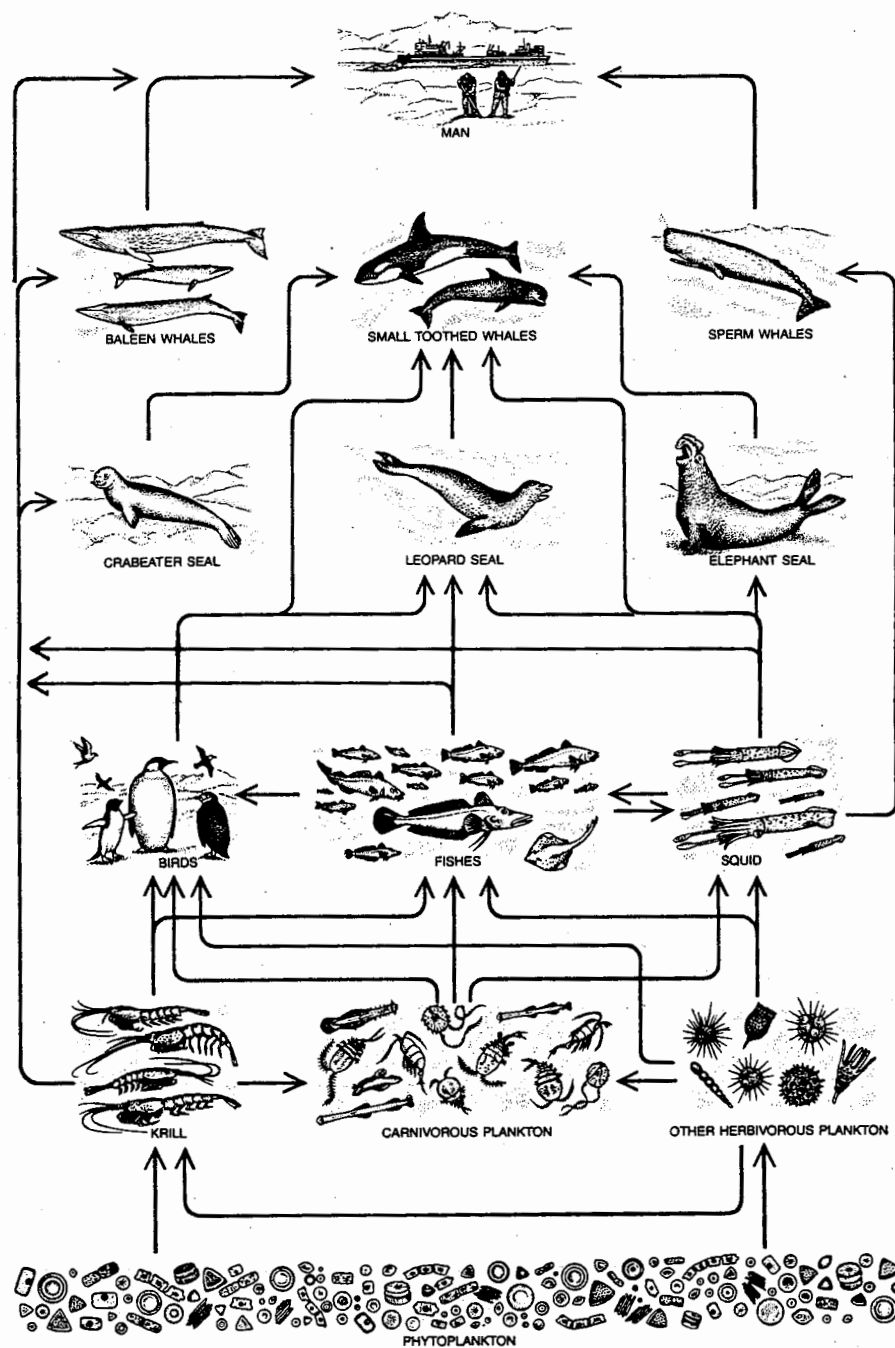


FIGURE 6

caught in the Duwamish River (Figure 7). The liver of the English sole, which was taken from the Duwamish River, is actually riddled with various tumors; it is a very nasty-looking liver. That particular animal was suffering from liver carcinomas and we have evidence to suggest that they were caused either directly or indirectly by exposure to environmental carcinogens, and perhaps to promoter chemicals besides. The reason I show this particular liver is because Mark Myers, one of our pathologists, determined that this carcinoma had metastasized to the kidney, the spleen, the small intestine, and other parts of the body. So, it is truly a good example of a malignant tumor.

There are other diseases of fish livers which don't look quite as gory, but which nevertheless do have a major impact, I would think, on the fish's survival. One such condition is called megalocytic hepatosis. It is a degenerative disease involving changes in the nucleus of the cell; another is hemosiderosis, which is the deposition of iron-containing compounds in the liver--almost certainly a deleterious effect.

I should remind you that we in Western Washington aren't the only ones to have problems such as these. There are fish from the Buffalo River that apparently have pollution-related diseases. For example, brown bullheads (Ictalurus nebulosus) were studied by Dr. John Black of the Roswell Park Memorial Institute, Buffalo, New York. These unfortunate fish often suffered from a profusion of epidermal carcinomas all around the lip and Dr. Black has found high frequencies of these lesions in the heavily polluted Buffalo River in western New York. I mention this, as indicated, to let you know that our pollution problems are not unique.

Let's have a look at the distribution and frequency of degenerative diseases in Puget Sound. If I were talking to you just about the occasional tumor that occurs, you may wonder if I'm wasting your time with essentially a non-problem. So, I should point out that these tumors, or these liver diseases in general, exist in fairly high frequencies in the polluted industrial areas such as Commencement Bay, Elliott Bay, and the Everett Harbor. That is what the data in Figure 8 show: Q is the Everett Harbor, J is the Duwamish River, and G is Commencement Bay. You don't find high frequencies of the lesions in the so-called "clean" areas, Port Madison (P), and Case Inlet (B). It is hard not to conclude, on the basis of evidence such as this, that the problem is associated with urban pollution, or at least some factor in urban environments which is bringing about these type of damaging effects.

If we look at Elliott Bay (Fig. 9), at liver tumors again, we find that sole from the Duwamish River have high frequencies of these lesions. In one study, for example, we demonstrated very high frequencies (up to 24 percent) of these liver diseases in English sole from the Duwamish. But, again if you look at Alki Point, you don't encounter many of these problems, and neither do you in the deeper areas offshore.

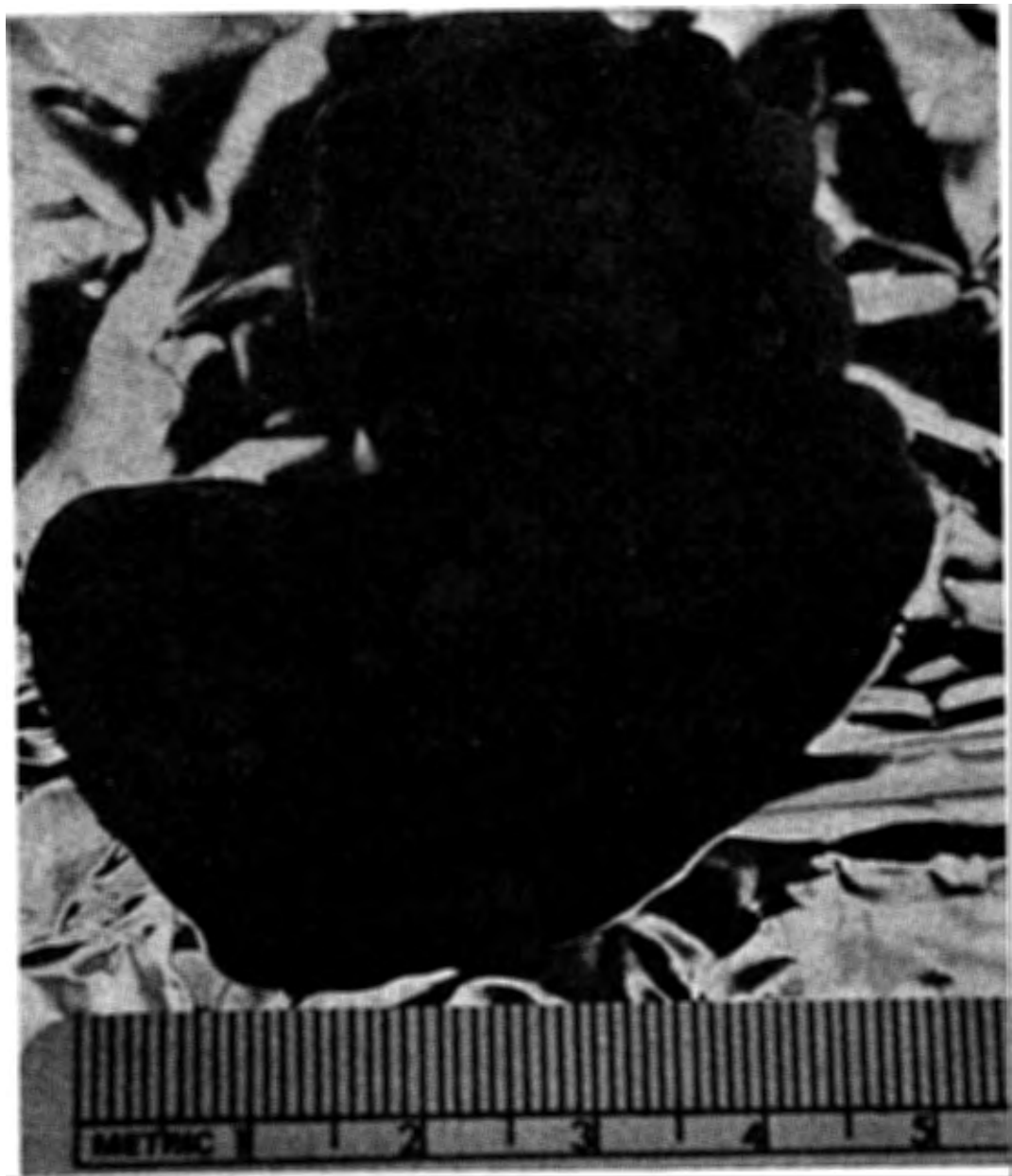


FIGURE 7

Liver from a Duwamish River English sole with multiple liver carcinomas

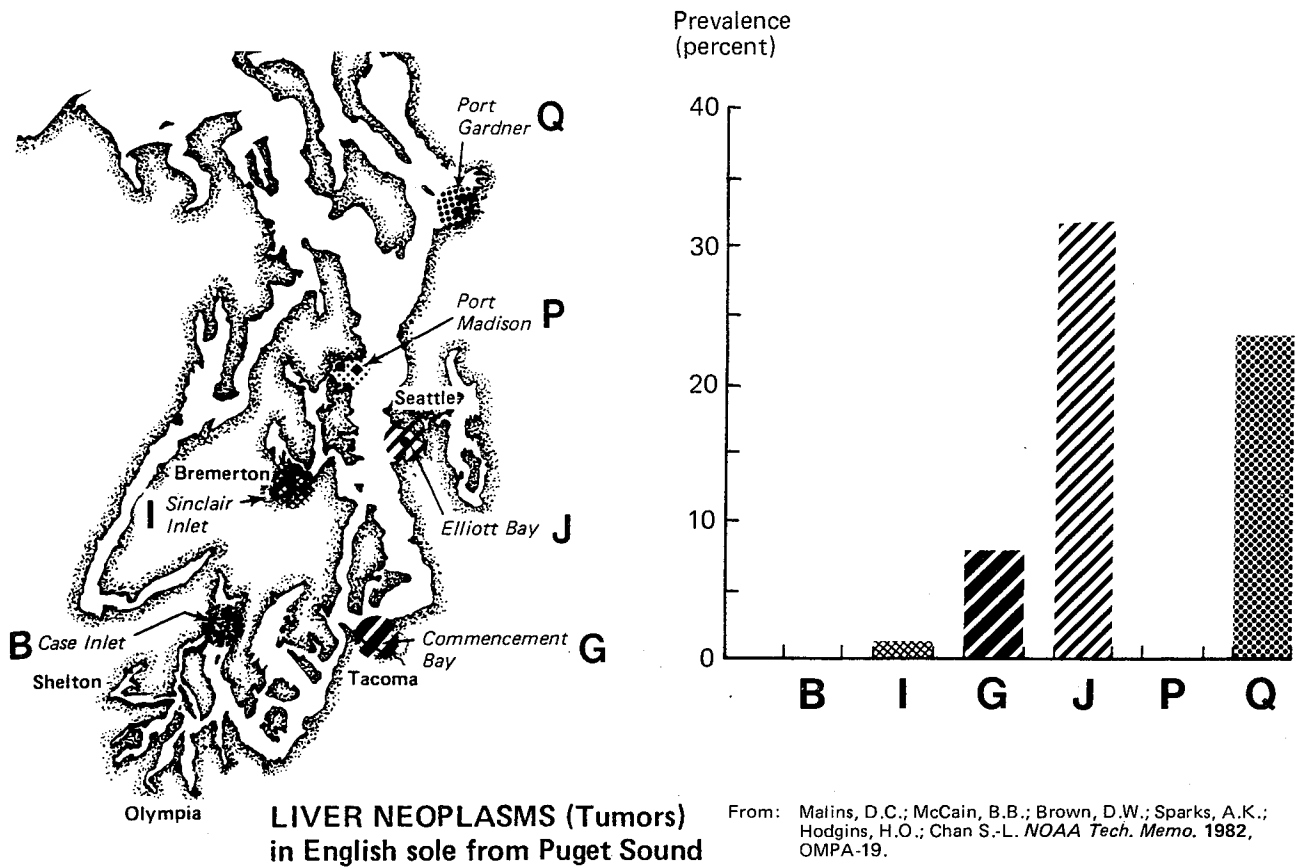


FIGURE 8

PERCENT OF NEOPLASMS (TUMORS) found in the livers of English sole sampled from the Duwamish River area (October 1978–January 1980)

From: McCain, B.B., Myers, M.S., Varanasi, U., Brown, D.W., Rhodes, L.D., Gronlund, W.D., Elliott, D.G., Palsson, W.A., Hodgins, H.O., and Malins, D.C. 1982, *NOAA/EPA Report EPA-600/7-82-001.*

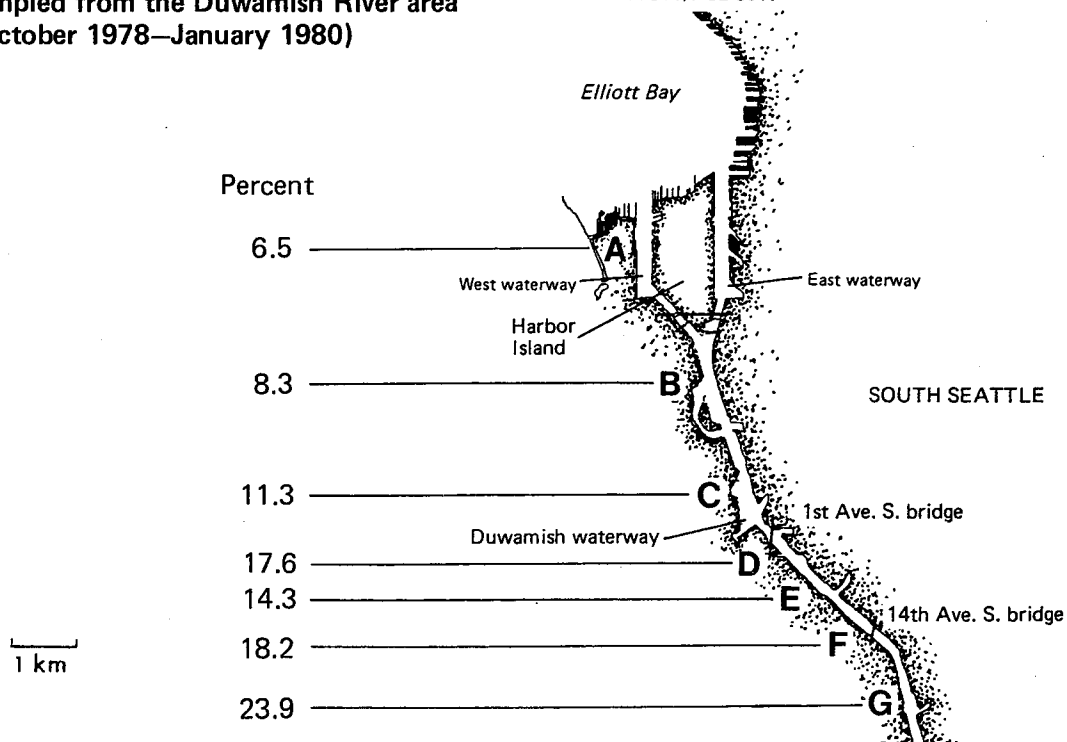


FIGURE 9

In our attempt to understand pollution-related problems in the Sound, it is not sufficient, in my view, to simply demonstrate that there are geographic associations between industrial development and/or human activity and diseases in fish. We need to go further and, ultimately, we want to explore the case for cause and effect in detail. In this regard, our statisticians have put a great deal of effort into applying statistical and mathematical treatments to the data, and I want to mention a few of these efforts here today.

We have been able to show that sediment concentrations of some compounds, such as aromatic hydrocarbons and metals, are highly correlated with liver tumors of English sole. They are also quite well correlated with liver tumors in rock sole (Lepidopsetta bilineata). Also, some of the degenerative disease I mentioned--for example, megalocytic hepatosis--are correlated in rock sole with sediment metals and hydrocarbons. Although this is not absolute evidence for cause and effect, it is clearly supportive. I might also point out that Dr. William Roubal, Mark Myers, and myself have shown that certain other liver carcinogens--for example, derivatives of the carbazoles (present in automobile and industrial emissions)--are strongly correlated with liver tumors in Puget Sound. So we have made some major steps forward in attempting to establish the chemical causes of observed lesions in pollutant-exposed fish.

Now let's talk about the crack in our "rule of thumb" regarding relationships between pollution and diseases in fish from Puget Sound. The waterfront of the City of Mukilteo is shown in Figure 10. I might describe it to you--the ferries come in here very frequently; there is a hundred foot sewage pipe that enters the area slightly north of the ferry terminal; there are fuel storage tanks all along the shore; there are a number of drainage pipes which apparently enter this general area also. Mukilteo is a small community of some 4,000-5,000 people and apparently has no really extensive industrial development itself--nothing that would apparently cause one to instinctively conclude that it would have a pollution problem. But, this isn't so--Mukilteo apparently does have a pollution problem. When we analyzed the bottom sediments just in front of Mukilteo, we found a number of troublesome compounds including known mutagens and carcinogens. To consider the nature and concentrations of these compounds, let's start off with the inner area of Mukilteo. Here we found that the sediments were pretty well polluted. There is a fair concentration, in fact, of a number of toxic compounds, such as aromatic hydrocarbons, in the sediments by the sewer outlet. When we looked somewhat north of the sewer outlet, we also found the carcinogenic compound, carbazole, at a concentration of about 200 parts-per-billion on a wet weight basis, together with relatively high concentrations of the carcinogens benzo(a)pyrene and benz(a)anthracene.

The bottom line then is this: the sediments around the small community of Mukilteo are polluted with potentially toxic, notably carcinogenic and mutagenic chemicals. Moreover, the concentrations of some of the compounds are not all that different from those in a number of Puget Sound's highly polluted industrial areas.

Dr. Peggy Krahn of our organization has done a fine job of studying benzopyrene-like compounds and naphthalene-like compounds (hydrocarbon derivatives) in the bile of fish around the Mukilteo area. The bile is a very good site for determining whether fish are taking up toxic compounds and processing them within their bodies. What Dr. Krahn has found is that at Mukilteo there are relatively high concentrations of benzopyrene-type structures which are potential mutagens and carcinogens.

To add to the chemical findings, our pathologists showed that 42 percent of the English sole caught at Mukilteo had diseased livers, to include almost 11 percent neoplasm (e.g., carcinomas). Overall, then, we might ask, "do similar pollution-related problems exist near other small relatively non-industrialized communities in Puget Sound, or is Mukilteo a special case"? More research will have to be carried out to answer this question.

We have been primarily discussing bottom-dwelling fish so far, but there are edible shellfish in the polluted areas too. Crabs, of course are of concern to many of us. Dr. Al Sparks and other scientists at the Center have looked quite extensively at diseases in crabs. We find a number of diseases in these animals and sometimes their frequency is quite high in polluted areas. But, we also tend to find diseases in crabs in areas where we don't find obvious cases of pollution, such as the Hood Canal. The fact is until we get a better sense of whether these problems are related to pollution or other factors, we cannot say with certainty whether crabs are showing serious pollution-related diseases in Puget Sound.

I want to point out a very important fact. I have, of course, stressed neoplasms and other serious diseases in marine life, but I don't wish to leave you with the impression that they are the only possibility for deleterious biological effects. They clearly are not. I look upon neoplasms as simply being one readily detectable manifestation of pollution-related problems, and they are among the easiest deleterious changes to detect. Yet, I believe that when you find these lesions in high frequencies, as we have, you must accept the possibility that there may be other significant diseases present in the affected animals, as well as in other organisms, which thus far have gone undetected. There are clear indications that this is indeed the case.

At this point I want to spend a few minutes discussing the implications of the Puget Sound findings to the human consumer of fish and shellfish. I want to set a certain ground rule, before I proceed. I'm not talking about commercial fisheries. I'm not saying that the fish you buy in the supermarket or that you eat in restaurants is not good to eat. As far as I know, commercially-caught fish and shellfish, which to my knowledge are not obtained from the polluted areas I mentioned, are as wholesome and nutritious as they have ever been. Incidentally, let me say that I enjoyed the fish at the banquet today. I would also like to point out that, to my knowledge, we do not have any evidence to suggest that the pollution-related diseases I have discussed are found in salmon or other mid-water organisms from Puget Sound.



FIGURE 10

View of the waterfront area of Mukilteo, Washington. (Photograph courtesy of Dr. Robert Clark, NMFS, NOAA)

The problem I am going to talk about now is certainly an important matter. And, that is the possible implication to human health for recreational and subsistence fishermen consuming fish taken from the highly polluted areas of the Sound. The evidence does suggest that there are possible risks from frequent consumption of fish from these highly polluted areas, and concern about this issue has resulted in "advisories" being issued by three county health departments that warn people about the consumption of bottom dwelling fish and shellfish from polluted areas.

There are a number of ways in which you can approach risk assessment. One can estimate chemical-related risks of human cancer, employing procedures commonly used by EPA and others. These procedures take into account chemical accumulations in edible tissues, human consumption patterns and other factors, as illustrated in Figure 11. But there are a lot of problems with this type of risk assessment; one of the major problems is that we have no toxicity data for most of the chemicals we find in Puget Sound fish and we still have a long way to go in learning about the consumption patterns of recreational and subsistence fishermen in this area. The epidemiologists and toxicologists on the panels will perhaps further elaborate on risk assessment, and may well develop a more detailed perspective of the human health risks for you.

My own general conclusion, which perhaps is conservative, is that the steady consumption of fish from highly polluted areas in Puget Sound--particularly when the fish themselves are inflicted with high frequencies of serious pollution-related diseases--is clearly an unacceptable risk. And I think it is very important that we get a much better picture of any threat that may exist to the consumer with respect to these pollution-related problems of Puget Sound.

Here are some of the things that need to be done in addition to making every reasonable effort to limit inputs of toxic chemicals into the system. First, we need to better identify the types and concentrations of chemicals entering the marine environment, emphasizing accumulations in important marine species. Of course, a certain amount of this work has been done and a considerable amount is contemplated for the future by the EPA, DOE, and NOAA. We need to identify, on a priority basis, chemicals which are responsible for altering the health of Puget Sound marine life. We need to evaluate the health of marine life through laboratory studies and by monitoring chemical accumulations and biological changes in indicator organisms stationed around Puget Sound. Regretably, our present ability to actually apply credible bioassays systems to evaluate these changes is very minimal indeed. Overall, I'd strongly urge that a considerable effort be made to develop better techniques for studying and understanding biological changes in marine life.

I think we need, as I've indicated, to conduct credible risk assessments to evaluate possible threats to human health. But, in order to be able to do that, we have to obtain the necessary chemical data, data on consumption patterns, and data on all the other requirements for doing a thorough job. Only by doing this can we get a real sense of the nature and the degree of possible threat to the consumer.

**Assessment of human cancer risk from consumption
of fish from polluted areas**

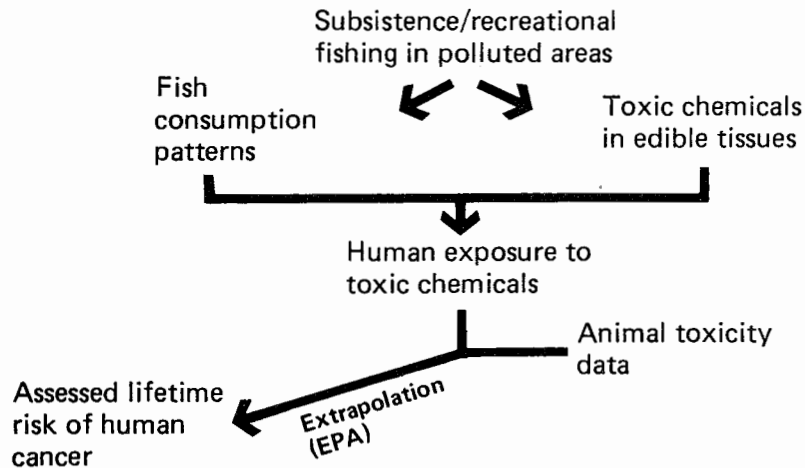


FIGURE 11

In closing, it gives me great pleasure to thank and acknowledge my colleagues of long standing who have worked tirelessly for many years on these problems--Dr. Bruce McCain, Donald Brown, Mark Myers, Dr. Sin-Lam Chan, Dr. Hal Hodgins, Dr. Al Sparks, William Gronlund, Dick Hughes, John Landahl, Wayne Palsson, Paul Plesha, Linda Rhodes, Dianne Elliott, Julie Feagley, Jolly Hibbits, Frank Marado, Dr. William MacLeod, Dr. Margaret Krahn, Andrew Friedman, Dr. Usha Varanasi, and Dr. William Roubal. I would also like to thank Dr. Howard Harris and Edward Long of the Ocean Assessment Division, National Ocean Services, NOAA, for their cooperation and for funding portions of this research.

I thank you very much.

OTHER WATER QUALITY CONCERNS

JOAN THOMAS
Water Quality Management
Washington State Department of Ecology

I have searched about in my mind for a unifying theme--the red ribbon to tie around my package of "other water concerns." It hasn't come to me in a vision--yet. Therefore, I shall briefly address a variety of water quality concerns by way of problem description, impacts on beneficial uses, current efforts to address the problem and then suggest some points for further discussion in our roundtable sessions.

Concerns about dredging and its effects on water quality and the question of how to dispose of or utilize dredged materials is as old as the Rivers and Harbors Act of 1899. Puget Sound is blessed with natural deep water harbors, but dredging is needed to provide channels and berthing facilities. Dredged material or dredge spoils can be disposed of in open water, in intertidal areas, in wetlands or on uplands. Both dredging and dredge spoil disposal are regulated by a variety of agencies for a variety of reasons--water quality protection, navigational safety, habitat disruption or destruction, wetland and shoreline protection, harbor development, potential groundwater contamination, and lots of et ceteras! One of the big et ceteras involves impacts of dredging when it is used as a method of harvesting clams. A typical port improvement dredging project in Puget Sound can require a great many permits and approvals.

For years dredging projects have generated many a knock-down drag-out controversy. The classic battle pits agency against agency, and environmentalists against agencies. For the most part, concerns have been about silt, turbidity, oxygen depletion, wetland values, fish kill potential, habitat destruction.

Then along came Commencement Bay, Superfund, and the problem of toxic sediments. We have already heard about the NOAA research, and we have seen a significant increase in regulatory concern about the sediments in our urban embayments.

Under an agreement with the Environmental Protection Agency (EPA) the Department of Ecology has lead responsibility for Commencement Bay clean-up activities. There is a deep water disposal site in Commencement Bay, and, although it is not included in the list of designated Superfund sites, it is involved in the overall Department of Ecology management program. An application is received for a permit to dredge Blair Waterway and to dispose of the dredged material at the open water site in Commencement Bay. Contamination is known to exist in the sediments of Blair Waterway as a nearby monitoring station of the National Oceanic and Atmospheric Administration (NOAA) shows high concentrations of polynuclear hydrocarbons. The EPA has data on the sediments at the deepwater disposal site. A decision had to be made: should the dredged material from Blair Waterway be allowed to be disposed of at the deep water site? All the facts aren't in; all the facts will never be in. Numerical sediment criteria for these contaminants have not been established but a decision needed to be made, with some rationale to

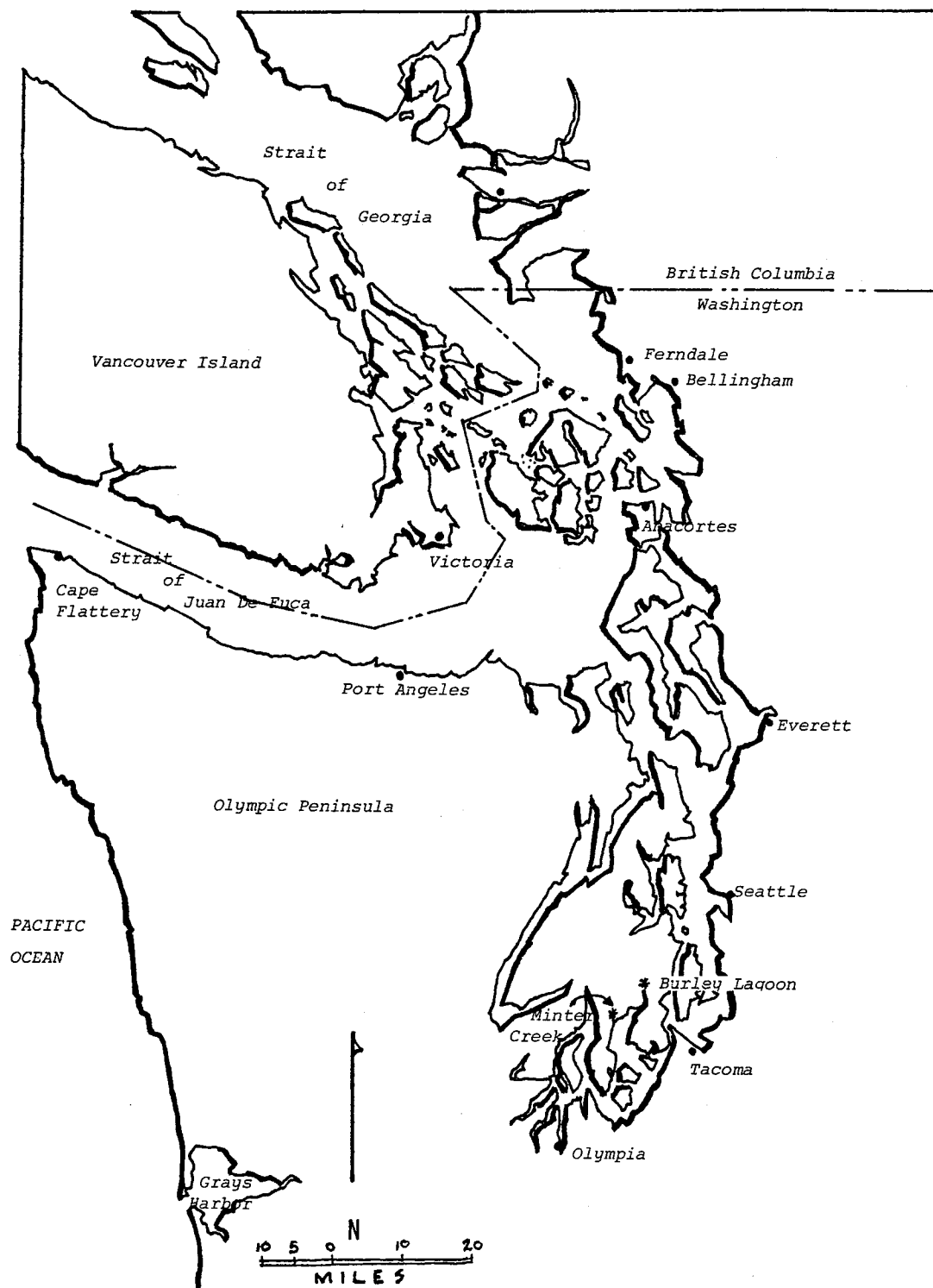


FIGURE 1
THE PUGET SOUND REGION

support it. The rationale adopted by the Department of Ecology is basically this: If the material to be disposed of is "worse" (i.e., higher concentrations of toxic contaminants) than what is already in the sediments at the deep water site, it can't go there. The traditional way of sampling and analyzing sediments for open water disposal is to take samples every few feet to the depth of dredging, and mix them together as a composite for analysis. The results of this method did not indicate a contamination problem. But an analysis of the upper sediments separately showed much higher concentrations, and the decision was made not to allow disposal of the upper sediments at the deep water site.

As has been said so often today, the example I have used raises more questions than it answers. What to do with contaminated dredge spoils? What about the cumulative effectiveness of allowing "more of some" or better? At present, the Blair Waterway dredge spoils are stock piled at a lined diked upland site. One decision has been made, and it has changed our way of thinking about dredge spoil disposal. We have made a decision about what can't go to open water disposal, but we have yet to determine the criteria for ultimate disposal.

Four Mile Rock, off Magnolia Bluff in Seattle, is another open water disposal area receiving a lot of attention. Through the joint WDOE/EPA Puget Sound Management Program, decision criteria for dredge spoil disposal are being developed in a concentrated, coordinated effort.

In our roundtable discussion, we will have an opportunity to catch up on the state of the art in dredge spoil disposal. Keith Phillips of the Corps of Engineers has just returned from a meeting on the subject. He can also elaborate on the role and interplay of the various regulatory agencies and the methodologies they employ.

A year ago oil spills would have been a "biggie." Tomorrow, or next week or next year they could be again. But the fact is that right now we are in pretty good shape--on Puget Sound, that is. Reports of oil spills are decreasing, even though we are transporting 200,000 barrels a day in Puget Sound. In 1973, there were 980 oil spill incidents statewide. In 1980, there were 627. After that, the numbers dropped so that we stopped counting. In EPA, Region 10 (the States of Washington, Oregon, and Idaho) there were 22 regional response team incidents; 20 of these involved the Coast Guard.

Oil spills are still a water quality concern, but the scene has shifted inland. Now its groundwater contamination from pipeline breaks, leakage from underground tanks and tanker truck accidents that occupy our emergency response teams. And other hazardous materials, in addition to oil, are carried in tanker trucks and stored in tanks underground. The most significant spills in recent years have been inland and have involved substances other than crude oil.

When the State of Washington passed its landmark oil spill liability law and established the Coastal Waters Protection Fund and prohibited dilling for oil in Puget Sound, Santa Barbara was still fresh in our minds. Development of Alaska's North Slope oil and proposals for pipelines and trans-shipment facilities raised everyone's awareness in the 70's.

Safeguards are in place now. We have improved tanker navigation procedures and facilities, we have better warning systems, better shoreside operations, a well developed emergency response capability. Everyone seems to be exercising a lot more caution.

The hearings on the siting of the proposed Northern Tier Pipeline brought to public attention the values of Puget Sound. It was the uncertain probability of significant damage to the resources of Puget Sound and the Strait of Juan de Fuca that lay at the heart of the Northern Tier controversy, and in the end it was the unwillingness to put these resources at risk that shaped the final decision.

Oil exploration and drilling in Puget Sound was a big issue in the 1970's. This scene, too, has shifted. The current action is either inland or proposed for the outer continental shelf.

We can't write oil spills off as a water quality concern--the potential resource damage and water quality risks are always there and the long-term, cumulative effects of spills on sediments is an emerging concern. Dr. Robert Clark of NOAA will be with us in our Roundtable discussion--he may wish to challenge my complacency.

As the technology-based controls of the 1972 Clean Water Act and discharges from easily identified sources were corrected, attention was drawn to the fact that not all water pollution was coming out of a pipe. Runoff from city streets, suburban hobby farms, commercial agriculture and forestry can have significant effects on water quality. We call this "nonpoint source" pollution, and a comprehensive program to find ways to control nonpoint sources was developed under Section 208 of the Federal Clean Water Act. Plans for dryland agriculture, dairy waste, urban runoff, and on-site domestic waste disposal have been adopted. Progress in implementation has been slow. The planning effort was generously funded by Congress under Section 208, but in 1981--perhaps in frustration over lack of progress, or perhaps in the belief that state and local governments should pay for the solutions--Congress cut off Section 208 funding. 1981 was not a good year for Washington State and its local governments to pick up the tab for a vigorous effort to implement nonpoint source corrections. Nor was it a good time to ask farmers and foresters to change the way they managed their operations. We planned for the solutions, but we didn't plan for the resources to carry out those solutions.

Earlier this month, the United States Senate Committee on Environment and Public Works passed out a new section to the Clean Water Act dealing with nonpoint sources. This amendment, Section 319, is now part of the Chafee Bill, S431, the vehicle for reauthorization of the Clean Water Act. It bears little resemblance to the nonpoint source provisions sponsored by Senator Durenberger of Minnesota. The Durenberger Amendment would have required states to implement nonpoint source programs within 18 months or EPA would do it for them. States could lose federal projects if they didn't comply. Their program management grants under Section 106 of the Clean Water Act could be lost. \$150 million was authorized for Fiscal Year 1984.

After several hearings in Washington D.C. and a field hearing in Moorhead, Minnesota, the Senate Committee marked up a Nonpoint Source Amendment on September 21. The amendment passed out by the

committee does not require cross compliance, and does not have mandatory deadlines, but it does authorize grants to states for implementation of nonpoint source programs--\$70 million for fiscal 1985, \$100 million for fiscal 1986, and \$130 million for 1987. Congress is serious about controlling nonpoint sources, and it's time the States got serious too.

Section 208 planning enabled us to learn a lot of things about the best ways to deal with nonpoint sources, and we were able to determine the agencies most appropriate for managing implementation programs. That has all been done for the most significant categories of nonpoint sources; now its time to get on with the job of getting controls in place.

Let's talk about a few specifics--Urban Runoff. We know it carries with it what's on the streets and lawns and what gets dumped in storm sewers. Litter, oil and grease, rubber particles from tires, fertilizers, bacteria, toxic contaminates. Seattle Metro is more completing a study of toxicants, and I've been told that some of the significant "hot spots" in Elliott Bay are near storm drains. The same thing is true in Commencement Bay in Tacoma.

Runoff from streets and highways can also cause flooding as well as water quality degradation--Arrow Lake in South King County is a case in point. The Department of Ecology's plan for dealing with urban runoff is based on the philosophy that storm water control is best handled at the local level.

The State has responsibility for: Water quality protection (Set goals/standards), Education of local officials/public, Research to a limited degree, Funding to a limited degree, and Enforcement against individuals and local agencies for violations of water quality.

The state's basic problem is how to get local communities to accept responsibility to develop local programs. We have used various approaches with planning money.

Bellevue National Pollution Discharge Elimination System storm and surface water utility and has agreed to participate in a pilot project to write a (NPDES) permit for their storm water. The preliminary idea is to: Assist Bellevue with enforcement using NPDES penalty provisions, Develop a permit that can be used for other urbanized areas, Test Best Management Practices, Test Bellevue's development standards, Test operation and mangement procedures, and Test monitoring methodology,

We plan to issue two general NPDES permits as pilot projects--one in Bellevue and another to State Department of Transportation. The DOT permit would cover temporary erosion and sedimentation at new construction sites and may cover existing discharges if this doesn't become unmanageable. We feel that general permits are preferable to specific permits for each point of discharge, if they cover all discharge points within any geographic area. If the pilot general permits work out, they will be offered on a wider basis.

Runoff from agricultural and silicultural activities can also cause water quality problems. But, perhaps the most direct impact on water quality in Puget Sound is the bacterial contamination of shellfish growing areas which I will discuss later. Nutrients and sediments are recognized as contributions, but the effects are of more concern in upland watersheds. However, it should be recognized that the major rivers emptying into Puget sound contribute major loads of pollutants. A dairy waste management plan has been developed for western Washington. It encourages proper storage and land application to recycle nutrients. Local conservation districts are the primary agency for working with land owners to develop dairy waste plans and best mangement practices in operation of the dairy farm. The Department of Ecology responds to water quality complaints, but its ability to do so has diminished with federal and state budget reductions.

The State Forest Practices Act is the implementation mechanism for controlling water quality impacts from forestry activities. Compliance with the forest practices act constitutes compliance with the state's water quality laws. Through 208 planning, best management practices were developed for all aspects of silviculture, and many of these are incorporated in the Forest Practice Rules and Regulations.

Nonpoint sources of pollution do not lend themselves to structured treatment facilities; most often they require proper management of the activites that create the pollution. Nonpoint sources are incremental--the animal waste from one person's hobby farm, or the human waste from one failing septic tank probably wouldn't result in water quality violations, but repeat the situation throughout a watershed and you have real problems. The costs of corrective actions are borne by individuals; there are no grant programs for failing septic tanks. The State of Washington does provide grants for agricultural pollution controls and lake restoration from Referendum 26 and 39, but state funds can only be given to public entities.

In our Roundtable discussion you may want to express your thoughts on how to achieve better control of nonpoint sources. Dr. Brian Mar, University of Washington Department of Civil Engineering will be our expert on runoff.

We heard this morning about the resource value of Puget Sound. Citing the League of Women Voters Survey: One half of the population visits Shoreline areas several times a year; 40% visit the ocean or Puget Sound beaches; 1/3 of those dig clams. The Department of Fisheries counts 441,000 clam digging trips per year in Puget Sound, yeilding 1,367,200 pounds of clams; and commercial shellfish production: 13,384 pounds per year, 800 people employed during the peak periods, and \$10 million contributed to the state's economy.

Clams and oysters feed by filtering micro-organisms from large quantities of water--as much as 50 gallons a day are pumped through an oyster. They filter out bacteria as well as the phytoplankton on which they feed. This can result in concentrations of micro-organisms many times higher than the levels found in the water. In order to protect public health, a tissue level standard has been set that commercially sold shellfish must meet.

State water quality standards are designed to protect designated water uses. Shellfish culture is a designated use in Washington's marine waters and state water quality criteria are established to protect this use.

I deliberately use the term "bacteria" or "bacterial contamination" because that's the public health concern. The technical water quality parameter is fecal coliform--this is an indicator organism that is found in the intestinal tracts of warm blooded animals. Sources of contamination are human sewage from failing septic tanks, runoff from animal keeping, and in-stream sources.

The Department of Social and Health Services certifies commercial shellfish growing areas, and they consider both water quality and shellfish tissue standards. Alarmed by the extent of decertified areas and recent closures, the Department of Ecology mounted a special effort to protect this valuable resource. Shellfish require an extraordinarily high quality of water--if we can protect this use, we protect all beneficial uses of marine water.

The Department used funds from Section 205(J) of the Federal Clean Water Act, and funds from the Federal Coastal Zone Management Act to put together a shellfish protection program. Elements of the program include: One-year intensive surveys of Burley Lagoon and Minter Bay in Pierce County (please refer to Figure ____). The Department Ecology's Water Quality Investigations Section is doing this work. These surveys involve frequent sampling at many locations during various streamflows, tide and weather conditions. The purpose of these surveys is to help us understand the transport mechanism by which bacteria in the water result in shellfish contamination, and to find and correct sources of contamination. The choice of Minter Bay and Burley Lagoon came from the Shellfish Advisory Committee, which includes all involved agencies and representatives of commercial shellfish growers.

Using Coastal Zone funds, the Department of Ecology's Shorelands Division is developing a package of technical assistance measures to use in basin planning--it includes land use, animal keeping and drainage practice elements.

The Shorelands Division has developed a comprehensive strategy for shellfish protection that attempts to intergrate the various programs and activities to focus on effective protection of the shellfish resource. The shellfish protection program is a part of the WDOE/EPA Puget Sound Management Program.

I have been talking about commercial shellfish so far. What about recreational harvesting? And what about paralytic shellfish poisoning (Redtide)? Dr. Nicola, the Tacoma-Pierce County Health Officer, can address the questions of risk, and who looks after the sport harvest.

On another very important issue, the Federal Clean Water Act requires municipalities to apply secondary treatment to municipal discharges by July 1, 1988, unless a waiver from this level of treatment is granted under Section 301(h). These marine waivers are

only available to cities which discharge into deep marine waters. EPA determines whether a waiver can be granted, but the state must concur.

Washington State law requires that wastes must receive "all known, available and reasonable methods of treatment" prior to discharge to the waters of the state. State law makes no distinction between discharges to marine waters and discharges to fresh waters. This has created a dilemma for the State. A bill clarifying the State's authority to concur in marine waivers was introduced in the 1983 Legislature; it passed the House but did not clear the Senate. Subsequently, a formal Attorney General's Opinion was requested by the Department of Ecology. That opinion is due to be published soon.

The State has 29 applications for marine waivers filed with EPA. There is a time clock ticking--EPA has deadlines it must meet in processing these applications. Congress has limited the opportunity for cities to apply; if the current applications are rejected or denied, the door is closed. The Department of Ecology's actions thusfar has been designed to keep that door open until the legal, technical and policy issues are resolved.

Meanwhile, keep an eye on Congress and the reauthorization of the Clean Water Act. The House version (Congressman Howard's Bill) currently deletes the words "estuarine waters" from Section 301(h). The Senate Bill, S431, establishes very strict criteria for flushing and exchange characteristics of marine waters in order to qualify for a waiver from secondary treatment.

The Department of Ecology places very high priority on municipal compliance by the deadline of July 1, 1988. If the State is unable to concur in waivers from the secondary treatment requirement for marine discharges, then the feasibility and cost of achieving compliance by 1988 changes drastically. I don't believe that Congress will extend the deadline; I don't believe that they can without jeopardizing the credibility of the Clean Water Act. The secondary treatment deadline for municipalities has been extended twice--from 1977 to 1983, and then to 1988.

I hope that in our Roundtable discussion we can begin a public dialogue about what I consider to be the public policy issues of municipal treatment and water quality in Puget Sound. A big issue is: Where will the dollars come from? The Federal Construction Grants program is being phased out. The future of the state grants program is uncertain. The availability of federal and state financial assistance has been taken for granted in the scenario for compliance with the Clean Water Act. This Conference is an appropriate time and place to address these issues.

I will close with an observation about where we have been and where we are going. To clean up biochemical oxygen demand and suspended solids is an engineering problem; dealing with toxic contaminants is a scientific problem.

LONG TERM ISSUES IN PUGET SOUND

DR. JOHN A. VANDERMEULEN
Marine Ecology Studies Laboratory
Bedford Institute of Oceanography
Dartmouth, Nova Scotia

Introduction

The timing of this conference is very appropriate, firstly because the evidence of apparently pollution-related diseases in Puget Sound fish suggests a potential problem, that should be addressed now, and not at some later date. And secondly, because similar problems are now being recognized elsewhere in the world, not only in other regions of North America, as in Chesapeake Bay, Los Angeles, and the New York Bight, but in European waters, in the outflows of the Rhine River and in the Baltic.

The fact that similar problems (of a similar magnitude or of even greater magnitude) come from other parts of the world is in a way useful to you here, vis-a-vis assessing Puget Sound's water quality. One can learn from those other situations, and see what has been done there to cause the problem and what has been done, if anything, to alleviate the problem.

There is one intransigent difficulty, however, in doing that kind of assessment--this is the complexity of ecosystems. This is an overwhelming part in assessing water quality and coastal zone contamination. It is equally overwhelming to the scientist as it is to the administrator or to the private citizen. One reason for this is that nature is made up of many parts.

I ask you to compare the health of Puget Sound or even your backyard garden, with the health of a human body. We can visit our doctor or the neighborhood clinic and have a battery of test run. It is a very simple and straightforward process and within a certain degree of certainty, your doctor can assess your problem and then try to come to some sort of solution. The problem with the ecosystem or even your backyard is vastly different. In those systems we are dealing with a wide range of organisms that differ each in their sensitivity to contaminants and to other factors. There are intricate interrelationships between any two of the organisms making up that system, whether the backyard or Puget Sound. Those interrelationships can vary, one from another.

To try and arrive at some kind of comprehensive understanding of all of those organisms and their sensitivities and of their interactions--this magnifies the problem beyond human comprehension. I suspect that we are not going to resolve this problem this year, or even this decade. We will still be working on the problem in the 21st century. This problem will continue with us as long as man continues to increase in numbers, as long as our populations continue to condense into centers called cities, and as long as society continues to develop technologically new items.

In the next few minutes I will address these two main points that I have raised--(1) that water pollution problems in large water bodies as Puget Sound are not unique, and (2) the complexity of these

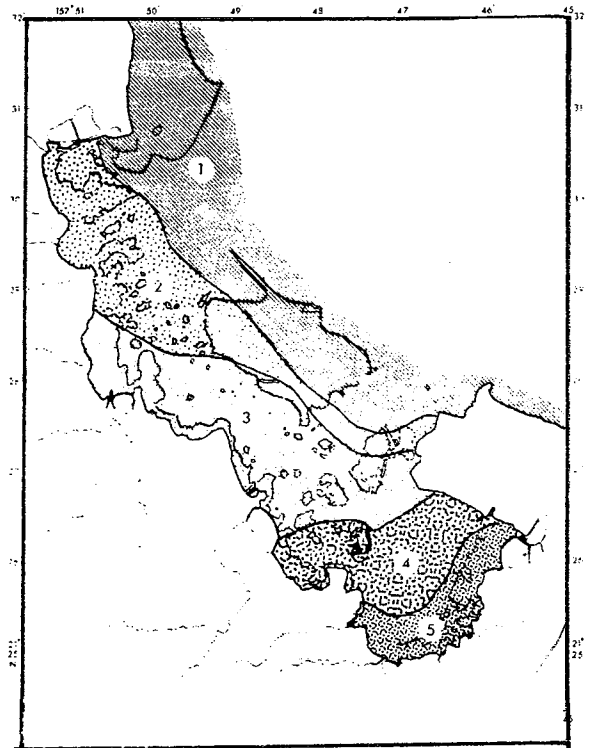
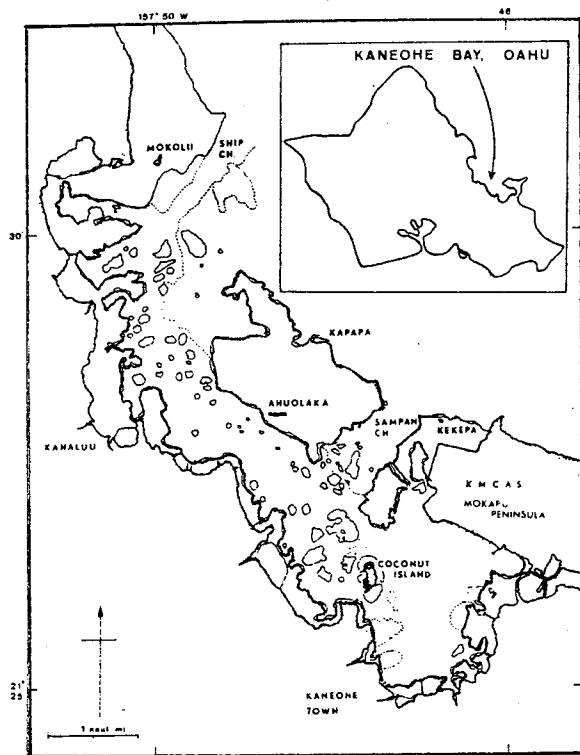


FIGURE 1

Left - Kaneohe Bay (inset, Island of Oahu), Hawaii. Right - extent of invasion of the encrusting alga, *Dictyosphaeria cavernosa*, in the bay: 1. northern zone (unaffected); 2, 3, transitional; 4, heavily affected; 5, dead coral. (From Banner and Bailey, 1970)

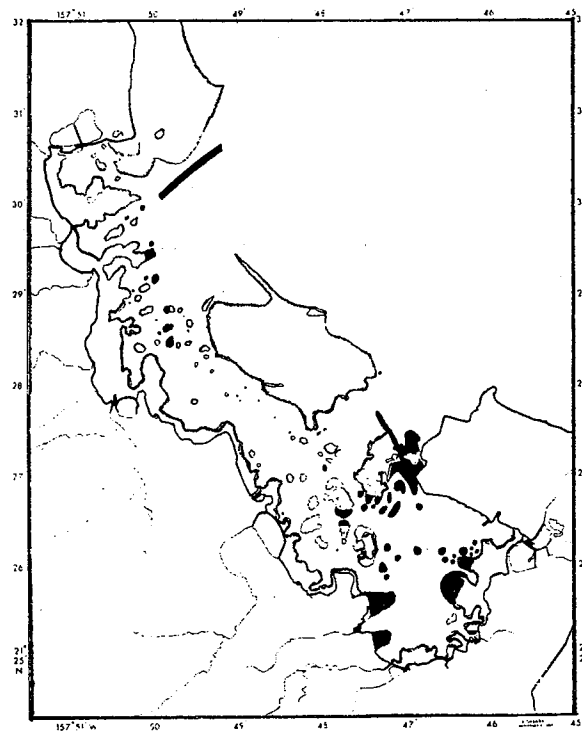


FIGURE 2

Kaneohe Bay, showing reef areas dredged in 1939-1941, in black. (After Banner, 1974).

systems. The common ground in both these points is that the problem is not immeasurable. I agree it is complex, but we can now visualize the various pieces of the puzzle. We can dissect the very large problem of Puget Sound pollution into its components. And we can also see, from earlier examples and case histories, the various causes that have led up to similar pollution problems in other regions. We will consider in particular two examples of coastal pollution--one in Hawaii, the result of a combination of population growth related problems; the other on Canada's east coast, involving the accidental long-term release of cadmium into coastal waters. In our look at these examples we will highlight "take-home lessons," which will lay the basis for our subsequent look at Puget Sound itself.

I. Kaneohe Bay: Hawaii

The first example is especially interesting in that it could serve as a model for what is happening to Puget Sound. Kaneohe Bay is a small bay on the north side of the Island of Oahu. The bay itself is about 17 kilometers in length by about 9 kilometers wide, on average (Figure 1). It has only about 8.9 kilometers of waterfront open to the Pacific Ocean.

Until about 1940, the area around Kaneohe Bay was largely agriculture, with meadowlands surrounding the bay. The region enjoys a very heavy rainfall during the winter rainy season, with heavy freshwater outflows into the bay during these periods.

However, beginning with about 1940, the situation, both on land and in the water, changed very rapidly. Up until 1940, the bay was characterized by a very florid growth of reef-building corals, arranged variously in patch reefs, fringing reefs, and one reef that surfaced in the form of a small atoll, Coconut Island. The latter has been the site of the University of Hawaii's Marine Laboratory. Beginning in the early 1970's, a survey of the bay showed that an encrusting form of alga had overgrown large areas of the southern part of Kaneohe Bay. A lesser infestation was found in the middle regions, with little or no encrusting alga in the northern parts.

The direct causes for the occurrence and overgrowth of this encrusting alga will always be unclear, because of the aforementioned complexity of nature. No one factor is ever the cause for any change in an ecosystem, except in rare instances--as for example an unusually heavy rainfall in an otherwise arid region, or the introduction of a particularly toxic or harmful effluent into an otherwise pristine environment. In this particular case, that of Kaneohe Bay, the domination of one ecosystem, based on the reef coral, by another, characterized by the encrusting alga, occurred over a period of time, and is the result of a number of factors, acting unfortunately in conjunction.

Factors Before 1940

Prior to about 1940, the main activity was agriculture or mariculture and fishing. However, heavy amounts of overgrazing in the area during the preceding decades eventually led to denudation of the wooded and grassy cliffs around the Bay. In time this led to

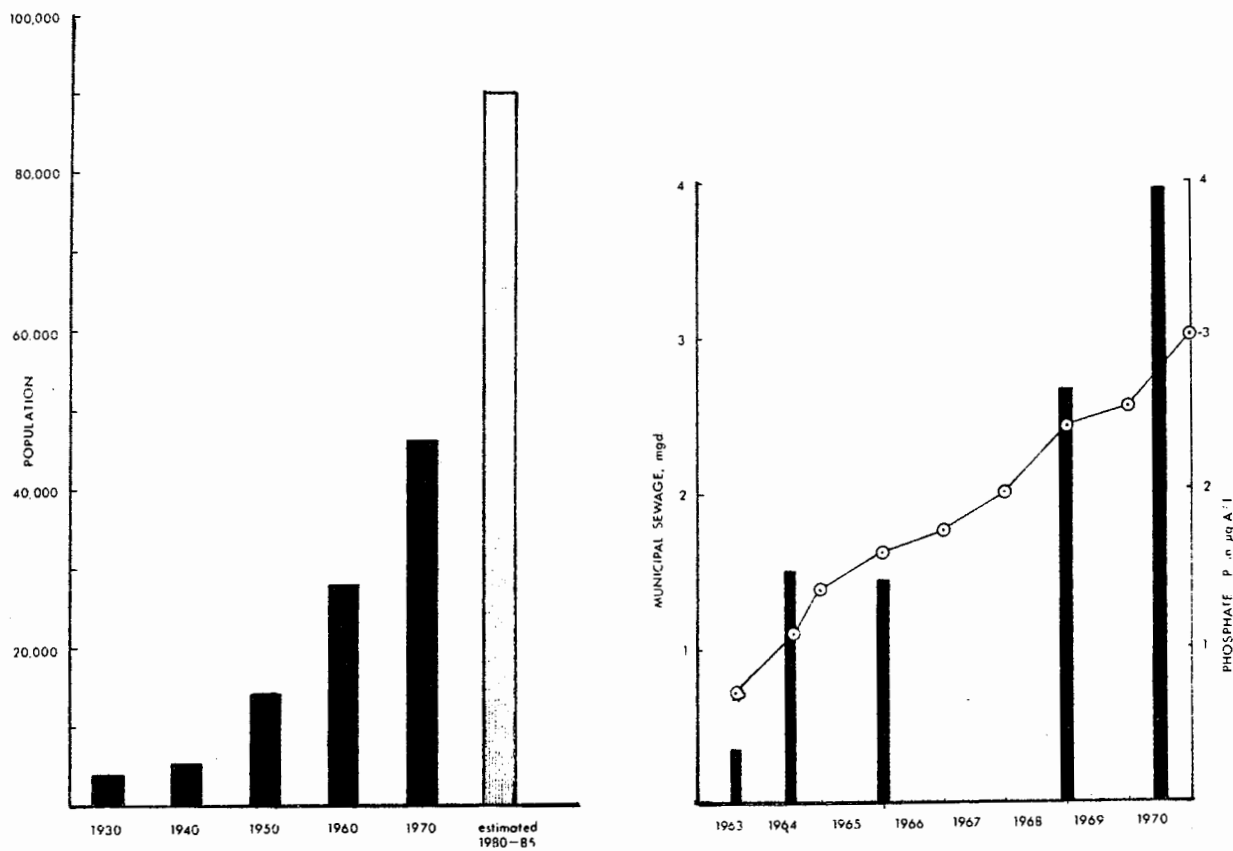


FIGURE 3

Population growth and sewage disposal in Kaneohe, Hawaii, 1930-1970. (From Banner, 1974)

	SOUTH BAY	MIDDLE BAY	NORTH BAY
LIGHT EXTINCTION COEFFICIENTS			
JULY 1965	0.16	0.09	-
1969	0.32	0.20	
APRIL 1971	0.53	0.31	0.27
PHOSPHATE LEVELS (UG A/L)	1.68	-	0.1333
INORGANIC NITROGEN (UG A/L)	4.06	2.03	1.61
INCREASE IN PHYTOPLANKTON			
1960-1970 (CHLOR. A)	1.56	0.38	0.07

TABLE 1

Water Quality Parameters in Kaneohe Bay, 1969-1974. (Data taken from Banner, 1974)

increased runoff into the embayment and inevitably to increasing siltation.

Urban Development

It is unlikely that overgrazing by itself would have caused any problem. But by about 1940 expansion of development came to the area, and we see the first signals of major dramatic change in the ecological character of the area--paving of the meadows and wetlands. Where previously the land surface acted to absorb the sudden extremes in rainfall, now the combination of paving-over and the new direct channels to the Bay ensured that the extremes of rainfall and erosion would impact directly onto the Bay. The result of this has been that tremendous pulses of fresh water were injected into a saline environment, carrying with them very heavy loads of silt and materials eroded from the hillsides and channel banks.

Dredging

Further changes occurred with the onset of World War II and the establishment of a large Marine base at one end of the Bay. Alterations included dredging for (a) shipping lanes through bay's reef system; and (b) the topping of patch reefs to allow landing of seaplanes in the southern bay (Figure 2).

In the course of construction about 133 cubic million feet of dredged material of reef coral material were eventually removed from the various reefs within the Bay. To be fair, most of the dredged material was dumped elsewhere outside the Bay or was used as landfill. Nonetheless, this was yet another factor in the general changing environment of this ecosystem.

Obviously a large amount of calcium carbonate particles were released into that embayment, and similar to the situation in Puget Sound, these are not easily flushed out.

Population Expansion

The third factor was an awesome increase in population, from just over 4,000 inhabitants in early 1940 to over 40,000 by 1970. As a direct result of World War II and the Marine Base, and the later tourist-discovery of Hawaii, the area had to absorb a truly immense population explosion in under 25 years--from meadow to supermarket parking lot.

The process was accompanied by sharp rises in sewage production, and its outfall into the Bay. (Figure 3)

The result has been a marked change in the water quality of Kaneohe Bay, as indicated by decreases in light penetration--light extinction coefficients (Table 1) rises in such nutrients as phosphate, an increase in phytoplankton, and eventually changes in the community of bottom-dwelling organisms. These changes have been most pronounced in the southern end of the Bay, that part of the Bay ringed by the marine base, by the burgeoning town of Kaneohe, the sewage outfalls, and the water runoff.

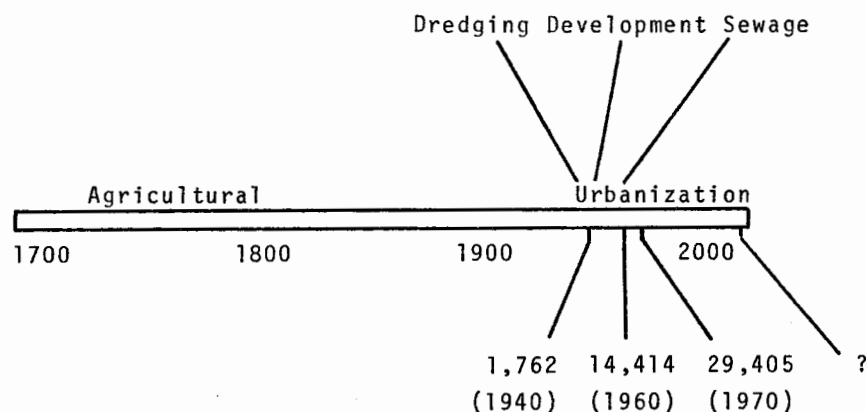


FIGURE 4

Schematic summarizing time-scale of environmental impacts on Kaneohe Bay, Hawaii. (Population data from Banner, 1974)

	ORE (225,000MT)	& COTTRELL DUST (4,500MT)	SINTER	PRODUCT
PB	38 %		30-32 %	60,000MT PB
S	27		0.1	175,000MT H ₂ SO ₄
FE	14		20-22 %	
CU	N.A.		.6-1.0	3,600MT CU
ZN	10		7.0-8.0	
CD	.02	CA. 1-2%	.3-.38	± 545MT CD

TABLE 2

Percentages of Metals (including Cadmium) at different stages of lead-smelting and refining at Belledune. (Taken from Uthe and Zitko, 1980)

In reviewing this parade of factors, which seen in hindsight all played a role in the degradation of water quality and the reef coral community of Kaneohe Bay, the factor that sticks out most dramatically of course is the rate at which all these factors occurred, in terms of the time scale for the Bay (Figure 4). The bay as an ecosystem was formed, slowly, over eons of time. Man urbanized it in 1940 with 4000 people, and jolted the system with population expansion, and its accompanying factors, in less than three decades, to over 40,000--i.e., a complex insult of a number of man-made activities impinged on a small, contained embayment that was not designed to accept or accommodate such insult.

"Take-Home Lesson 1"

Environmental pollution results from two main factors: expanding population pressure, and the time-scale in which this occurs. In all known cases the population expansion and the pollution incidents accompanying this occurred over a very brief period, relative to the time scale nature normally operates on.

II. A Coastal Cadmium Spill

The second example is that of spillage problems that resulted from lead smelting activities on Canada's east coast, but there are also some interesting implications in terms of bio-availability of toxic contaminants.

The story is very simple. About 1977, clams, lobsters, and crabs taken from the Belledune Harbor and from adjacent waters were found an inordinately high level of cadmium. The puzzle, of course, was to determine where the cadmium originated and the finger was pointed at the Belledune lead smelting plant. The story illustrates, in a most simple way, two significant points. First, that we can expect a toxic effect, not necessarily from the main product of some process, but also from the by-product--in this particular instance a very small amount of cadmium originating from a very large turnover in refining and smelting of lead.

The second point is that despite the very low levels of cadmium in the water column, surprisingly high levels were found in the biota. Table 2 illustrates in a very simple way the relative proportions of lead and other materials that pass annually through this smelting operation, producing not only a very large amount of lead, but also respectable amounts of sulfur, which is in turn converted to fertilizer. Cadmium clearly is a minor aspect of the operation, amounting to only about 545 metric tons versus 60,000 tons of lead or 175,000 metric tons of sulfuric acid.

Yet the combination of sediment absorption processes and sorption of water-borne cadmium onto particulate matter in the water column resulted in a cadmium-contamination problem that eventually carried over into the bottom-dwelling organisms and those in the water column.

Analyses have indicated that the cadmium from the plant followed various routes, including via air emission, rain runoff from the plant generally, including the pavements and the machinery and the

	Belledune harbor	coastal zone	biota
Sediments	9-61 ppm	.1-1.8 ppm	lobster 11.6-30 ppm
Suspended matter	6.6-96 ppm	2.1-6.2 ppm	muscle 18.9-112 ppm
Seawater	.17-125 ppb	.38-.75 ppb	seakelp .42-1.84 ppm shorekelp 1.7-30 ppm

TABLE 3

Concentrations of cadmium in various environmental compartments (physical/biological) in offshore stations within 17 km from Belledune lead smelting operations. (After Uthe and Zitko, 1980)

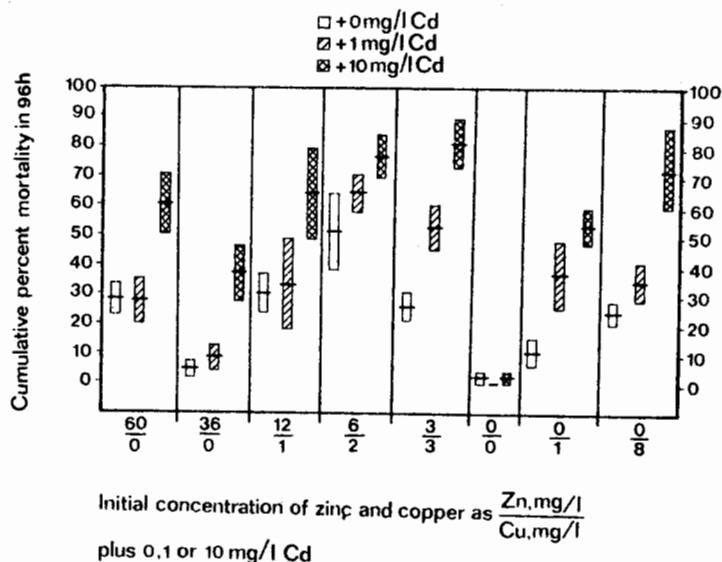


FIGURE 5

Synergistic toxic action of cadmium, zinc, and copper on the intertidal fish Fundulus heteroclitus (mummichog). The individual concentrations of cadmium alone are too low to produce any mortality in mummichogs. (Eisler, 1971). However, small amounts of copper and/or zinc will result in significantly increased mortalities. (After Nriagu, 1980)

buildings, leaching of water running through the stored cadmium material at the end of the refinery process, and so forth. The end result was that in Belledune Harbor between 1977 and 1980 the sediments were found to contain as high as 61 parts per million.

Concentrations of cadmium in the suspended particulate material in the water column are also in the parts per million range, not too surprising since much of that material is probably derived directly from the bottom sediments. The harbor water column is relatively low, but still contains up to 0.1 ppm cadmium (Table 3).

In contrast, 15 kilometers downshore from the Belledune Harbor the sediments have decreased to a range in the order of 1.0 ppm, the suspended matter is 2.0 to 6.0 ppm, and concentrations in the water column have decreased to the low ppm range.

A very different pattern arises, however, when we compare at the same time the tissue cadmium concentrations in marine organisms that inhabit these three different compartments--the sediments, the suspended particulate material and the water column itself. Parallel analyses show that lobster tissue, from these contaminated sediments also contain cadmium in the parts per million range. This in itself is not too surprising, since biological concentration factors for cadmium have been calculated in the order of 1,000 times and higher.

Again, it is not too surprising that such marine filter-feeding organisms as mussels, which filter out suspended organic particulate material from the water column, also contain high levels of cadmium, in the ppm range.

Much more unexpected, however, is the observation that even marine plant tissues contained cadmium in the low parts per million, clearly derived in dissolved form from the water column via their leaf cell surfaces. And the respective concentrations, water column vs. plant tissues, indicate that bio-accumulation is again an important process.

"Take-Home Lesson 2"

The right mix of environmental factors, such as sediment absorption and water solubilities, can elevate a minor by-product into a major contamination problem.

"Take-Home Lesson 3"

Bio-accumulation and magnification can result in tissue contaminant concentrations well above those found in the water column or sediments, i.e., a simple examination of environmental concentrations is no indication of potential tissue contamination levels.

III. Contaminants and the Ecosystem.

The problem becomes more complex because of two features of the action of contaminants--synergistic toxicity and sub-lethal toxicity. Synergistic toxicity simply stated describes the phenomenon that the combined toxicity of two or more contaminants in some way is greater

Initial concentration in mg/l, Zn ²⁺ /Cu ²⁺ /Cd ²⁺	No. moribund fish (n=6 per group)	Incidence of histologic lesions*		
		Kidney	Lateral line epithelium	Oral epithelium
0/0/0	0	0	0	0
0/0/1	0	0	0	0
0/0/10	0	0	0	0
0/1/0	2	+++	+++	0
0/1/1	1	+++	+++	0
0/1/10	2	+++	+++	0
0/8/0	1	+++	+++	+++
0/8/1	4	+++	+++	+++
0/8/10	6	+++	+++	+++
3/3/0	6	+++	+++	+
3/3/1	6	+++	+++	+
3/3/10	6	+++	+++	0
6/2/0	2	+++	+++	+
6/2/1	6	+++	+++	+
6/2/10	6	+++	+++	0
12/1/0	6	+++	+++	+++
12/1/1	3	+++	+++	+++
12/1/10	4	+++	+++	+++
36/0/0	0	0	0	0
36/0/1	0	0	0	0
36/0/10	1	+	0	0
60/0/0	5	0	0	+++
60/0/1	5	0	0	+++
60/0/10	5	+	0	+++

TABLE 4

Interaction of zinc, copper, and cadmium and the incidence of tissue abnormalities (histologic lesions) in mummichog exposed to individual and combined concentrations of the heavy metals. (From Eisler and Gardner, 1973)

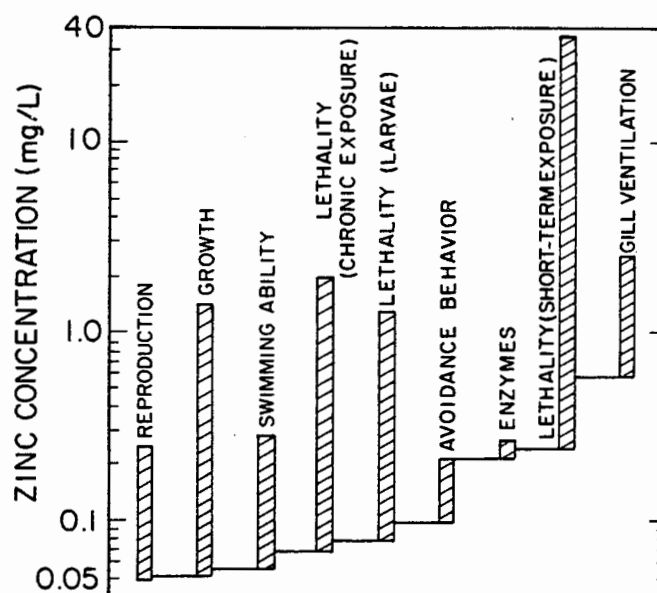


FIGURE 6

Typical "stepped" response of an aquatic organism to zinc exposure. Note that onset of sub-lethal toxic effects occur at zinc concentrations well below those required to elicit acute mortality. (From Phillips, 1980)

than that of the contaminants taken separately. This phenomenon is illustrated in Figure 5, which shows the influence of cadmium on the individual and the combined toxicities of copper and zinc.

This combined effect is shown again in a slightly different way in Table 4, which relates synergistic toxicity of cadmium, copper, and zinc to a range of histopathological abnormalities such as skin lesions. The significant point here is that the combination of even very low concentrations will cause significant disease problems, apparently absolutely unrelated to the actual amount of any one of the causative contaminants.

It is precisely this latter point that underlies many of the concerns of environmental scientists studying water quality and its epidemiological aspects. One cannot establish a simple concentration/toxicity threshold for cadmium, or for zinc, or for polycyclic aromatic hydrocarbons, in isolation of the other contaminants also found in that environment. Establishing an allowable toxicity concentration for a contaminant may be useful, if that is the only contaminant in the water column or sediments. However, in the presence of a second and/or a third other contaminant, the toxic effect used to determine the first allowable concentration may well be expressed at a concentration an order of magnitude lower.

"Take-Home Lesson 4"

In meaningful environmental assessment and planning, discussions must include potential synergistic effects of multi-species contamination, i.e., a concentration of a contaminant, normally considered too low to be toxic, can become toxic through the presence and combined action of other contaminants.

This touches on the second feature of toxicity, that is the sublethal toxicity of contaminants versus their acute lethal toxicity. The latter toxicity is the one that is normally determined in toxicity tests, and is the basis for the determination of allowable toxicity levels. Expressed usually as LC50 concentrations, these are concentrations of contaminants that will cause 50 percent mortality in a number of test organisms over a known period of time (usually 24-, 72- or 96 hours). The problem with that approach toward establishing toxicity is that under natural (i.e., ecological/ environmental) conditions and organism will probably fall prey to its predator or in some other way will be harmed well before that lethal concentration is reached. That is to say, the LC50 is an artificial standard, useful for ranking the relative toxicities of different substances, but not at all relevant to the natural environment where one can determine effects on reproduction, on egg development, on larval survival, on metabolism and growth at contaminant concentrations in some cases several orders of magnitude below those necessary to kill that organism.

The problem is illustrated in Figure 6, which shows the concentrations ranges at which some of these sublethal effects are expressed by zinc in one test organism, in comparison with the lethal concentrations. Clearly these different effects occur at different toxic concentrations. The difficulty therefore arises in determining which toxic concentration one uses to evaluate the health of a water

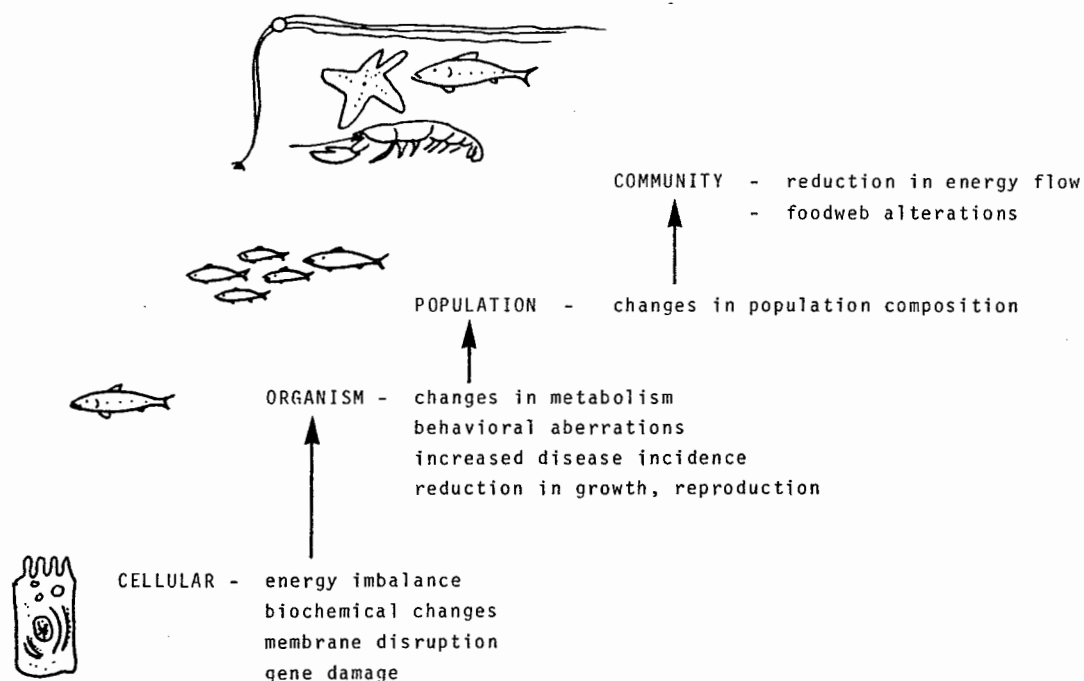


FIGURE 7

Biochemical or physiological disruptions due to toxic contaminants at one level of organization can elicit further disruptions and imbalance at subsequent levels. Thus progressive and persistent contamination can eventually lead to disruptions at the community level. (After Capuzzo, 1981; Vandermeulen and Capuzzo, 1984).

COMMUNITY	-	KANEOHE BAY, HAWAII RHINE RIVER SEWAGE OUTFALLS/INDUSTRIAL HARBORS
POPULATION	-	NEW YORK BIGHT NORTH SEA DUMP-SITES
ORGANISMIC	-	CHEDABUCTO BAY WEST FALMOUTH
CELLULAR	-	LARGE OIL-SPILLS/OTHER TOXICANTS ENZYME CHANGES NEAR REFINERIES

FIGURE 8

Examples of environmental contamination/disruption at various levels of biological organization for the marine coastal zone.

body--that concentration at which reproduction is threatened, that concentration at which juvenile organisms experience development problems, that concentration at which adults experience behavioral difficulties, or that concentration at which metabolism is perturbed? By themselves these concentrations will not kill an organism within 72 hours. But is that a valid criterion?

"Take-Home Lesson 5"

The establishment of lethal concentrations does not take into account that degradation of health, of reproduction, of development can occur at contaminant concentrations well below those considered lethal.

One useful way of viewing the problem of environmental pollution is with the scheme developed by Dr. Capuzzo of the Woods Hole Oceanographic Institution, in which the environment is viewed as a series of sequential steps or stages--with environmental degradation resulting from pollution moving progressively from one, the lowest, stage to the next higher, until the entire system collapses (Figure 7). Dr. Capuzzo argues that each level, beginning at the biochemical and/or cellular and progressing eventually to the level of the ecosystem, can tolerate some contamination and some contamination-related changes and deterioration. Also at each level there are compensatory mechanisms which can offset the toxic effects of the contaminant. However, as these are over-ridden, as for example through chronic exposure or through weakening of the system or through overloading, then the abnormalities at that level are too many, and impact is then felt at the next level. Thus, increases in metabolic problems at the organism level if not corrected, will eventually show up as a weakening at the population level. Such perturbation at the population level, if severe enough, may lead to loss of such a population and a rearrangement at the community level. The appearance of certain "opportunistic species" in areas receiving large sewage loads is a prime example of perturbation at the population and the community level.

This scheme also has predictive potential, in that one can examine an ecosystem for evidence of abnormal behavior or functioning at its various levels. And in fact there are examples of such disruption in several regions of the oceans (Figure 8). The earlier example of mass reef community disruption in Kaneohe Bay, Hawaii clearly represents disruption at the highest level of organization, having surpassed all of the levels below it. Similarly there exist problems at the population level in the New York Bight and near dump sites in the coastal waters of the North Sea. Problems at the organismic level can be seen in a great many places, as in Chedabucto Bay, site of the 1970 ARROW tanker oil spill. In that particular instance the environment is undergoing marked recovery, and is progressing downwards in Dr. Capuzzo's scheme, recovering from the spill damage through the various recovery processes that nature can call on--reintroduction of species that were killed off, temporary invasion of opportunistic life forms to maintain a productive biomass, and physical and chemical erosion of the residual oil.

POPULATION	REDUCED SETTLING AND COLONIZATION	(SCHOENER)
	REDUCED TAXON RICHNESS	(MALINS ET AL '82)
MORTALITIES	INCREASED IN AMPHIPODS	(SWARTZ ET AL '82)
	INCREASED IN OYSTER EMBRYOS IN 96H ASSAY	(CUMMINS US/EPA)
PHYSIOLOGICAL	REDUCED RESPIRATION RATES IN OLIGOCHAETES	(CHAPMAN ET AL)
DEVELOPMENTAL	ABNORMALITIES IN OYSTER EMBRYOS 96H ASSAY	(CUMMINS US/EPA)
	INCREASED CELL MUTATION RATES IN FISH	(CHAPMAN ET AL)
DISEASE	LIVER LESIONS IN ENGLISH SOLE	(MALINS ET AL '80 '82)
	HIGH FREQ. MIDGUT LESIONS IN CRABS	

TABLE 5

Field and laboratory measures of adverse biological effects and results for Commencement Bay, Puget Sound. (After Long, 1982)

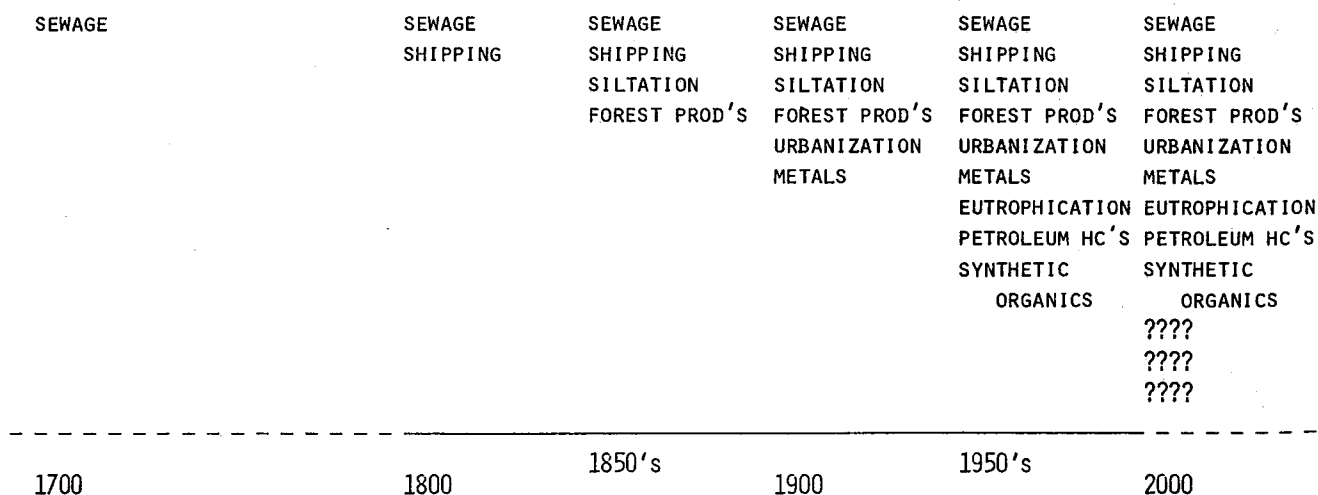


FIGURE 9

Time sequence of pollution impacts on Puget Sound.

"Take-Home Lesson 6"

"All responses (to pollutants) are not disruptive in nature and do not necessarily result in the degeneration of the next level of organization (there being adaptive mechanisms in nature). Only when the compensatory or adaptive mechanisms at one level begin to fail, do deleterious effects become apparent at the next level. For predictive purposes, one must be aware of the early warning signs of stress at each level before compensatory mechanisms are surpassed." (Capuzzo, 1981)

If we apply this scheme to Puget Sound, and list the available evidence of pollution impact into the various levels (Table 5) then clearly there is an indication of disruption, at least at the lower levels of organization (viz. Take-home Lesson 6). While these perturbations are not uniform across the Sound, i.e., to our knowledge not all fish have an unusual incidence of skin lesions and not all larval forms are experiencing settling problems, clearly there are single data points that suggest a pattern of abnormalities that are perhaps different from what we would expect in a non-polluted region. Clearly, the defense or compensatory mechanisms at each level for the whole Sound have not yet been tripped. But in some localities the compensatory mechanisms appear to have been overridden. For example, the reduction in species richness in benthic populations of some of the parts of the Sound suggests that some species were forced into reduction through some incorrigible impact on the organismic (metabolic, growth) level.

IV. The Underlying Cause

It is not very difficult to find the cause or causes for this coastal marine pollution. There are two--an ever increasing human population that tends to concentrate into large human population centers, and the increasing development of materials to make our life more comfortable, but at the same time not too compatible with life on this earth--that is, human life on this earth.

Dealing with the second cause first, the transition from one kind of waste to a bewildering range of wastes as experienced by Puget Sound itself is shown in Figure 9. In a way it is a mirror-image of the environmental impact on Kaneohe Bay. From 1700 to 1800, sewage was about the only problem in the Seattle region, and it probably was not much of a problem. By about the 1800's, there is added to this, increased shipping. By the 1850's, siltation becomes a factor, with the increasing development of Seattle, Tacoma, and a few other urban centers now large enough so that runoff and forest products become significant features of the environmental landscape.

However, by the 1900's, the pattern of waste effluent is changing to include contaminants that are chemically of a different nature. By the 1950's, we have added eutrophication, i.e., enrichment of the coastal waters through the runoff of chemicals that are potential fertilizers, both from agricultural runoff but also from human wastes from a burgeoning human population encircling Puget Sound. These unwanted fertilizers can cause marked changes in the natural ecological balance, causing unwanted blooms in marine algae which can in time both smother existing species but also, being the

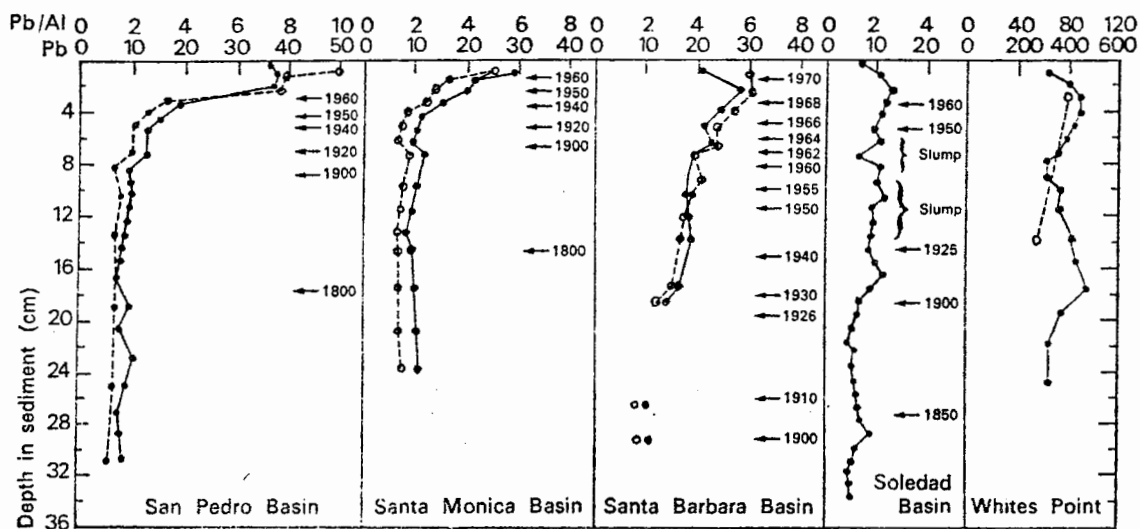


FIGURE 10

Lead concentrations in bottom sediments from coastal waters off southern California, and from the Whites Point (Los Angeles County) sewage outfall. The Soledad site is not adjacent to industrial or urban outfall, and is used here as a non-contaminated reference location. (From Goldberg, 1976)

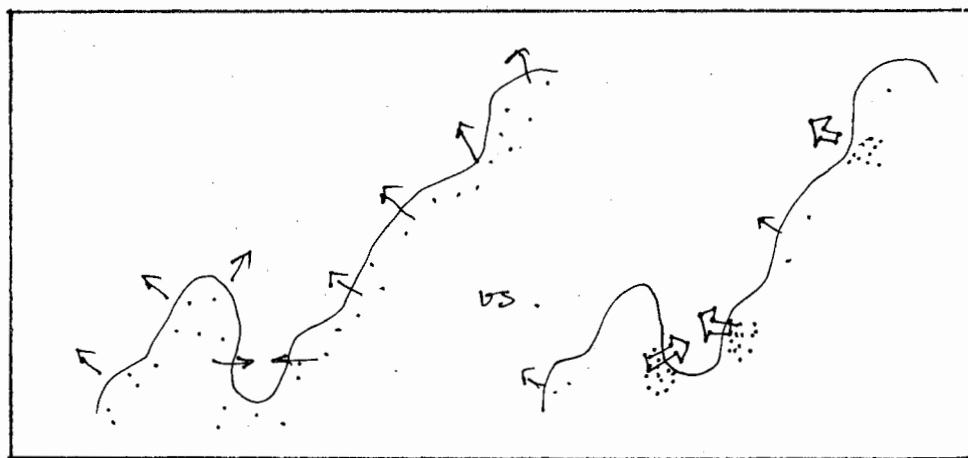


FIGURE 11

Schematic representation of the effect of concentrating population centers on sewage and waste outfall into coastal waters. Left - homogeneously distributed coastal population. Right - patchy distribution of heterogeneously concentrated population centers.

wrong food for the existing animal populations, give rise to a drastic change in the animal populations of the Sound.

The transition in the chemistry of wastes includes increasing releases of petroleum hydrocarbons and a new class of chemicals, the synthetic organics. Besides being toxic, the latter also share other properties that make them real problems in the environment--they are long lived with long turnover (degradation) times, and often they are lipid, i.e., fat-soluble. The latter property means that they are readily stored in fatty tissues, once taken up by an organism.

This part of man's increasing impact on his marine environment is very clearly shown in Figure 10, depicting increases in lead concentrations in coastal marine sediments off Los Angeles, California. This analysis of marine sediment cores shows very clearly the correlation between the expansion in man's activities in the Los Angeles region and the deposit of lead emanating from the use of automobiles for the same time period. Very dramatic is the awesome increase in lead concentrations since 1955, exceeding manyfold the background concentrations prior to the 1900's.

A wide range of examples exists that can be used to illustrate this point, but they all indicate that the primary culprit in this problem is man himself. We are by nature an integrating community, a companionship-seeking society that seeks each other out and congregates in large urban centers. The wastes of these centers therefore also become concentrated in its effluent points, causing problems if they are centered on embayments such as Kaneohe Bay, or on large enclosed or semi-enclosed water bodies at Puget Sound (Figure 11).

We tend to not recognize this phenomenon of population increase because of our subjective involvement--comparing this year's population with that of five or ten years ago, and planning in our municipal and regional projections only five, ten, or at most fifteen years hence. However, if we view these same population trends more objectively, over a period of one hundred years, then the urbanization of an area is seen to be a very dramatic and sudden feature of that environment (Figure 12). Thus seen in terms of the larger time scale and as a "long-running" ecosystem, the population growth for the Puget Sound region represents a sudden pulse of human activity together with its impact that is of an entirely different nature, than would be a similar growth, but extended over a much longer time period.

The environment cannot react, cannot respond in a gradual way to that kind of increase in the population and all that it entails. If the environment were able to do that, if the changes were stretched out over a long time scale, then it would be able to change and adapt physically, physiologically and biochemically. But it does not have that opportunity. Organisms and communities and ecosystems do not have the fast response time that is required here. Instead, man pumped in a projected population of three million in only 50 - 60 years. Obviously, the system has difficulty responding.

The solution to the problem is not clear. We can identify the causes rapid population growth and technological development of new wastes and new products. Clearly that is where your answers are going

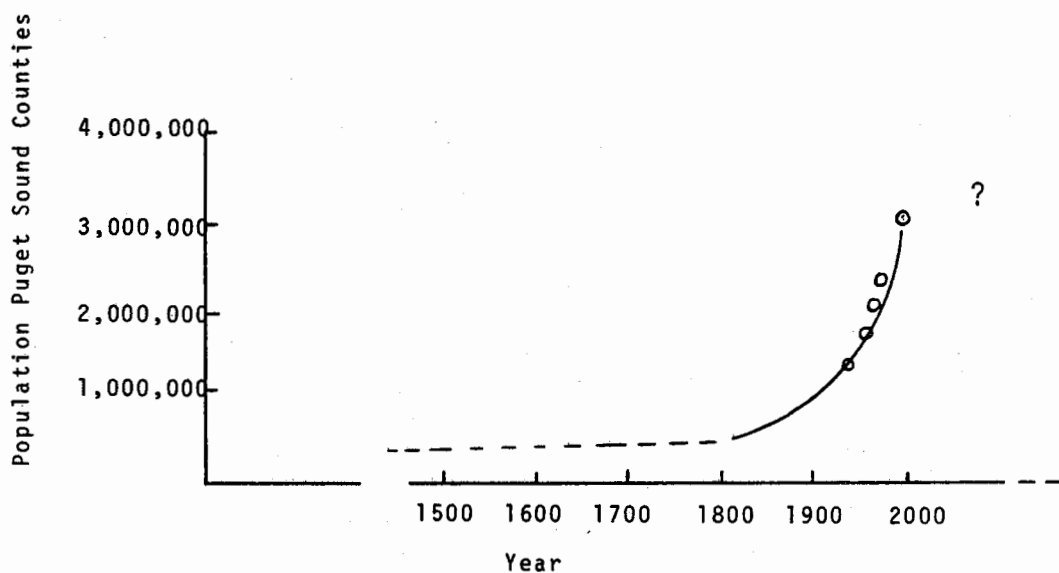
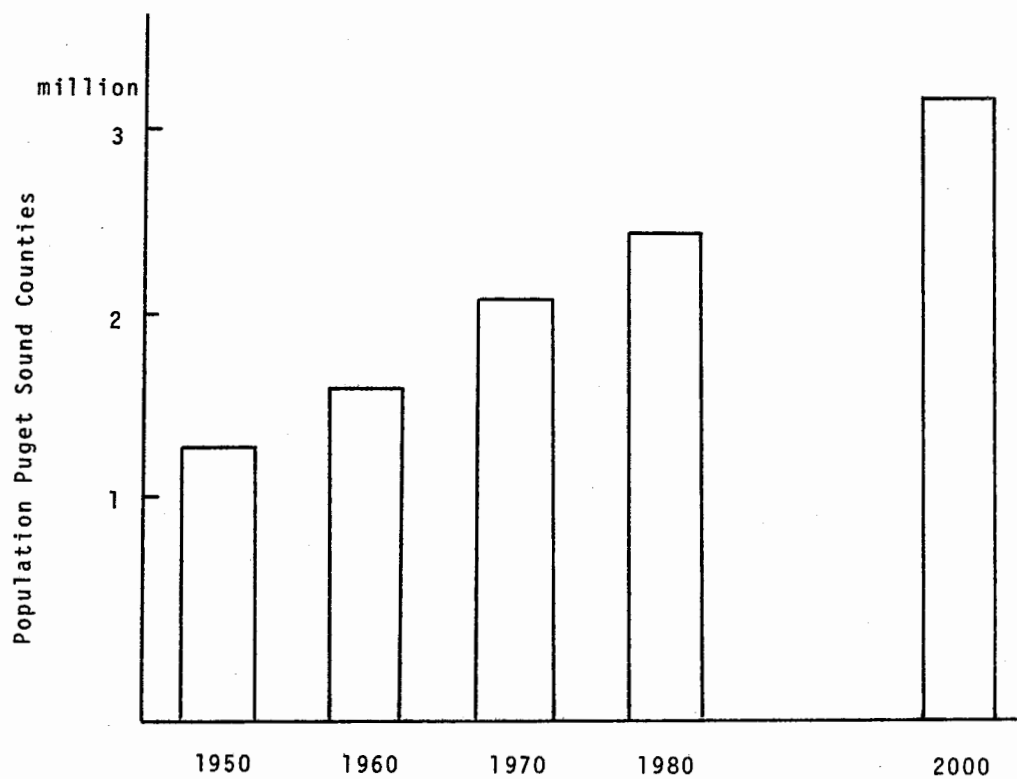


FIGURE 12

Population growth for the Puget Sound Region. Upper figure - for the period 1950 - 1980, with estimated population growth to the year 2000. Lower figure - for the period 1500 to 2000. (Data provided by Puget Sound Council of Governments)

to come from. How to deal with population growth and the wastes that come with that. For that you need an open forum for discussion, and a discussion that involves all counties, municipalities and governments that impinge on Puget Sound. To point a finger at any one organization or industry is not meaningful. The problem is a common one, including all those who use the Sound, including the generations that will follow on the present one. The awesome rise in population over this past few decades indicates a need for managing and planning the resources of the Sound, well beyond the level of effort that is done now.

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INSTITUTIONAL SETTING: PAST, PRESENT AND FUTURE

A. HENRY SCHILLING
Director, Science and Government Study Center
Battelle Human Affairs Research Centers

Let me start by noting that it is a pleasure to be addressing a group whose main concern is with preserving a mutually-valued resource, as opposed to doing everything possible to keep something noxious out of its back yard, which is the case in radioactive waste.

An advantage, or perhaps a disadvantage, of speaking last (at a conference like this, particularly on the institutional side) is, I find, that almost all of the points that I might have intended to make have already been made generally by people who know more than I about the specifics of water quality management in Puget Sound.

What I will do, since time is fairly short, is concentrate on two (broad) themes. One is something that EPA Administrator Ruckelshaus, in a recent article in Science magazine, described as "the problem of closing the dissonance between science and the creation of public policy." This is the central institutional issue that arises from the presentations that we have heard this afternoon about toxic pollutants and long-term management issues. It is also central to some of Ernesta Barnes' comments from this morning.

We have imperfect scientific understanding of the effects of toxic chemicals in the Sound and elsewhere in the environment. We don't know (quite yet) what effects toxics in the Sound might have on human health or other parts of the environment. We have reason to believe there are grounds for great concern about these toxics. We may need to make regulatory and other public policy decisions about them. The problems are when to make these decisions and how. Scientists can almost always argue for more research to settle outstanding questions. Research and other public budgets are limited. Once political decisionmaking shifts into high gear, there is not much time to deliberate or improve scientific understanding. The problem is integrating good science (and its generation) and the uncertainty that marks its limits, with political (and other policy) decisionmaking.

Before I go into this problem, let me give a little bit of institutional history, my other theme. I will paint (this) with quite a broad brush. There are, it seems to me, three pertinent stages in the history of the evolution of institutional and policy aspects of water quality management in Puget Sound. The first of the stages, a pre-history if you will, is pre-Earth Day. Before roughly the 60's there were some concerns with public health problems and their management, and then increasing concern through the 60's with the balancing between fisheries, and recreational uses of the Sound, and uses of it by industry and (to some extent) by municipalities as a place to get rid of waste. Conflicts were resolved by piecemeal solutions to problems. Don Moos talked this morning about a major

development during this period: a symposium, 20 years ago, on what to do to manage Puget Sound. It led to a multi-year study by the Puget Sound task force and proposals in the late 60's for the abatement of pulp and paper pollution problems in the Sound. (It seems to have been a success story, although I speak from rather limited understanding about something that happened before I ever entered the State, so I exercise some caution.) Citizen's groups focusing on environmental problems, emerged during the latter part of this period, culminating in the formation of the Washington Environmental Council (formed sometime during this time). Metro is an important exercise in institution building from this end, with some impact (obviously) on the Sound.

Then came Earth Day (it is not Earth Day itself so much, obviously), the expression of rising public concern about pollution (and the problems it creates) through the 60's, leading to a burst of institution building, policy-making, legislation, and litigation from the late 60's into the early 70's. The National Environmental Policy Act (NEPA), passed with strong influence by Senator Jackson, was a major milestone in this line of development. Other major federal legislation included the Clean Air and Clean Water Acts, the Safe Drinking Water Act, the Federal Insecticides, Fungicides Regulatory Act (FIFRA), the Toxic Substances Control Act, and the Resources Conservation Recovery Act (RCRA).

The two leading federal institutions created to implement these laws were the Council on Environmental Quality and the Environmental Protection Agency (EPA). EPA was, in part, an amalgamation of pre-existing programs from various parts of the Executive branch (nipped together in the administration of vastly increased programs). An important result of this amalgamation and the pattern of legislation (and one of the problems that faces us generally.) is that EPA generally approaches pollution problems by environmental media. This, in turn, leads to some pushing of environmental problems from one medium to the next, at least in theory, limiting our ability to think clearly about how to best regulate. For example (and a local one) is that Metro's sewage sludge at Westpoint is really the transfer of a water pollution problem into a solid waste one.

Parallel developments occurred on the State side. Major state legislation included the State Environmental Policy Act (SEPA) and the Shoreline Management Act. The institutions included the Energy Facilities Siting and Evaluation Council (EFSEC).

All of these developments came with a rush in the early to mid-70's. They produced major perturbations in the loosely defined system which existed before.

One of the results was a great volume of litigation, not only in the state but nationwide, as the various interests affected by these environmental policy changes tested them. Developers and other industry interests, some of whom had created pollution problems, tested the new policies, sometimes through lawsuits, sometimes through lobbying or whatever other means were at hand, in order to find out

just what the changes meant. Similarly, environmental groups pushed hard at the regulatory agencies (particularly the new ones) to enforce the policies, especially to meet statutory deadlines.

I might add that there was a considerable optimism implicit in much of the statute writing of the early 70's. The American economy was strong and generally unchallenged in economic terms worldwide. There was a sense that we could afford to clean up all pollution problems and, for example, reach zero discharge of water pollutants by 1985. Reaching this goal by the year after next seems impossible now. This optimistic view was perhaps also conditioned by a need to respond to real horror stories in pollution. The Earth Day era was not a time to count the costs of environmental quality or to ask precise questions about how much environmental quality was enough.

In Washington State, an important aspect of this period was a series of major studies. A baseline study in the early 70's took a comprehensive look at Puget Sound with particular emphasis on oil pollution. The federal Sea Grant program began supporting research on the Sound, including some of Dr. Bish's work.

Perhaps more important was the evolution of a very interesting relationship between the Federal government, largely EPA, and the State government, largely, but not entirely, the Department of Ecology. To some extent, this relationship used tried-and-true methods of federal/state cooperation, that is, dollars in the form of matching grants, the most noticeable is the Waste Water Treatment program. But the relationship is a new device, and turned even more heavily on delegation to the states of responsibility for implementing federal regulatory programs. Almost all of the major pieces of federal environmental legislation provide for delegation to state agencies. The states are usually given the discretion to make more restrictive standards, that is, to exert higher degrees of control, as part of the partnership. Washington (it seems to me) has been a relatively aggressive State at taking on the delegation of responsibility for implementation of those programs.

The EPA/State relationship has been formalized through the execution of a written agreement called the SEA or State/EPA Agreement, the first of which was promulgated in 1979. The agreement sets priorities, defines objectives for the year, lists programs, problems, budget and the like. It provides for reasonable (it seems to me) public participation in its development. It provides a fairly coherent framework for planning and addressing problems of interest to EPA, DOE and several other agencies. Its focus is broader than the problems of Puget Sound or problems of water quality.

A final note on the 70's, (which is the main thrust of historical development in the area) is that this period was marked by conflict. Some of it was the litigation I mentioned earlier, a predictable set of institutional responses to major change affecting many interests. (Some of it was marked by uncertainty; in fact that was behind some of the litigation.) There was an enormous volume of litigation over Environmental Impact Statements (EIS's), and

complaints about the impossibility of getting them or similar documents approved. Part of the reason for the complaints is that nobody knew how to write EISs; consultants had to learn how to do it, public agencies didn't know what they involved, nor did the various kinds of developers who generally picked up the tab. It took awhile to figure out how to write adequate EISs and to review them. This learning process added uncertainty and delay to a wide range of permitting and other governmental decisions.

An important aspect of the uncertainty embedded in new environmental regulations and procedures was its impact on the private sector needing to make investment decisions. How do you decide what kind of refinery to build for your oil company if there is a draft regulation requiring the reduction of lead in your refinery output (the draft regulation still open to lobbying and other pressure). Even if it is promulgated, it may be open to legal challenge. Therefore, maybe you shouldn't invest (a whole lot of) money in building new refinery capacity aimed at a product which complies with the regulation. You want to be sure that you are not dealing with a short-term and artificial alteration in the market for your product, and therefore, the kinds of investments you want to make, but rather something that will be in effect long enough for you to recover the investment you intend to make in complying with the new market.

This example, I think, was repeated in innumerable ways in the face of the environmental policy activism in the 70's.

By the late 70's, all this led to cries for regulatory relief. While such relief is often viewed as a conservative, Republican approach to environmental policy, it certainly got under way late in the Carter administration (a Democratic, and I suppose one could read liberal, administration as well). That is to say, that while there was clearly more concern expressed with relief from regulatory burdens from the industrial side of our society, it was by no means isolated to that. Part of the reason is that economic times were tough through the late 70's. The costs of pollution control and other regulatory compliance looked even more objectionable than they might otherwise. As an aside, there has been some argument that the improvements in air quality in the 70's, particularly in the Northeast, were largely because the plants were not operating for economic reasons, rather than because of effective pollution control programs. That is a debatable point, but it does suggest 1) that times were tough and 2) that levels of economic activity have strong relationships with pollution problems.

A second factor (leading to some shift in the late 70's, it seems to me) was we began getting more bucks for the bang in environmental improvement. Early on, we solved, or got underway to solving, relatively large and easily solvable problems such as reducing lead emissions from automobiles by forcing the adoption of catalytic converters and the use of low-lead or unleaded gas. (Those got taken care of, not completely satisfactorily perhaps, but at least progress was made.) Gradually, we moved to problems that are much

more difficult and more costly to solve and for which there are less dramatic payoffs in solutions.

This is often because the risks the problems pose are either lower, or they are less well understood. This applies to the problem in toxic sediments in Puget Sound we have heard about this afternoon. While toxic sediments look like they could be horrendously damaging in the long run, it is not clear that there is much to worry about in the short run in human health terms. And, who knows how much it is going to cost to clean them up, or even to stop their further generation, since they seem so highly linked to human activity generally. This is a tougher set of problems to a) understand, and b) solve, than the problem of lead in automobile emissions.

Another possible reason for adjusting environmental policy is an ironic result of having directed intense public concern, government dollars and scientific research to the health impacts of toxic substances in the environment. You might call it the Delany irony; the Delany amendment being part of the Food and Drug Act that says "no carcinogens in food." As a result of these concerns we have learned to detect concentrations of toxics in parts-per-trillion, where we were at parts-per-million roughly a decade ago.

At parts-per-trillion carcinogens appear almost everywhere. One of our papers last week, ran an article reporting that vegetables naturally produce pesticides. It is an evolutionary response to the problem of being eaten by insects before they can mature and reproduce. Some of these are likely to be carcinogenic and therefore, it will be illegal according to the Delany amendment to eat vegetables as nature produces them. Science has outrun a policy that may have made some sense at the time that it was enacted.

This, beyond the irony, is a conclusion that there may be no way of avoiding risks from toxics in the environment, and therefore, a need to make balancing decisions about how much risk to bear and how much to pay to reduce risks when the resources could be used to address health problems or social concerns.

This kind of balancing, or the sense of its value, is not a central part of the statutes as originally written in the early 70's. Indeed some of the statutes make balancing very difficult.

During the late 70's, a sort of policy revisionism emerged within part of EPA consistent with this balancing. The "bubble" concept is an alternative to direct regulation of pollution emissions, which lets a polluter choose between making pollution among old or new facilities in order to be able to develop new plants, while maintaining a given level of pollution. Discussions of trading rights and other market approaches in order to ease off the direct regulation of economic activity, all seem in line with a rethinking of how much to invest in solving pollution problems.

At the same time, Superfund passed in the late 70's. Superfund is a major piece of environmental legislation addressing a horrendous

problem, one that may be much more costly to resolve than estimated. Concern with acid rain arose, remains a concern, and subject to discussion. Thus, there were both tendencies to rethink the optimism of the early 70's and an awareness of the even more difficult problems to be resolved.

And, then comes an interlude between the second and third stages of my historical story which I will describe (with apologies to those who voted for him) as "Reaganenvironmentalism". This is, roughly, as ambiguous a term as "Reagonomics" was a clear one, and yet probably, an equally reasonable approach to solving the concerns it addresses simply because it didn't work very well. Reaganenvironmentalism is a set of actions by the Administration to address pressures to reduce the burden of environmental standards not by explicitly changing the policies, but by taking steps that greatly reduced EPA's ability to enforce the existing policies.

Some estimates were that EPA's effective budget was down by forty percent over a couple of years, at the beginning of the Reagan Administration. Policy level jobs seemed to remain vacant for an inordinately long time in the first year of the Administration. And, then many were filled by people who really weren't very able professionally. This is in stark contrast to an agency that originated under a Republican administration, enjoyed bipartisan support at its inception, and for its development through the 70's.

The Congressional response to this (I think) can be read as digging in and holding on harder to the policies originally legislated in the 70's.

A second result of all this was that, as Brock Evans told me at lunch today, that membership in the Audubon Society went up by 100,000 and funding increased dramatically. In sum, polarization, or environmental policy, has increased as a result of Reaganenvironmentalism, making rational thinking and discussion very difficult for all those who might be interested about setting a better balance or more effectively using environmental protection resources.

A note on public opinion on all this. Public opinion remains very strongly supportive of strong degrees of environmental protection. I suspect that this is a legacy of public information activities by environmental groups, including EPA itself, to mobilize public support to solve problems. The irony here is that the very effective job the federal government did in dramatizing Valleys of the Drums and similar horror stories on mismanagement of hazardous waste before passage of Superfund may have made it very difficult to site new facilities to dispose of waste under RCRA; the facilities needed to correct the horror stories. Public opinion, once mobilized, does not unmobilize uneasily even though there may be strong reasons to carefully reconsider what has been done.

Ruckleshaus' appointment puts EPA back on the path of the trend that seemed to be emerging in the late 70's toward recalculations of where to invest most heavily in environmental controls, where there

needed to be adjustments and better balancing. His article in Science, which I quoted from earlier, talked about a central issue in this trend: the need to separate risk assessment, which is largely a scientific enterprise, although an imperfect one, from the decisions about safety. That is, "safety" involves some decision about whether a given level of risk is acceptable, and implies that if something is unacceptable steps be taken to reduce it. Ruckelshaus argues for scientists to acknowledge more clearly the uncertainties of their understanding, particularly in the toxics area. This afternoon's other speeches suggested the enormous uncertainties that remain about toxics in the Sound. Yet, there is a need to make decisions.

Decisionmaking about risk marked by uncertainty can by no means be a scientific enterprise. It must involve wide participation. It requires ways to explain to a wider pool of people than merely government regulators, or even elected officials, what is known about the risks, what is unknown about them, what the options are for dealing with them and so on. The public discussions of the arsenic standards (and the public debate) in Tacoma appears to be an attempt to fashion a way to solve this problem. Rather than a referendum among the citizenry, EPA seems to be trying to figure out how to get direct public input into decisions about a scary and potentially very grave, yet uncertain, set of public health hazards. There are great economic costs and other social costs on the other hand of trying to eliminate them. Moreover, it is probably impossible to completely eliminate all arsenic in the environment around the ASARCO smelter. Thus, there is (some) need to figure out how much of it to reduce and at what cost. This kind of decision will need to be made again and again. We need to learn to make it well.

A couple of notes on institutional change. I think we will save till the Roundtable a discussion of Brock Evans' proposals about using the San Francisco area's Bay Conservation and Development Commission, and discussion of the effect of these general historical developments on the State/EPA partnership. Now, just a general note or two.

One is that there is enormous value in analysis. Particularly with respect to unsettled scientific questions, analysis can improve decisions about the value of more research to reduce the uncertainty (and so on). It is also essential in thinking about institutional change to draw a good bead on who the relevant parties are to make sure that they are involved. Brock Evans' discussion of the San Francisco Bay exercise confirms this point.

And finally, it is very important to be quite attentive to the system on which institutional changes will operate, because of the interdependencies that Professor Bish described in his talk.

In general it is useful to set things up so that it is possible to do the science that needs doing before, rather than during or after, explicit political decisionmaking. What scientists do and the way they talk, is often inconsistent with what politicians or policy decision-makers need to do.

Ernesta Barnes described this morning in her remarks the need to make decisions, often under the gun of lawsuits. The scientists whom she asks for answers will often respond "Gee, that is an interesting question, I need five more years to address it." The scientists' and regulators' styles of operating and incentives are quite different.

This applies to more explicitly political, as opposed to regulatory, decisionmaking as well. There is a tendency in political systems to push aside contentious issues whose resolution may impose great political cost until it is absolutely necessary to decide them. Once that point comes, the pace picks up. By this point there is precious little time to run analyses on interesting options for resolving whatever problem is at hand. A legislature looks to the bills introduced in the last session, forms some amalgamation of them, tries to get the titles right on the sections, puts things together, votes, and goes on to the next issue. That doesn't leave for very much in the way of deliberate policy analysis, and it certainly doesn't fit with the scientific approach which is very deliberate. The overtly political process often involves a lot of calculations about related issues, even unrelated ones, as politicians move to build consensus and resolve issues.

Hence, a major challenge in thinking about institution building in this area, is to develop a system that integrates effectively the need to gather and assess more scientific information and make decisions analytically with appropriate political decisionmaking.

EVENING SPEAKER

DR. JAMES WARREN

Director, Museum of History and Industry
Seattle, Washington

- o Past Administrative Vice President of Seattle Community College,
- o President of Edmonds Community College (1969-1979)
- o Historical Columnist (Post Intelligencer, Seattle Business, Journal)
Author
- o Present Director of the Seattle Museum of History and Industry

Thank you, Bill (Kitsap County Commissioner Bill Mahan, Master of Ceremonies). I once lived in Kitsap County too, and sitting here tonight we started discussing the fact that Kitsap County was once named Slaughter County for Lt. Slaughter who was killed by the Indians during the Indian battles of the 1850s. But, the name didn't stick, so instead they changed the name to Kitsap after the chief who was one of the Indians who might have had a hand in killing Lt. Slaughter. So there is irony in some of our place names. And, next to Bill was sitting Ruth Fisher (Washington State Legislature), who is from Pierce County. As I am sure you all know, Pierce County was named after the election of President Pierce, who turned out to be one of our poorer Presidents. And here we are in King County, and of course, King County was named for Pierce's vice-president, who had tuberculosis when he was elected and went to Cuba to get it cured. He became worse, and died before he ever served a day in office. So much for the counties. And their names.

After your serious labors of the past couple days, and after this repast this evening, it seem to me my major duty is to keep you awake through one more speech. Really, mine is the easiest of speeches to make interesting, because I am going to tell you a few tales of Puget Sound, stories that have to do somewhat with ecology, a word that did not exist, of course, in pioneer times.

We sit here this evening in God's country, blessed in so many ways. A country that by every prognostication will continue to attract people. And, I say that with some knowledge, because there are several of us here this evening who served on Dan Evan's Alternatives for Washington, and we looked far into the future. I don't know whatever happened to our projections, but we did them, and anyway everyone's prognostician says that we will continue to attract the human species, as this neck of the woods has since the glaciers receded 20,000 years ago. There is no door for us to close, no law for us to pass, that will keep people away, even if we did want to do so.

In the next 20 minutes or so, I would like first to give you a quick review about how this land became part of the United States of America, then I will show you some historic slides of great grandfather's days and ask you if you would prefer to live in those days rather than now, and finally, I will discuss preserving what is so special here in the Puget Sound country.

(There has to be room for one commercial, so let me throw it in here. I presume you are all members of some historical society. I have left outside the door on the left as you go out, a quarterly from the Seattle-King County Historical Society, and also, you will find beside it a very colorful brochure, which I hope you will take home and peruse. It is called a membership brochure. I happen to represent the Seattle-King County Historical Society membership committee. I should tell you that even though you may come from another county, we do condescend occasionally to take membership from other counties.)

There was a time not so long ago when the multitudes who lived on the shores of Puget Sound relied entirely on nature for their sustenance. And, life was good, for this is a bountiful land, that provided game, and fish, and shellfish in abundance, berries, and roots in profusion, fibers of many kinds for clothing and matting and containers, logs that split easily into boards for building, and tree trunks that were easily hollowed into canoes. This inland sea and its many rivers created a natural transportation system, and for thousands of years these shores were inhabited by a people who developed a society in many ways unlike that of native Americans elsewhere. The Puget Sound country influenced their way of live greatly, for they were almost entirely its dependents.

On the shore not far from the present Kingdome, back in 1854, Chief Seattle first met Governor Isaac Stevens, and the Chief's prophetic speech, as it was interpreted by Dr. Henry Smith, contained these thoughts among others:

"Every part of this country is sacred to my people." (The old chief said). "Every hillside, every valley, every plain and grove has been hallowed by some fond memory or sad experience of my tribe. Even the rocks, which seem to lie dumb as they swelter in the sun along the silent seashore, thrill with memories of past events connected with the lives of my people. The very dust under your feet responds more lovingly to our footsteps than to yours, because it is the ashes of our ancestors, and our bare feet are conscious of the sympathetic touch, for the soil is rich with the life of our kindred. At night, when the streets of your cities and villages will be silent and you think them deserted, they will throng with the returning hosts that once filled and still love this beautiful land."

Now that is what Chief Seattle said nearly 130 years ago. The Indians not only revered their natural surroundings, they were comparatively few in number, and with their simple tools, with the possible exception of fire, they could do little to harm their environment even if they had wished to do so. But the world changes ever more quickly. Chief Seattle, they say, recalled watching as a child, the first sailing ship to visit on Puget Sound, that of the British Captain Vancouver. The year was 1792, and Vancouver had been sent to the Pacific Coast to meet the Spanish and sign the new treaty, which gave the British right to these lands. And, after exploring the Sound which he named for a lieutenant aboard, named Peter Puget, Vancouver wrote in his report, and I quote,

"To describe the beauties of this region, will on some future occasion be a very grateful task to the pen of the skillful panagerist. The serenity of the climate, the innumerable pleasing landscapes, and the abundant fertility, that unassisted nature puts forth, require only to be enriched by the industry of men, with villages, mansions, cottages, and other buildings to render it the most lovely country that can be imagined. Whilst the labor of its inhabitants would be amply rewarded in the bounties which nature seems to bestow on cultivation."

George Vancouver said that, and he was the first European to visit this part of the country. Young Peter Puget himself, somewhat awkwardly, paid tribute to the sound named for him, and he concluded his statement with this, "An island distinguished in the general chart by the name of Whidbey's Island is absolutely as fine a tract of land as I ever saw." Puget spoke as though he might have settled here, had he not been a career Navy man who went on to become an Admiral.

A little sidelight story, if you don't mind. A couple of decades back, a Seattle man, H.W. McCurdy, was in England on business and he decided that he would like to visit Puget's grave. But not even the Royal Navy had record of where it was located, so at a friend's suggestion, McCurdy placed an ad in the personal column of the London Times asking if anyone knew where Peter Puget was buried. And, a lady named Kitty Champion responded that records indicated that he lay in the little churchyard, in the tiny village called Woolley, outside of Bath. And McCurdy found this to be true. The tomb was weathered and illegible, but today a brass plaque placed there by the Seattle Historical Society, marks the site.

Well, Vancouver in his ship explored and sailed northward to treat with the Spanish, and at the same time Yankee traders including Robert Gray and the ship Columbia were off the coast. Gray, as you all know, would soon cement the American claim to Oregon by the discovery of the Great River of the West. Almost without exception the early explorers who viewed this inland sea, offered up praise for its scenery, its magnificent forests, its fertility, its natural foodstuffs, its moderate climate.

And, during the first half of the 19th century Americans were constantly twisting the tail of the British lion. One area long a source of contention was this very Puget Sound country. The Treaty of Ghent, which ended the war of 1812, established the U.S./Canadian border at the 49th parallel westward as far as the Columbia River. The territory west and north of the river, this very land we live in today, was to be jointly held. In actuality, it was under the control of the Hudson's Bay Company, which managed to steer migrating Yankees south of the Columbia.

It was the Hudson's Bay Company in 1833 which established the first settlement on Puget Sound, a trading post at the mouth of the Nisqually River. And, here Indians from the area traded pelts for blankets and tools. And it was here that young Dr. Tolmie, newly arrived at the fort, met a chief, who was then in the prime of his life, whom Tolmie described as "Selah", or "Seattle", and he wrote of

him, he was "a brawny Suquamish, with a Roman countenance, and black, curly hair. The handsomest Indian I have seen.

And, here at Nisqually the British company began to farm and to raise cattle and hogs, and to teach the Indians to till the soil and harvest seeded crops.

American interest in this land developed rather slowly. They discovered they knew very little about it, and yet it was jointly held.

In 1837, President Jackson sent William Slacum, a Navy man on leave to take a census in Oregon and to report back on what he found. Slacum spent three weeks on the Columbia. Though he never traveled north to our inland sea, he heard plenty about it. And, he reported back that Puget Sound should never be abandoned, that it lay south of the 49th parallel and should be considered American country, for it was very placed an ad in the personal column of the London Times asking if anyone knew where Peter Puget was buried. And, a lady named Kitty Champion responded that records indicated that he lay in the little churchyard, in the tiny village called Woolley, outside of Bath. And McCurdy found this to be true. The tomb was weathered and illegible, but today a brass plaque placed there by the Seattle Historical Society, marks the site.

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In 1841, an expedition was sent to the Northwest with several ships under Lieutenant Charles Wilkes, and he was to report on the disputed territory and map part of the region. It was Wilkes who charted a nameless bay and named it, probably for a midshipman on board, we are not sure, whose name was Samuel Elliott. Interestingly, Wilkes thought very little of Elliott Bay and he reported "the anchorage is of comparatively small extent owing to the great depth of the water, as well as extensive mudflats. From the west it is exposed to the prevailing winds, and during their strength there is a heavy sea."

And then, to cap the climax, in 1845, the Simmons-Bush party arrived at the southern tip of Puget Sound. The first Americans to settle this far north. Simmons settled at the falls of Tumwater, near the present Olympia Brewery. His friend George Bush had come north across the river to escape prejudices in old Oregon that prevented him from owning land or even staying overnight in the territory. You see, he was the offspring of an Irish mother and an East-Indian, or black, father. Eventually the Washington Territorial Legislature memorialized Congress to allow Bush title to his land claim and Congress passed a law just for him. He was described as generous, industrious, and was one of the wealthier and best educated of the early immigrants.

In 1846, after James Polk became President, he sent Daniel Webster to meet with Lord Ashburton, and both countries compromised on the jointly held territory and the border west of the Columbia was established at the 49th parallel. The Puget Sound country, for the first time, belonged clearly to the United States of America, but American settlement was to be delayed principally for two reasons. The California Gold Rush drew most of the immigrants, and secondly the Sound was isolated and very difficult to reach. But the 1850's brought increasing numbers of settlers and villages began to sprout among the stumps in the raw hillside clearings.

There was a time 130 years ago when an intelligent man became lost between Smith's Cove and downtown Seattle, lost in the endless forest for a day, and he wrote about it. Again, it was Dr. Henry A. Smith, who had settled on the cove that is named for him, and that is not very far away. Today, Pier 91 is located there on the northern margin of Elliott Bay. And, this is what Smith said about his experience,

"I once had a little experience, but a very amusing one, of being lost. In the summer of 1854 I concluded to make

a trail from my place on my cove to Seattle. Up to that time I had ridden to the city in a Chinook buggy (that is what they called the dugout canoe). One bright morning I took a compass and started for Seattle on as nearly a straight line as possible. After an hour's travel, the sun was hid by clouds and the compass had to be entirely relied on for the right course. This was tedious business for the woods had never been burned, and the old fallen timber was almost impassable.

About noon, I noticed to my utter astonishment, that the compass had reversed its poles. I knew that beds of minerals would sometimes cause a variation of the needle, and was delighted at the thought of discovering a valuable iron mine so near salt water. From that place I followed the compass reversed, calculating as I walked the number of ships that would load annually at Seattle with pig iron, and the amount of ground that would eventually be covered at Smith's Cove with furnaces, rolling mills, foundries, tool manufacturing establishments and so on. As night came on I became satisfied that I had traveled too far to the east, and had passed Seattle, and the prospect of spending a night in the woods knocked the iron calculations from my mind.

Soon, however, I was delighted to see a clearing ahead, and a shake built shanty that I concluded must be the ranch that Mr. Nagle had commenced improving sometime before, which I understood lay between Seattle and Lake Washington. When I reached the fence surrounding the improvements, I seated myself on one of the top rails to ponder the advisability of remaining with my new neighbor overnight, or going on to town.

While sitting thus, I could not help contrasting his improvements with my own. The size of the clearing was about the same, the house was a good deal like mine, the only seeming difference was that the front of his faced west, whereas the front of mine faced east. While puzzling over this strange coincidence, my own mother came out of the house. She fed the poultry that had commenced going to roost in a rookery, for all the world like my own, only facing the wrong way, in the name of all that is wonderful, I thought, what is she doing here? And how did she get here ahead of me. Just then, the world took a spin around, my ranch reeled into line, and low, I was sitting on my own fence, and looking at my own improvements, without knowing them.

Now, from this story, Dr. Smith drew a moral. That people cannot see and think alike owing to their point of view, and we therefore, must all be charitable. And, so must we as we look at those pioneer great-great-grandfathers of ours, and the Puget Sound they lived on. Else we tend to criticize them unjustly.

I have with me a few images of the good old days. Now these are lessons in those old lantern slides, some of which are hand tinted,

they speak for themselves, so I will speed through them. Would you want to go back, I ask you, and live as did the people in great-grandfather's day.

There weren't many people in beautiful Seattle in its pioneer days, but there was lots of nature. Now we taught the Indians to live like us, to wear clothes first of all, and to "work hard."

The first water system in Seattle extended down James street and bent at Front Street or what is now First Avenue, so it could go to Henry Yesler's steam sawmill. It was an open flume fed by a stream at Fifth Avenue.

Even though you lived in town, there were certain necessary outhouses, and barns and stables. If you look to the right down a ways in the middle of picture, you will see a barn there standing in a field. That was Arthur Denny's barn on the block where the Arcade Plaza is today in downtown Seattle. The old Rhodes Department store stood there. It is the only block in Seattle that doesn't have an alley! Arthur Denny didn't want an alley put between his house and his barn.

Again, if you will notice there are several smaller structures behind the larger structures. At center is the first public school in Seattle. It was built in 1870. The last to be built were the two outhouses. That was because the contractor wouldn't build those necessities until he got the last payment. Interestingly enough, the University of Washington was built in Seattle in 1861. The first public school building was built in 1870. Seattle is the only town I know of that had a university for 9 years before it had a public school. Seattle was very proud of its school house.

The main industry in town was Henry Yesler's mill, shown here at the end of what was then called Mill Street, which was the original Skid Road (not Row, but Road) in the country (Figure 1) And, if you will notice, at least they were polite enough to pile the garbage off the sidewalk. Now Yesler's first mill burned, so he built this second mill. It burned later too. Garbage, as you can see, was burned in the streets.

Elliott Bay served as Henry's millpond. A good wind spread his logs all over Puget Sound. The most beautiful part of Seattle in those days was the University of Washington campus, which they put a white fence around, and which stood on Arthur Denny's knoll, the site now of the Four Seasons Olympic Hotel.

The pioneers found it easier to build on the mudflats on pilings than through the forests or over the hills. When one set of pilings rotted out, they left them, and built another string along side. No one worried about filing an Environmental Impact Statement. Actually, not until statehood did the state have any control over the property between low and high tide lines. As for the tide flats of Elliott Bay, all are now filled, but these are the tideflats that used to exist down where the train stations are today. (Figure 2).



FIGURE 1

North side of Yesler Way (then Mill Street) in Seattle, west of First Avenue in 1973. The Yesler Sawmill is on the right. (Courtesy of Museum of History & Industry, Seattle, WA)

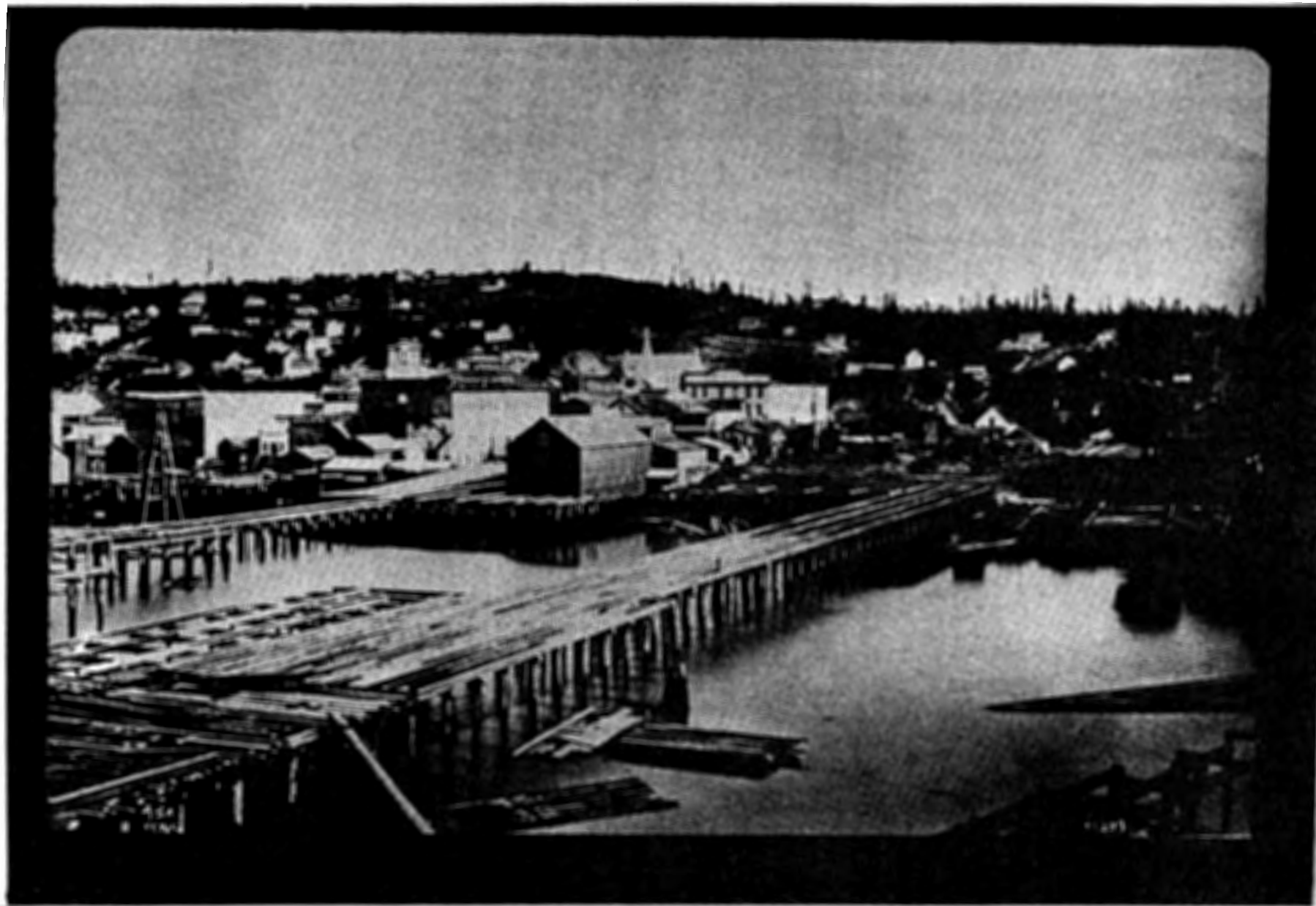


FIGURE 2

South end of Seattle Waterfront (c. 1880) (Courtesy of Museum of History and Industry, Seattle, WA)



FIGURE 3

Looking south from Denny Hill down Third Avenue, Seattle (c. 1890). (Courtesy of Museum of History and Industry, Seattle, WA)

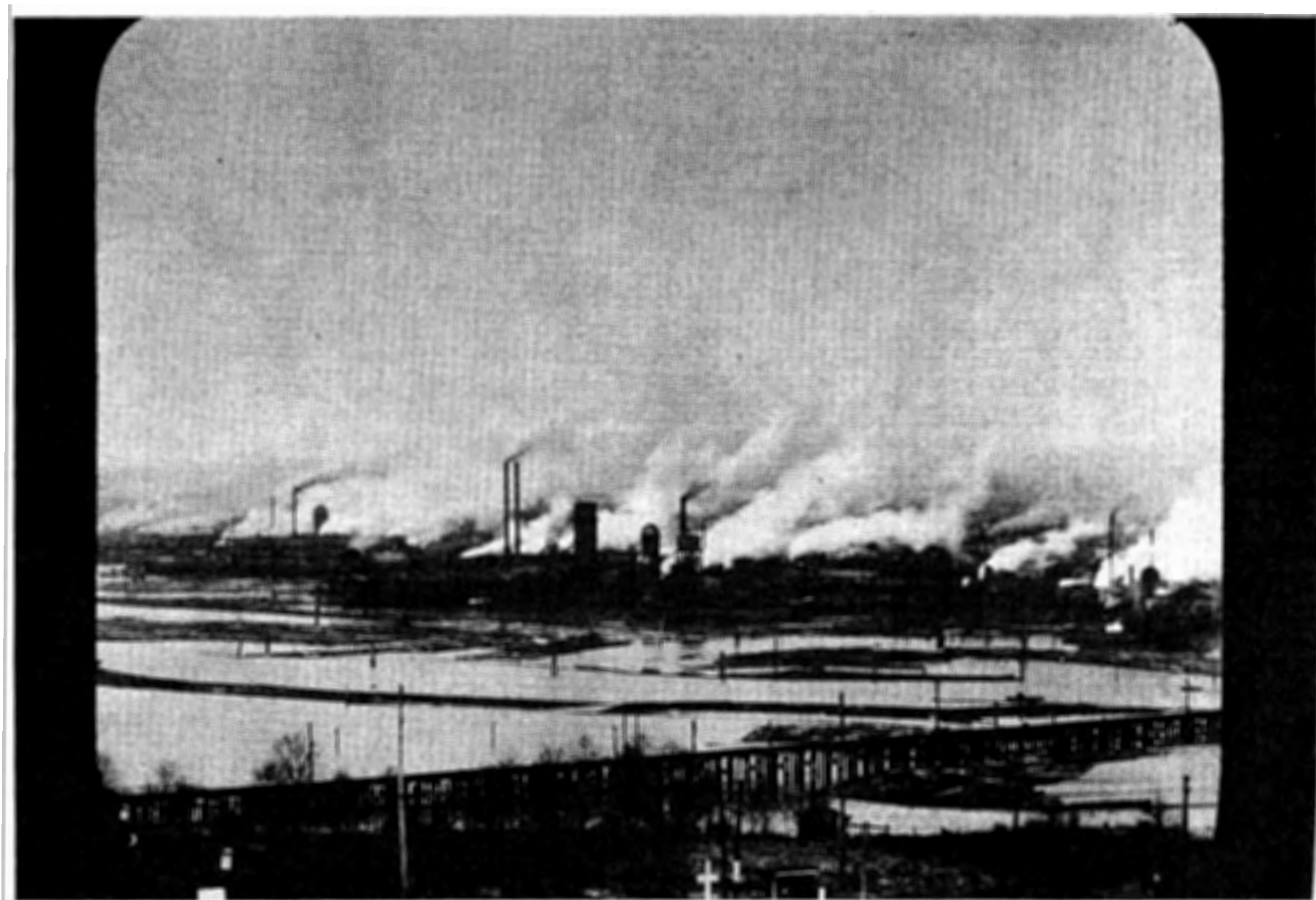


FIGURE 4

Mill at Salmon Bay, Ballard area of Seattle. (Courtesy of Museum of History and Industry, Seattle, WA)

In the 1890's, Seattle began to develop as a manufacturing center and there were many mills and factories along the waterfront and they belched enough smoke to haze up the city. It wasn't called smog because automobiles weren't invented and the word wasn't developed yet. This is the beautiful Seattle waterfront just prior to the fire of 1889. The 1889 fire burned all this down, and within a year and a half it had all been rebuilt. Here we see Pioneer Square rebuilt of brick and stone (Figure 3).

I threw this photo in because I thought some of you outlanders from other cities might be snickering a little bit at Seattle's early beauty. This happens to be Tacoma's beauty, in, as you can see, 1871, and note that the forests really hemmed in the early settlements.

These are the suburbs with their clean air! This happens to be Ballard at the turn of the century (Figure 4).

And, for all those years, they had no way to set emission standards for the main means of locomotion. And the city fathers kept insisting they needed more space. The former county courthouse was purchased by the city as a city hall and was beautified by adding on, and adding on. It was called, rightfully, the Katzenjammer Palace.

And there were the lovely residential areas during the depression. This one happened to be on a dump on the Port of Seattle property near where the Kingdome stands today.

Though the population was very tiny, and the technology rudimentary when the settlers first arrived, the effects of the Industrial Revolution began to be felt very early on Puget Sound. When Henry Yesler put that first little steam sawmill together in 1854, it began spewing out sawdust which old Dutch Ned in his red wheelbarrow spread over the nearby tideflats at the foot of Mill Street, now Yesler Way. And, many more mills soon developed, larger ones operating on various parts on Puget Sound.

And, the forest at water's edge gradually retreated, stripped of the better trees, and the remainder burned. Over the 130 years since then, the population around Puget Sound has exploded and the technological advancements have provided man with new capabilities of not only harvesting nature's bounty, but of damaging nature as well. Along with the more sophisticated life of the 20th century, came the realization that nature could not forever replenish what man took from her. Vast forests of the midwest and east were gone, the great buffalo herds had vanished. They talked about the passenger pigeons becoming extinct, and the frontier mentality that came out west with the early pioneers, that believed that all wild game was for the taking, had to be reconsidered.

You could not reside on Puget Sound without realizing the aesthetic as well as the commercial value of our natural environment. And, from Chief Seattle and Captain Vancouver through the pioneer authors of our day, men and women have striven to describe in words the land we live on, and this is what a few of them said (very briefly). Roberta Frye Watt, who is Arthur Denny's granddaughter, in her book Four Wagons West, explained what drew the Denny's west from Illinois in 1851, and I quote,

"The letters told of the wonders, the grandeurs of the mountains, the vastness of the untouched forests, but best of all they told of the mild climate and the fertile soil and of the flowers that blossomed in the wintertime. Magic words, and magic letters from a magic land."

Archie Binns in his Northwest Gateway, published in 1941, "Seattle offers great opportunity for the enjoyment of life, with its lovely summers, mild winters, its surrounding mountains and forests, and its infinite variety of salt water and fresh." Even in the book, Time, Tide, and Timber, which is the story of Pope and Talbot, the two authors wrote that Captain Talbot in 1853 brought his ship into the straight of Juan de Fuca, and to his delight, and I quote

"Could see even at a distance the coastline showed a covering of forest so dense that jungle seemed a better word than timber, that trees presented a continuity of green impenetrable shade. Even Mount Olympus, in the distance, reared its snowcapped crest above a collar of firs. Nothing was visible except an expanse of water and the still broader expanse of the forest primeval."

And on, and on, and on. And Nard Jones, in his book on Seattle published in 1962, "Ask a contemporary Seattleite if ours is an exciting city and probably after a moment's thought he may say, well maybe not exciting, but I wouldn't live anywhere else." Possibly he likes the setting. Jones said, "The awe inspiring background of rugged mountain ranges with peaks forever topped with snow" and on, and on, and on. Roger Sale, in Seattle, Past and Present, wrote

"From late fall and early spring it is the greenness that gives the essential feel of the climate, that sets off the sudden bursts of sunlight during the spring and fall that accentuates the relatively short, but brilliantly clear and dry summers. It is a magnificent climate for growing things,"

And on, and on. And finally let me quote Edith Sanderson Redfield in a little book she wrote in 1930 called Seattle Memories, she said

"What a peaceful haven inside the straits seemed Puget Sound. The coast and the Cascade ranges of mountain on either shore of Puget Sound were just as white in January of 1869 as they are today. The low dark fir lined and the rippling waters made a picture just as inspiring then as now."

And on, and on. I think this proves one thing, we hold a heritage in common. Hardly a one of us fails to admire the lifestyle we have developed on Puget Sound. It is hailed as one of the most livable areas on earth. Through the years appreciation of our natural setting has not diminished. Our history is short. If you are 65 years old, you are half as old as the American settlements on Puget Sound. We have among us, those who are old enough to remember what it used to be like.

Unlike much of the midwest and the east, here it is not too late to preserve our heritage. Much of our forests still grow, much of our water still runs clear. We have something special here on Puget Sound, especially so since we have preserved it, or perhaps one should say we have not gotten around to altering all of it.

I have spent some time trying to assess why this is such a livable country? What is the Northwest lifestyle we all seem to appreciate and want to preserve, and what do our natural surroundings have to do with it? I made a list, about what I personally appreciate about Puget Sound, and why I live here rather than elsewhere, and you know what, it came out very similar to what George Vancouver wrote 190 years ago, as the first European to see the area. And it also came out very close to what hundreds of residents have written since. If indeed our Northwest way of life, much the envy of the nation, depends on the surrounding natural attributes, we can only conclude that we must preserve those attributes unless we are willing to alter our lifestyle.

If we ask our citizens what it is we must preserve, there is considerable agreement. Even the most conservative industrialist will usually agree with the most ardent conservationist. The disagreement comes with the how. How to preserve? With a common objective, surely we can work out the problems of conservation. I have high hopes that we can, especially with people such as yourselves working on the problems. (I have high hopes). That we will (and are) save for future generations, that something special that makes the Puget Sound country such a fine place for mankind to call home. I am glad I am here.

Thank you.

ROUNDTABLE #1

"Toxic Chemicals in Urban Embayments:
Effects on Marine Life and the Consumer"

Discussion Leader: Dr. Dale Carlson
Dean and Professor Emeritus, Department of Civil Engineering
University of Washington, Seattle

Panelist: Dr. Donald C. Malins,
National Oceanic & Atmospheric Administration

DR. JAMES WOODS
Health and Population Study Center, Battelle, Northwest
Seattle, Washington

Health "risk" is a consideration of increased danger over the background condition, as measured by cancer incidence to the exposed population. Absolute risks to exposed populations, of varied susceptibilities, are not known. The policy, therefore, should be one of risk reduction.

"Does a significant risk of cancer or some other adverse health effect exist from eating fish contaminated with high enough levels of chemicals to cause cancer in those species?"

Supportable assumptions are that substances causing cancer in aquatic species in the Sound also cause cancer in humans, and that safety thresholds do not exist for carcinogenic chemicals.

Research supports the general finding that carcinogens in Puget Sound increase the risk to humans, but much more research is needed before we can predict precisely the magnitude of that risk.

PAM CROCKER-DAVIS
Seattle Audubon Society
Seattle, Washington

There is a need to act, even with imperfect knowledge and before technology catches up. Science can only give "guidance" in making urgent policy choices.

The Clean Water Act of 1970 (as amended) is inadequate in terms of toxics and non-point sources of pollution.

The Puget Sound resource is a complex ecosystem which must be considered in its entirety.

Important to the general citizen is the establishment of priorities when funding is debated. Funds are required both to provide treatment systems, and to control technology at the source of the waste stream.

DR. GARY O'NEAL
U.S. Environmental Protection Agency, Region X,
Seattle, Washington

The complexity of our impacts on natural systems has outrun the competence of the management system. New hot-spots are identified even as we deal with Superfund areas such as Commencement Bay.

It is extremely difficult to set a regulatory program to reach a biological goal. A "best-judgment" approach will be used. This depends upon more dialogue and understanding among parties.

The process involves four steps: problem definition (extent and severity) goals and standards, regulatory measures, and evaluation. All of these are underway. The goal is now to identify target compounds and to set "interim criteria."

Also being developed is a better long term management system for Puget Sound.

DR. BRUCE FOWLER
National Institute of Environmental Health Sciences
Research Triangle Park, North Carolina

While chemical toxicants are important, non-carcinogenic damage to organs and organisms is also of concern. This "silent damage" can also serve as a trigger to cancer responses. The actual chemical form of the agent is critical (soluble or insoluble, etc.) in predicting damage. Further, we are most often dealing with mixtures, rather than single chemicals, and either heightened toxicity or reduced toxicity may result.

Exposure and the results of exposure are not confined to the past as some might imagine, and the necessary research to better understand present trends is not yet in place.

Biological interactions with toxics are very complex, for example, some toxicants are accumulated in "protein sinks" within specific organisms.

DISCUSSION POINTS:

The transfer of toxics in the marine system to people should not be overstated, since the level of consumption involved would quickly be interrupted by the total number of fish available in the study area. In response to this it was noted that while this is correct, other people in other parts of the Sound (beyond the study area) are also being affected.

As in the case of sludge disposal, there are no perfect solutions since the waste, once generated, must be disposed of somewhere.

It is myopic to monitor only a few target chemicals. Yet we have no technique for looking at the long-term effects of even those few. It is also a mistake to regulate only on the basis of tumors, since over the long term other effects are also present. In general, the problem and our inadequacy in even defining it, is an international problem.

Many toxicants may be in decline in Puget Sound as a whole. (This does not speak to deposition rates in local areas.) Hydrocarbon deposits are 50 percent the 1950 rate. Chlorinated compounds have reduced 30-50 percent since 1960. Since the 1960's, mercury has declined 20 percent, arsenic 15 percent, lead 10 percent, silver, copper and cadmium have remained steady. In response to this encouraging trend, based on sediments, the point was stressed that we simply do not know whether monitoring of a broad range of chemicals would show a general reduction in discharge rates, or an increase, or a steady condition.

Possible corrective actions include improved point source treatment, reduction of combined sewer overflows, pre-treatment, air pollution control, runoff controls, bans on some chemicals, land use controls, better dredge spoils policies and other remedial actions. In Japan damages have been awarded to the victims of severe pollution.

The list of possible actions is lengthy and prohibitively costly. Where is the forum for weighing the relative costs and benefits of alternative courses of action? Reference was made to the EPA/DOE Puget Sound Management Program and the recently appointed Puget Sound Water Quality Authority.

ROUNDTABLE #2

"Other Water Quality Concerns: Dredge Spoils,
Oil Spills, Runoff and Shellfish Contamination"

Discussion Leader: Mr. Ben Shuey,
Attorney and President of the
Washington Environmental Council, Seattle

Panelist: Ms. Joan Thomas
Washington State Department of Ecology

DR. BRIAN MAR
Professor of Civil Engineering and
Institute for Environmental Studies
University of Washington, Seattle, Washington

Highways are not a large source of pollution runoff, rather pollutants from this source become airborne. Runoff from streets, parking lots, is significant.

In urban areas, trace metals are introduced by rainfall and will significantly degrade water quality even if the legislative goals of correcting point sources (and the goal of non-point correction) are successful.

Nature is an effective filter, which suggests strongly that surprising results can be achieved by providing buffer zones along all streams. This is an alternative to pipe technology.

On a regional scale, the effective policy would be to confine development to some parts of Puget Sound while restricting it in others. This would preserve the more vulnerable areas, something which is unlikely with a more uniform distribution of lower density development throughout the region. Hard decisions of this kind are the thing that is missing.

Maintaining clean resources and a healthy aquatic population misses the point somewhat, since people are greedy and will eventually consume the total resource in any event.

R.M. NICOLA, M.D., Director
Tacoma-Pierce County Health Department,
Tacoma, Washington

There is a need for regulatory protection of the most sensitive parts of Puget Sound, which would include the shellfish areas.

Paralytic shellfish poisoning (red tide) has not yet made its way into South Puget Sound, but is a serious public health issue requiring periodic closure of shellfish beaches. By the time pollution becomes a health risk, clean up measures are very expensive. Wise land use decisions, based in part on natural systems, are needed.

MR. KEITH PHILLIPS
U. S. Army Corps of Engineers
Seattle, Washington

To clean up toxic sediments, the Corps is developing dredge techniques which minimize loss of toxic-saturated water. The current technology is foreign and extremely expensive (conventional costs are \$1-5 per cubic yard, specialized technology is up to \$100-\$400 per cubic yard).

Opportunities for land disposal of dredge spoils are limited. Comments were not offered on specific disposal locations in the Sound, although it is clearly difficult to make long term predictions on the effects of disposal based on short term tests.

Under proposed dredging regulations it is very important whether dredge spoils disposal is considered a new pollutant load (subject to possible total "loading factor" limitations, or simply a rehandling of previous loads allowed under this loading factor).

DR. ROBERT CLARK
Environmental Conservation Division
National Oceanic and Atmospheric Administration
Seattle, Washington

Oil pollution is unevenly divided between acute incidents and chronic sources. Fifteen percent of global petroleum pollution is due to spills, while 85 percent is due to other causes (of this share, 45 percent is due to coastal facilities such as refineries, 8.5 percent to the atmosphere, 8.5 percent to natural seams, and 38 percent to transportation).

Puget Sound consists of a complex and vulnerable geography, however chronic input sources are the only significant contributor (300,000 barrels are transported daily).

MS. LORNA CAMPION
Washington Environmental Council
Seattle, Washington

A major concern shared by the citizens, is the long-term future of Puget Sound. A recent survey sponsored by the Economic Development Council placed environmental quality high on the list of citizen values, together with such items as safety and quality of schools.

A major frustration shared by the citizens is that no one can effectively plan for and enforce an environmentally sound future for the Puget Sound resource. Public officials were challenged to work with the citizens to develop a creative solution.

DISCUSSION POINTS:

While the Conference is giving due attention to toxics, non-toxics are also a problem, competing for the public budget.

Proposed changes to the Clean Water Act include a new Section 319, recently reported out of the Senate Committee, which would address non-point runoff. However, local governments do not have the front end funds necessary to form the necessary runoff utilities.

On-site solutions have limited merit in that potential overloading of nature processes does occur. The issue finally is "who pays?"

While Federal law has been amended to allow waivers from secondary treatment into marine waters, Washington State law apparently does not permit the Department of Ecology to accept waivers offered by the Environmental Protection Agency (recent State Attorney General Opinion).

Coliform contamination in Island County illustrates the overlapping jurisdictions of several agencies: leasing of clam beds by some agencies presumes earlier coliform monitoring by others (etc.) and this often has not taken place.

In its efforts to investigate the sources of the difficult dredge disposal issue (the sources of the polluted sediment), the Corps was criticized for reaching into the turf of other agencies (e.g., the suggested use of NPDES permits to regulate forest management).

While the Conference is deliberately focused on water quality in Puget Sound, there is a need to consider the entire scope of the water resources issues, including contributing factors in the tributary watersheds.

In addition to crankcase oil (at least two-thirds of which is not recycled), household toxicants are also a significant pollution source, as well as products of the more easily identified industries.

ROUNDTABLE #3

Long Term Issues in Puget Sound:
Water Quality and Beneficial Uses

Discussion Leader: Ms. Ruth Fisher,
Washington State House of Representatives,
Vice-Chair, Environmental Affairs Committee, Olympia

Panelist Dr. John Vandermeulen
Bedford Institute of Oceanography

DR. JUDY CAPUZZO
Woods Hole Oceanographic Institution
Massachusetts

The goal is to optimize waste disposal in a manner which minimizes the risk to biota and human consumers. This depends upon identification of sources, and designing of controls for these. Transport patterns in the Sound are important.

Domestic sources are as significant (e.g., silver from home photography, zinc from some shampoos) as the more familiar pollution sources.

While nature does offer recycling capacity, this does not apply to synthetic compounds which are foreign to nature. The effects on a hierarchy of biological systems, not simply isolated species, is only beginning to be studied.

DR. SPYROS PAVLOU
JRB Associates
Bellevue, Washington

Puget Sound recirculates, but offers only very limited flushing.

Enrichment is concentrated in the shallow zones (less than 100 meters), and we do detect toxicity in some species from sediment, but we do not know how significant this is. (In the Metro toxicant studies, examples are found of high sediment burden combined with low biotic degradation.)

For the future, the environmental manager needs "decision criteria" which might key off of a clear definition of intended water uses (in his example, the Washington State Water Quality Standards are applied to seven segments constituting Puget Sound). Factors to consider are carrying capacity, loading, transport deposition, enrichment, partitioning of the water column, sediments, as well as biological indicators.

With this information, it would be possible to define levels of degradation, and the significance of these, in terms of the intended uses. With this information, one could develop project management

priorities. Because of the high cost of sophisticated treatment, some toxics should be eliminated at the source.

DR. ROBERT STEWART
Pacific Marine Environmental Laboratory (NOAA)
Affiliate Assistant Professor, Institute of Marine Studies
Seattle, Washington

Water circulation in Puget Sound consists of two flow layers offshore of Seattle (one 50 meters deep, and the other extending from 50 to 200 meters). the upper layer flows north but at Admiralty Inlet drops to the lower depth and returns.

South of Seattle, the current divides horizontally, with the East Passage moving southward and further dividing at Tacoma with some heading into South Puget Sound and the larger share moving north through Colvos Passage.

The practical meaning of these currents is that 70 percent of any discharge at north Seattle will return after one week, while 30 percent will move into the Straights of Juan de Fuca (perhaps still to return). Of the 70 percent returning, one seventh returns to Admiralty Inlet, while four sevenths cycle north through Colvos Passage, and two sevenths move into South Puget Sound (See Fig. 1).

Research findings show that dissolved copper is due to natural and man sources (25 percent from rivers, 42 percent from the Pacific Ocean, and 33 percent from man).

Puget Sound was never pristine from a water quality point of view, however, slightly elevated levels now occur and these may be synergistic.

There is a need from a management perspective, to regard Puget Sound as a unit, rather than focusing only on specific permit requests and acting on the tacit assumption that flushing does occur. We are concentrating on the wrong issues in some cases ("suboptimization").

MR. PAT ROMBERG
Municipality of Metropolitan Seattle
Seattle, Washington.

Puget Sound was characterized as a puzzle consisting of transport systems, point sources, non-point sources and natural sources of pollution. Research is being done by Metro (\$8 million toxicant studies), DOE, NOAA, Battelle, etc.

The Metro effort includes 1500 samples designed to identify the nature of toxic inputs, their sources, how well they are removed by treatment, where they go, and any related biological problems.

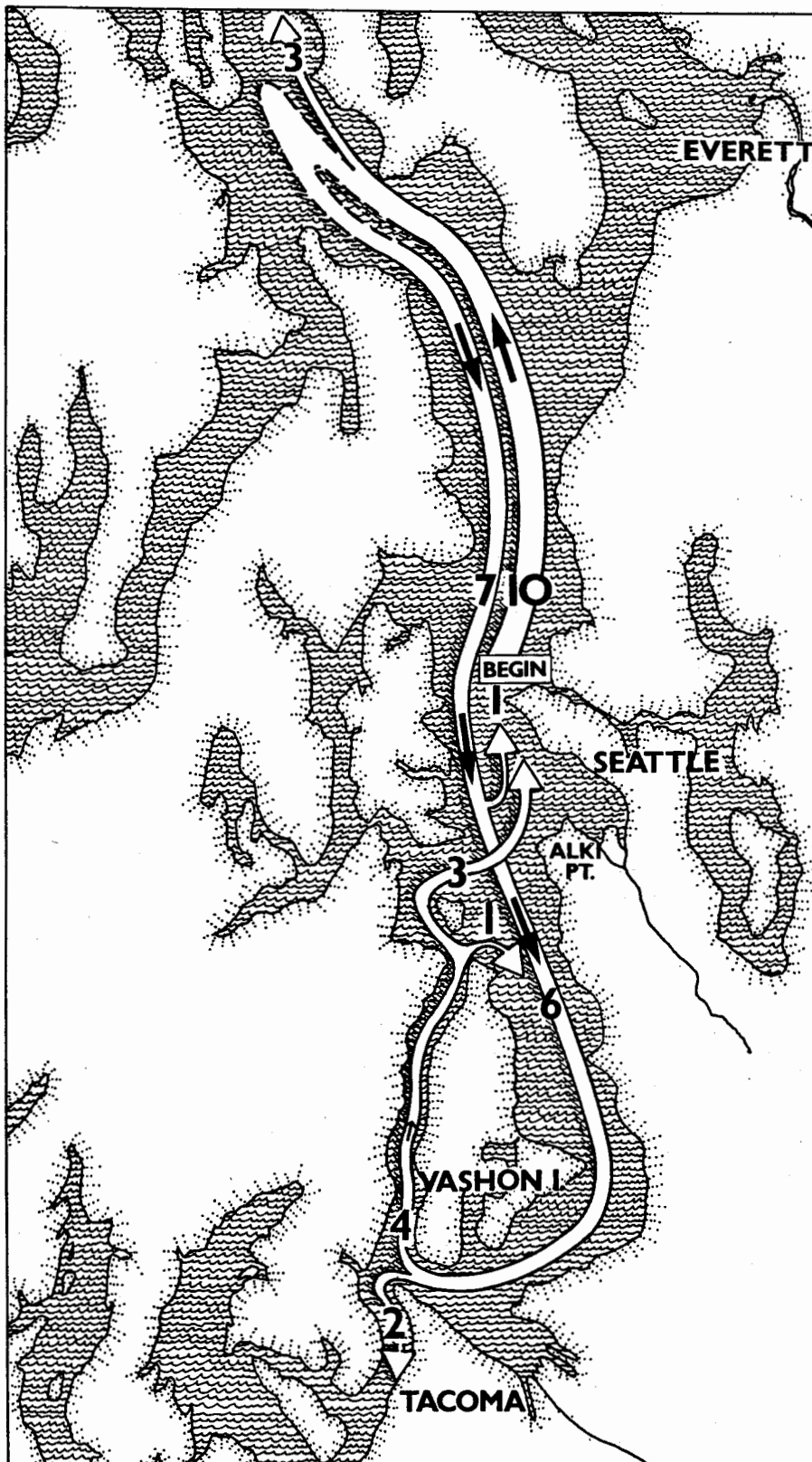


FIGURE 1

Schematic of a water parcel's path
in the Central Basin of Puget Sound
(begins off Shilshole in Seattle)

Following this, costs of alternative corrective measures can be identified, and political decisions can then be made as to where to spend limited resources to achieve maximum results. Removal at the source is attractive.

MS. BETTY TABBUTT
League of Women Voters of Washington
Olympia, Washington

A major deficiency in information being presented is the lack of dollars-and-cents information on the economics of alternative actions. Without knowing the economic implications for the future, it will be difficult to build the necessary constituency.

Also necessary is more information and education of the public on the needs to be addressed and the criteria to be used in establishing these needs.

What is the role of the public in decisions which must be made before all of the information is in?

Standards can change. It is necessary to avoid getting locked in on certain levels of safety which bear exponential costs, only to find later that more complete information would suggest different levels of safety. What is the "carrying capacity" of Puget Sound, considering the information that is available?

DISCUSSION POINTS:

The relationship between costs of pollution control and other priorities at the national level was noted. Many of the institutional issues are sharpened by diminished federal financial involvement.

The need to manage resources effectively as scientific information expands implies wise expenditures of limited funds. There is a serious need to find those who are willing to deal with controversial issues where the information to resolve questions is uncertain.

Consternation was expressed at the finding that the Puget Sound does not flush, after 20 years of public policy and decisions based on the assumption that the Sound was periodically cleansed.

While many metals are declining, they are still elevated, and it is possible that biological correction may take much longer than improvement in the ambient environment where this is occurring.

Research needs include quantitative techniques to establish cause and effect relationships between discharge and observed consequences.

A need exists to educate elected and appointed officials to the fact that technical issues precede and are important to the

decision-making process, that technical facts are not simply implementation details. There is a failure to use the data on hand, as well as to increase this data base.

A need exists to educate the public to cost-effectiveness concerns, so that constituencies do not compromise the most advantageous actions in favor of haphazard agendas offering lesser benefits.

The commercial value and use of Puget Sound must be recognized. Also, if the Sound must be used as a sink, to some degree, then what is its "carrying capacity."

Other points raised in summary comments offered by Dr. Spyros Pavlou included: while there is a shortage of data, we don't use the data we have; the need for anticipatory research, the need to simply define agency roles, and the need for detailed plans for the near bays.

Four key points were offered by Dr. John Vandermeulen in summation: (a) the difficulty in disposing of wastes such as sludge somewhere, (b) the absence of standards in many areas, and the advantages to be gained by using the very unusual community of scientists in this region, (c) the dangerous but perhaps realistic use of Puget Sound as a "sewer pipe" (with only 10 percent net flushing capacity), and (d) the very high cost of preventive action, yet the possible higher cost of remedial action later.

ROUNDTABLE #4

The Institutional Setting:
Past, Present, and Future

Discussion Leader: Mr. Russell Cahill, Deputy Director
Washington State Department of Fisheries

Panelist: Dr. A. Henry Schilling, Battelle Northwest
Dr. Robert Bish, University of Victoria

MS. LEE CARPENTER
League of Women Voters of Washington
Issaquah, Washington

While progress has been made in citizen participation, much remains to be done. Advisory Committees are established, but these are sometimes given only lip service.

Decision-makers must avoid intimidating the public, should actually incorporate citizen advice, should be able to explain clearly the reasons for their actions, and should help unpaid citizens access available information.

DR. ROBERT STOKES, Assistant Professor
Institute of Marine Studies
University of Washington

The decision process was inadequate before, but now must deal with the "knowledge explosion."

It is helpful to think in terms of personal incentives and constraints confronting individual officials rather than in terms of a monolithic public sector intervening into the market from time to time to improve outcomes. The government sector is an "arena," and so too is the research and knowledge interest.

"Rational ignorance" refers to the universal need to simply avoid becoming informed on many issues. This explains and also exacerbates the need to recombine areas of specialization into a coherent perspective.

Rather than clarifying the confusion, the scientific method often yields only partial answers and is often used to reinforce political and partisan positions. (Editor's Note: A recurring theme in the Conference is the need for an assessment step, a mediator, between the scientific efforts and the decisionmakers. This is variously described as a Commission, as the need to view the Sound as a whole, as the need for a "translator," or as involving a risk assessment, and as the public itself, etc.)

MR. RONALD WEST, President
Chemical Processors, Inc.
Seattle, Washington

While a lot has been done, a lot remains to be done. Expanding technical capabilities confronts us with multiple new choices and opportunities.

As we discuss these complexities, it is very important to recall the advice of the opening address, to inject "civility" into our dealings with each other.

DISCUSSION POINTS:

The conference poses as a question whether there are significant problems. This is not yet a conclusion. Proposed actions must follow a finding on this point. A feeling of urgency on the part of the public is not clear. The current structure is legally adequate, but the "tragedy of the commons" may threaten over the long run. The issue therefore is one of political will. There may be a need to "unitize" the agencies to pay due attention to cumulative effects. One respondent commented that he would not argue that because there is a problem, we need a new institution.

The approach represented by the San Francisco Bay Development and Conservation Commission might have limited relevance in Puget Sound because (a) Puget Sound is a larger geographic unit and will be of direct interest to the state, (b) the 13 adjacent counties have considerable authority and are uniformly regulated by state agencies, (c) advantages are to be gained by only marginal changes in existing Washington State legislation addressing wetlands and non-point sources.

The Puget Sound Water Quality Authority is a new player in an already complex game. It offers potential, but it should not cause all present activity to relax awaiting findings of the Authority. The legislation establishing the Authority is "sloppy" in that it is impossible to predict what it will actually do, particularly in view of the general issue of unpredictable research budgets.

The institutional need is for a party which mediates between legislators and administrators and between other existing groups in a meaningful and civil manner. Another need, however, is a publicly controlled institution authorized to enforce day to day compliance with existing law.

State law apparently prohibits the Department of Ecology from concurring with the Environmental Protection Agency in accepting waivers from marine secondary discharge. The cost significance of this should not be disregarded (the total sewage "needs" list for the state is estimated at \$7 billion by the year 2000, with a capital shortfall of \$4.4 billion, the Washington State Infrastructure Study, July 1983). This is identified as the "sleeping" issue in the Conference.

The original federal law was concerned over non-uniform standards as these might become an inadvertent growth reallocation policy. From an economic point of view, variations based on varied pollution assimilation capabilities would make sense. The state could certainly review its own legislation, based on knowledge about Puget Sound.

General citizens often despair to participate, since there is often a general lack of trust, based on failures to influence many past decisions. Others commented that reasons may exist why proposals of some citizen groups are not always acceptable. The public hearing process was identified as a legal process taken very seriously by the State Department of Ecology.

One should not look for a "final decision" on Puget Sound, still, there is concern over being "nickled and dimed to death" by all the small decisions.

Whatever decisions are made must be fair to long term investment planning in the private sector. (Ironically, major opposition to relaxed standards comes from private interests which have complied with the more expensive earlier requirements.)

While business interests often think of the short term, this is not always true of the public elected officials. The issue here, instead, is "sloppiness" of legislation which disregards actual consequences of bills, leaving this to be sorted out by the courts. The courts find it difficult to incorporate technical data into their rulings.

Legislators lack the necessary technical staff to ensure that bills actually promote their stated intentions. Some recommended adequate staff, others, a Commission to work between the legislators and agency administrators.

Many laws actually cause environmental problems. The example was the prohibition of tankers of over 125,000 tons in Puget Sound. This forces oil transfer to barges at Port Angeles which is a greater threat than tanker traffic. Institutional analysis should be more attentive to unanticipated behavior to get around the adopted regulations. This is aggravated by the fact that the Canadian policies prohibit international supply of tanker needs, which causes tankers to Vancouver to be refueled in transit. Emergency response capabilities can handle spills of up to 125,000 tons, but not above this, so there is a rationale for this threshold.

One alternative to intricate regulations would simply be unlimited liability placed on the tankers, but this offers little promise since courts demand proof of damage which is demonstrable only in extreme cases, and since the tanker operators are self-insured and might limit vulnerable assets to the tankers in question.

The general problem of growth in the Puget Sound region was raised. The entire Puget Sound region needs a hearing. If the government structure is not adequate to deal with this concern, then what should be recommended?

REPORT FROM ROUNDTABLE #1
"Toxic Chemicals in Urban Embayments"

DR. DALE CARLSON, Discussion Leader,
Dean and Professor Emeritus Department of Civil Engineering
University of Washington.

The discussion that we had on the toxic chemicals was a fortunate one for me to work with because we had an excellent talk by Dr. Malins and then a very fine panel to work with. As Dr. Malins indicated he has the job of looking for trouble, and a part of that trouble is assessing risk, so Dr. Woods, who was in the panel, looked at the questions of risk. And, one of those that seems to be pertinent to us, whether the risk here in the Puget Sound area is any greater than any other parts of the country; and then, what is the absolute risk for a specific population, which is much smaller, such as we have here. He then looked at what goes into risk assessment; 1) that the chemicals that are carcinogenic in animals seem to be also carcinogenic in humans; 2) that test equipment has been improving the potential for finding and detecting more possible carcinogens, and 3) that we so far are not able to detect any threshold limits for carcinogens. There is then some risk whenever there is exposure.

And the second part of the question was, who is at risk? And, the dose relationship and so forth, the personal susceptibility problems, the realization that these kinds of susceptibilities vary with the makeup of your population, and with the environmental milieu in which you exist. The idea he expressed is that, absolute risk is not yet definable. So what is needed, is how to define the reduction of risk. And, the list of priorities for notorious "bad actors" needs to be developed, and then we need to develop, as he said, better research on control technology.

The second speaker/discussor was Dr. Fowler, and his discussion centered on such points as what do we know about marine organisms as vectors, and he discussed some striking cases, such as minamata disease in Japan and the effects that were notable there. He then recognized, as well as Dr. Woods, that we really don't have a good handle on what is a recognizable health effect. He recognized, of course, that the nature of the chemical makes a difference. It is not enough to measure mercury, you must also know the form of the mercury. He looked a little bit at the idea of toxic end points; sensitivity versus the end effect, for example. He also asked the question if we couldn't find simpler tests that could indicate "silent damage"; the damage that occurs that doesn't appear as a tumor or in the morgue downtown, but has a more long term effect; or an effect that might exist not just for a generation, but for generations to come.

Pam Crocker-Davis, the speaker for the general public, spoke on the four groups that are involved. Pam talked about the researcher, the regulator and the regular folks, as well as the regional developers, all being interested in Puget Sound. She spoke also of the interest on the part of the community around Puget Sound; noting that two-thirds of the citizens have indicated a very active interest in maintaining the quality of this area. She urged that we not wait for the exact costs and relationships that are involved in pollution

control, but get on with control and preventive measures. She recognizes that field research is important and has really just been started, but it is important to integrate what we know and to maintain the human health in the area.

And, finally, the fourth speaker was Dr. Gary O'Neal from the EPA, Region 10, who informed us on of the problems that they have. What the regulatory agency has to do is, first, problem identification, then problem definition on the scope and sources of contaminants, and relative priorities; third, goal settings or standard settings; fourth, they have to put actions in place that they can follow through on using a spectrum of tools that are available to them; and fifth, they have to evaluate as to whether they made the right decisions in the first place and develop feedback loops in which information of what they have been doing can be used to develop an enhanced process for handling the problem in the future. So they have to target where they are going; and then develop what it is they need to be doing and then follow up and make the best judgments possible.

All in all then the overall institutional system is looking at the problem and saying we are living in an environment which was developed over eons in a non-industrial society, we are looking a biological systems that are dynamic, that are actually flow through systems; and we try to evaluate this by looking at the residues that are static in the body or in a system and trying to figure out what happens as materials flow through an organism.

The exciting thing about the panel and the group that was there to discuss things, was that even though there were divergences in views, there was convergence on the fact that there is indeed interest in the area in doing something about the problem; that there is a willingness to tackle the problem, and also an optimism that we can and will do something worthwhile to maintain the Puget Sound area and the Puget Sound basin as a quality area in which to live.

Thank you.

REPORT FROM ROUNDTABLE #2
"Other Water Quality Concerns: Dredge, Spoils,
Oil Spills, Runoff, and Shellfish"

MR. BEN SHUEY, Discussion Leader
President, Washington Environmental Council

Our group of course, addressed a diversity of concerns, and I think this distinguishes it somewhat from the other panels. But covering a broad spectrum of concerns, interestingly enough, there were definite themes that developed during the discussion which ran through the entire Roundtable process. I think that I am going to tell you what those themes were now, and then as I summarize the matter, you will be able to pick up on those themes.

Before I do that, I want to remark that not only did we have an excellent panel, a well-informed panel, but we had excellent audiences on both days, and this was ideal because I have always felt and this illustrated the point, that we can learn together by coming together at conferences like this, and in round table groups. The questions of the audience, a good audience, will enlighten and inform other audience members and even the panel members themselves. We were very successful in that.

The themes that we found running through the diverse approaches to the problems of Puget Sound were these: One theme was the public's willingness to pay or not to pay for the necessary governmental steps to protect the Sound. A second theme was what I might refer to as the interagency or inter governmental problem. By that I mean the fractionalization of government agencies all having some jurisdiction over a particular problem. Is there coordination, is there a working together to solve the problems? And the third theme that ran through this whole thing is that all of these problems relate to human activity. We are dealing with the detritus, the waste and so on, of people, and we have a growing population and these things are related to the need for land use planning.

So those are the three themes that we picked up, which pull together the diverse topics of our panel. Dr. Mar, an engineer and professor at the University, talked about population, the impact of an increasing population, increasing activities on land, and the concurrent increase in toxic washoff, because of the throw-away, the detritus of human activity. Now, he mentioned that if you have a situation involving a very thin population, the land is able to absorb the impacts of human detritus and so on, but you also have the opposite situation of a highly concentrated population, such as in a highly concentrated urban area. And, he identified the middle area, or the transition area, the relatively low-density as the real problem area. He also mentioned, what I think could be characterized, as the pipe syndrome. The desire of people, somehow, to collect wastes and discharge them through pipes, and he suggested that the best solution to non-point problems (and that was the area that he was addressing) was first keep it on your land, second clean it up before it leaves. He also mentioned the frustration of the public with successive levies to take care of these problems. As an example, first you pay for the septic tank, then you pay for the sewer, and third you pay for the

runoff problem of surface waters. He indicated that the public can become frustrated with this type of thing going on. The indication here, of course, is that we need better land use planning from the beginning, we need wise leadership that will take into account all of the environmental aspects in the land use planning process so that you don't have to play catchup at great cost.

Dr. Nicola, the director of public health for the Pierce County Health Department, as an M.D. approached the matter very much from a human point of view, a point of view of people. He mentioned that traditionally, the public health doctor, the public health officer was concerned classically with the matter of bacteria. Now, he said, we are moving into something new, the problem of toxicants. The problem of heavy metals and organics. He indicated that there is a need, again, for land use planning in population distribution and suggested that a function of government should be to locate environmentally sensitive areas. For instance, let's take a drainage basin, as he would put it, and consider whether this drainage basin has a high ecological value. For instance, in shellfish production (etc.) as it drains into the water. And, upon locating an environmentally sensitive area, then planning should be done to preserve that area, and so on, by shifting the people in a proper direction. Again, we are talking about land use planning, and he suggested that by the time a pollution problem becomes a public health problem, it is too late. And, that we should be looking at the precursors of the public health problem.

Ms. Campion, the citizen activist, talked about the problem of multiple-jurisdictions having some responsibility or management impact on any given environmental problem. She suggested that when you have this, you get into a situation where there is a failure of accountability. Any one player in the game can say "it is not my responsibility; I did my thing and there are three or four other agencies involved." She also pointed out that as an activist, she is in favor of public input in environmental decision-making and this is very difficult when you have a failure of coordination of the public agencies that are responsible for any given environmental decision. This is the theme that was picked up on by other speakers, and I will get to that as I go along.

Dr. Clark, is an expert in the problem of oil spills. Now, this was very interesting, because, as he said, we tend to think of oil spills in the context of the catastrophe, the big tanker breaking up, etc., but only 15% globally of oil pollution in waters results from the catastrophe type of event. The rest of it, globally, is an incremental type of pollution which results from many, many things. Most of them are land based. Use of automobiles, oil runoff, the disappearance of crankcase oil, nobody knows where it goes. We have a pretty good idea where it winds up, but So again, the problem of oil pollution of water was not related to transportation or trans-shipment on water so much as it was related, again, to increasing populations, use of products and the incremental pollution by this type of thing.

Keith Phillips from the Corp of Engineers, talked about dredging. He said that the classical use and function of dredging by the Corp has always been for navigational use. Now, we have a new thing, dredging to remove contaminants. So, just like the public

health situation where we are moving from concern about bacteria to toxicants, the same thing is happening with the Corp of Engineers. He told us that there is much new technology developing. He said that traditional dredging operations for navigation (I thought this was quite striking) cost between \$1 and \$4 per yard, but when you are talking about removing contaminated sediments, we are talked suddenly about \$100 to \$400 per yard.

He also talked about the range of testing that is needed to determine predictive effects. This is best done in the lab; there is never an absolute consensus about the predictability of the effects of the contaminants, or how to get rid of them. He pointed out that there is a definite limit to upland disposal capacity, and he said that pretreatment, in his opinion, was the best long-term solution to this problem.

Now, I thought that Mr. Phillips had some very interesting comments on the matter of interagency problems. He pointed out that runoff siltation, of course, results in a lot of dredging. The stuff comes down from the rivers and so on, and if you could reduce the siltation, you could reduce the dredging. He also pointed out that identification of the contaminants going into the water, the sources and so on, is another problem that touches on the dredging problem. But, he said, when the Corp begins to want to look into the area of forest practices or solid waste management, and things of that sort, they are stepping into someone else's jurisdiction, they are in the other fellow's territory. And this highlights the need for an interagency approach to handling the pollution problems that we are concerned with in Puget Sound.

Regarding the public willingness to pay, there were those who tended to be somewhat cynical, as was Dr. Mar, that people here tend to believe that they are still living on the frontier, they are still living the John Wayne myth, so to speak, whereby you can use up resources and throw your stuff into the water, and they don't want to pay. On the other hand, there were those who said the polls indicate a willingness to pay. Other people indicated the need for educating the public, and that with education would come awareness and a willingness to pay and so on.

Thank you.

REPORT FROM ROUNDTABLE #3
"Long Term Issues in Puget Sound"

THE HONORABLE RUTH FISHER
Member of the Washington State House of Representatives

The first respondent, Ms. Betty Tabbutt, was the person from the public, and the League of Women Voters. She mentioned that the public is not yet sure that it is our responsibility to clean up Puget Sound. The attitude out there, and I have seen it myself, is that we can keep polluting until we are ready to conduct a cleanup. The public needs a new sense of irreversibility, and we need a lot of public input. We are going to have make priority decisions on the uses for clean water, and whether we are going to keep using Puget Sound as a sink or a sewer. We need to focus on the source of some of our problems.

Dr. Capuzzo identified the need to optimize waste disposal in a manner causing minimal damage to the ecosystem. She also told us that in Los Angeles, it was found that the zinc from a certain shampoo is one of the major contributors of this pollutant at point sources. We need to identify all major sources. We not only have to look at the short-term solutions, we have got to look at the long-term solutions.

Dr. Pavlou told us, and this shocked me, that Puget Sound does not flush. We thought for a number of years that it does. The tidal action is up and down, but it is not out. He is more optimistic than most of the panelists. We have large problems, difficult chemicals, but he is still hopeful. He suggests that we keep gathering data, and that the decisions we make, the controls and enforcement actions have to have a lot of public input. That seems to be the catch phrase of this. And the public must define what the uses of Puget Sound are.

Dr. Stewart talked about circulation patterns in Puget Sound and the pre-conception of many, and I am one of those, that it was going to flush. It doesn't. We are seeing sewage from Seattle in Tacoma, and believe me, we have got enough, we don't need yours. He sees a real need to look at Puget Sound as an entire body.

Mr. Romberg also reiterated the holistic approach to managing Puget Sound. We have a resource management question involving many factors: industrial, municipal, dredging, atmospheric, urban, river runoff, erosion, all of those things must be looked at in the total concept of Puget Sound.

Next the Roundtable addressed the part that politicians like. The question is, "what is the cost?" I think we could have spent another four or five days on that subject. That is the question that most of us who deal in public decisions want to know. Maybe you are not the people to tell us, but we have to start building a constituency to pay for those costs. We have to weigh the costs of those against other priorities that the taxpayers are asking for, such as prisons, highways in Eastern Washington. We need a strong constituency behind us to make those decisions and to make them work, or you are not going to get the funds.

Dr. Vandermeulen ended up with four observations on the Roundtable. The first is the difficulty that waste has to go somewhere, as is the case with dredge disposal. We can deal with those problems, it is not yet too critical on Puget Sound. Second, there are many researchers here and his suggestion was that we use Northwest research community. Third, he asked the question, is it an acceptable view that Puget Sound is a sink or a sewer. And that is a question that the public has to answer. His fourth point was that the costs are going to be high, but they may be higher if we wait.

REPORT FROM ROUNDTABLE #4
Institutional Setting, Past, Present and Future

Mr. Russell Cahill, Deputy Director
Washington State Department of Fisheries

The first thing that I want to say is that we had an awfully good time in our Roundtable, and consequently my notes may not be as well organized. I would like to go through a couple of statements that the Roundtable participants made, and I would also like to share with you some of the pertinent comments made by the other participants in the Roundtable. I think there were some very pungent remarks made. We had lots of elected officials attending our session because in dealing with the institutional issues, they are very interested in whether the structure that we have can solve the problems, if enough resources are put on it, or whether we need a new structure as Brock Evans proposed yesterday at our luncheon address. We were fortunate to have five lively and knowledgeable people at the front of the room and two rooms full of inquisitive participants.

Dr. Schilling, in his address yesterday, identified several issues and they were themes throughout the discussion. There was quite a bit of discussion about the shifting regulatory base, and how industry or government must deal with regulatory changes when both private and public investments are made. And, also, how the public responds to those kind of things, particularly citizen activists. We had lots of citizen activists in our sessions and there was quite a bit of interplay.

The conclusion that our panelists came to, if I can synthesize it, is that we do need to have the ability to change regulations to meet immediate needs, as this rapid knowledge increase takes place, particularly in the public health area. When we discover something wrong, then we need to have the infrastructure to be able to fix it, but at the same time these kinds of regulations should be from necessity and not just be in the arena of contentious, regulatory fiddling. These are my words.

One of the problems that was identified by our panelists was that industry has had to spend quite a bit of money in meeting water quality requirements over the last ten years, and then all of a sudden, one government structure or another, in this case the Federal government, has let their competitors who have lagged behind in these investments, off the hook. And there are quite a few angry people because of that.

There was a lot of discussion about the rapid increase of knowledge, and how difficult it is for managers and citizen activists alike, to keep up with the scientists and technicians. During that same discussion, there was some dissent from the statement of Dr. Vandermeulen's about synergistic problems. One observer felt that the search for these multi-faceted villains was not capable of accomplishment and that we should continue to pursue and solve the simplest problems, starting at the base of the problem, and not construct Gordian knots or tiltat windmills.

There was discussion of the reduction of funds from the days of inflationary times and times when a lot of money was put on these problems. One participant, after the session yesterday, came to me and said that he felt that the funds came down during the days of guns and butter and that all of our priorities aren't being cared for now.

There was also discussion that we are pouring money down unproductive pipes, that our budgeting is not catching up with the technological needs. We're using old technology and spending money where perhaps we shouldn't be doing that.

Ms. Lee Carpenter, of the League of Women Voter's, I think generated a lot of the discussion with citizen activists. We even had elected officials who came from the ranks of citizen activism, and who talked about the discouragement of pitting volunteer skills against the government technocrats. There is sort of an underdog syndrome of the volunteer versus the paid government specialist, or consultant, and how do we deal with those things? Ms. Carpenter called for decision makers to make the material understandable to the citizen, and we discussed this morning a little bit about the role for interpreters. When you go to a National Park that has some sophisticated geological story, then you are given an interpretative story by someone who knows more than you do about it, perhaps, and how do we fulfill that role in this explosion of knowledge that we have?

Dr. Bish believes this would be a proper role for an advisory council, and that advisory councils are not simply formulated to go into the existing government infrastructure and make it more complicated, but that they should spend time learning as much as they can about the subject and become this interpretive buffer between the rules, the management, the scientists, and the public.

Dr. Stokes used fishery management as an example of a resource being closely tied with air and water quality management. He pointed out, and the audience seemed to have agreed, that the decision making is getting tougher as knowledge explodes. And, he made some points having to do with common property issue of fisheries, and observed that the market does not always make things come out right, and some of us have a relatively simplistic view about that.

A lot of discussion ensued about how citizens can participate, and the general consensus of the panel, as well as many of the participants in the audience, was that citizen activists must dig into the information pool along-side government and industry and participate through hard work in the decision arena. Now that is not new to most citizen activists, I think they know that, but there does not seem to be any easy way and the transfer of that knowledge often takes place only at the initiative of citizen activists. Not very much is being given away free.

Mr. West expressed the opinion yesterday that the technical capabilities are moving so fast that industry may have to go through another serious round of regulatory change, and in times of economic difficulty that is going to be a tough pill to swallow. He echoed Mr. Mahan's call yesterday for civility in the negotiation process, and he talked about how the same thing exists in labor-management relations. Most of the participants, I believe, agreed with that sentiment. I

think that if there is a keynote to this conference, that civility cry yesterday has woven its way through most of these discussions.

Dr. Bish pointed out to us yesterday that government is not a monolithic agent. It consists of people. It consists of reward systems, and other things in common with industry. These things are very tough for outsiders to understand in representative government, and he believes that perhaps the diverse populist government we have in Washington State is a very effective system for getting some of these things done, while the public participates. There are going to be some interesting comparisons in the near future, that his group in Victoria is working on, that have to do with the success of fishery management in Washington State under our system as compared with British Columbia, under a very different centralized government system, and I fully intend to try to find out what is going on with that study, and I hope you do.

There was quite a bit of debate over Brock Evans' call for an infrastructure similar to the San Francisco Bay Conservation and Development Commission. In fact, at the end of the session, I polled the members of the panel as to their opinion, and got no one 100% for it. I will give you the vote; 4 were generally opposed and considered that the existing structure is capable of handling the problem as long as enough pressure is put on, and enough resources are put to the problem.

The legislators who were in our session got up and talked about the lack of technical expertise that they are given as legislators, the lack of staff, to be able to deal with these problems. And it is a serious problem to have a citizen based Legislature that we expect to resolve these problems. There is very little year round staff serving the Legislature, and consequently they don't feel in many cases, that they have adequate technical staff to do the job and to give them the correct advice on how to deal with these things. But, generally the panel felt that we have adequate government infrastructure in Puget Sound to do the job.

I wanted to read to you just a couple of notes that I read from the members of the audience comments. There was one opinion that the Puget Sound Water Quality Authority announced yesterday is faced with a piece of "sloppy" legislation. From the audience, the existing government infrastructure is okay, just make it serve and provide incentives for it to work. Don't expand the overburdened decision-making process too much. Quite a bit of discussion about how regulations sometimes do not do the job that they are set out to do. An example brought up by the audience and then discussed by the panel, was the dead weight tonnage limit on tankers on Puget Sound. In order to keep the large ships out of Puget Sound, we have large ships coming in and anchoring off of Port Angeles, taking off crude onto barges, which are then pulled into Puget Sound by tugs. There was quite a bit of discussion about the potential for spills during that transfer perhaps being a greater problem than a potential accident with the tanker.

There was a lot of discussion on whether citizen advisory committees are effective, and advice from the panel was to get adequate staff advice from the government if you are being asked be on an advisory group by the government. Then demand that you get some

an advisory group by the government. Then demand that you get some staff to help you with it. Also, there was advice that the groups get clear standards of operation and clear goals, that they see the issue in person, and that they plan the amount of time that they are going to be able to spend on learning and bringing their expertise levels up high enough so they can deal with it in the decision arena. There was a statement that environmental mediation at this time is promising, if the issue is capable of being mediated.

And the last thing that I would like to leave you with, which I thought was one of the more pungent comments from the audience, was a person from Yakima who said that while you are doing all of this business, remember that Puget Sound belongs to the rest of us in this State as well.

Thank you.

FIRST RAPPORTEUR

MR. NEWTON CLARK
Pacific Northern Oil Corporation

- o B.A. in Economics, Washington State University
- o Chairman of the Board, Pacific Northern Oil Corporation
- o Owner, Chemical Processors of Oregon, CHEMPRO
- o Chairman, Northwestern Management Group
- o Chairman, Pacific Northern Marine Corporation
- o Trustee, Greater Seattle Chamber of Commerce
- o Trustee, Alki Foundation

The first observation is that the role that they have chosen for Ralph and me, to try to condense and distill the essence of this Conference, of course, is a bit presumptive. So I am going to do it in a little different manner. First, of all, my background is not at all scientific, it is more in the management realm, and of course, in business management you have to be quite pragmatic to survive. I am going to look at it with that in mind.

One nagging thing that came out in this entire Conference, to me, was that in looking at Puget Sound we consistently say Puget Sound, but of course, we do look primarily at the hot spots. Pragmatically speaking, we are not only going to look at them, we are going to try to something about the hot spots as we have identified them. In doing so, we're talking about priorities here, and this is one point of synthesis that I feel is important, that we are really placing a priority and focus on these spots, and not really on all of Puget Sound at this time. This is the major issue until these areas are properly cared for.

We also have the issue that, "Puget Sound does not flush." I suggest issues of this type are downstream a ways, I also suggest that the focus, I am actually hearing has been a discussion of what are our worst problems and where they are.

Now, let's talk about three ideas: 1. Where have we been for the last 50 years? 2. Where you think we are now? 3. Where you think we are going? When you try to wrap up a session like this, or be involved in it, these are, of course, the major questions we have been looking at all along. (Sort of the macro approach). I have heard the scientific micro approach on many items here and yet I find that we really need to remind ourselves where we have been for a moment. I think we need to be upbeat for a little bit. There is a lot of pessimism because we are dealing with problems, many of which are not understood and of course we're concerned, so it is easy to be pessimistic. There is an old adage that for every ten positive notions, it only takes one negative to defeat them all. So I have some positive notions here, although I recognize the negative factors also.

Some remarks made by Joan Thomas, going back to her arrival here in 1955, were interesting. She came in on the train, if I

remember rightly, and she had an impression of Puget Sound and she also had an impression of Everett Harbor and of Bellingham Harbor. She said, I believe, that to her knowledge there were no fish in Everett Harbor when she arrived, and I think she went boating in Bellingham Harbor and the smell was so bad they were choking.

Well, as we move along a few years, (during the same period of time, 1955, by the way) Lake Washington, for those of you that were here, was polluted by whatever definition you care to use. It had a problem and we worked on it hard for a long time. I suggest that there has been a major improvement in Everett Harbor and in Bellingham Harbor, certainly in Lake Washington, and I think we have some successes to point to, since 1955 when she arrived here. So in the "where have we been" we were aware sometime ago that we had problems, we seemed to be working on those problems, and the intensity of our work is now being focused more than ever in the last 11 to 13 years.

There is a little contradiction here that I am having a little trouble with; population and industry have increased dramatically in the last 50 years, and yet we see the above improving factors, and that is somewhat of a contradiction to the notion that "more people and industry equal more pollution." Now, I think that basically that is a general direction we can document, but in terms of what has actually happened here, I suggest that our environmental awareness has slowed the problem down, maybe turned it around, in spite of increasing population and increasing industry.

Which brings me to, "where are we now?" In the last 11 to 13 years we have seen a major body of legislation in just about every corner of environmental concern. Some would say that we have over legislated and some would say that we have under legislated. I think one fact really sticks out, which is that today, there is legislation on the books and that we can now expect action on environmental decisions. We can make a decision and expect some action today. You couldn't say that 12 or 13 years ago, because the decisions had no "teeth." How we get to those decisions, is what I perceive to be one of the focuses of this group, and of this meeting.

So, "where are we now?" We are in an information matrix that is difficult for us to manage. It was identified by several people. I think Ernesta Barnes made several remarks about the technology explosion. And, in fact, she made some rather colorful remarks about an 8,000 gallon martini, which I have written in my notes, having to do with parts per million, parts per billion, and parts per trillion. It is interesting to use those kinds of analogies when you get away from the scientific group and try to bridge the gap to the community. We need to make those kind of analogies, because there is a communication gap problem here, and yet we do have a technology explosion of producing large volumes of information, and I find much of it to be on a micro basic, not a macro basis. We are looking at specific geographic areas of concern. I find that most of the scientific work that has been done and presented here consists of worst case scenarios. This is a habit we have in the business community too. Every time we make an investment, we make the worst case scenario; what is going to happen to us, what are our bailouts?

Well, we are doing the same thing here, and it is useful as an attention getter, an alarm device, concerning the direction that we

are heading. But, I think we need some more information that suggests levels or stages of correction and which moves from the objective into the subjective area before the political decisionmakers get ahold of it. I am talking about; "when do we contain a problem, and what will it take to stop the increase of pollutants?" Just stop it (rather than to correct past actions). Then what will it take to abate and clean up? Now, these are all various degrees of questions that have been asked, and we are getting into a subjective area. It seems we leap from objective scientific information right to the subjective decisionmaking machinery at the political level. We need interim work. That is "where we are now."

Where are we going? First of all, again, I will emphasize, I think the mood tends to be a little negative and it doesn't need to be. I think we are going in the right direction; I think that the fact of this group meeting, is proof we are heading in the right direction; and I think that you might ask yourself the question, have we stopped a general degrading of Puget Sound? The answer today might be, "maybe." Now, you can always give me 25 arguments how we haven't stopped it and 25 how we have. But, if you allow yourself to say "maybe," then we have come a long ways, and I think we are on the right track.

I feel that that is the case, as a non-scientific member of the community, that "maybe" we have at least slowed it down, or stopped the degrading, and "maybe" we are headed in the right direction.

The need for a coordinated government effort for managing Puget Sound resources is generally agreed upon. Don Moose says; "Let's work together, be efficient, have common objectives." Ernesta Barnes says, "Let's bury our hatchets." If this is the kind of thinking we have at the top, then hurray, it is exactly what we need. My conclusions are that we need to work towards more cooperation in government management this resource, as we have here, a dynamic, changing management job which need to be streamlined continually.

Thank you.

SECOND RAPPORTEUR

PROFESSOR RALPH JOHNSON
University of Washington School of Law

Position:

- o Adjunct Professor for the Institute of Marine Studies, and
- o Institute for Environmental Studies
- o Visiting Professor at the Harvard Law School, 1981-1982

Education:

- o Lehigh University, University of Oregon
- o Hague Academy of International Law.

Memberships:

- o Washington State Bar Association
- o International Association for Water Law
- o International Council of Environmental Law

Consulting Work:

- o U. S. Senate Committee on Interior
- o National Water Commission
- o Committee on Water of the National Academy of Sciences
- o Stanford Research Institute
- o Hudson Institute
- o States of Oregon, Washington, Alaska
- o Various Indian Tribes

It is a special pleasure to be able to participate in this meeting. It is a unique position to be the "cleanup batter." Whatever I say can hardly be repudiated now, at least the time available for repudiation is limited.

What I heard was not quite so optimistic or upbeat as what Newton Clark heard, although a lot of it was similar. I would like to reflect a somewhat different tone on some issues. I think the one thing that we both heard a great deal about was the need for cooperative efforts. The need for real cooperation between the various parties, science, industry, environmentalists and government for a very complex and difficult problem. I think we both feel that the Conference comes at a most timely point. That the speakers were excellent; the public participation was excellent. I remember those meetings that we had in the early 70's when confrontations were the order of the day. People were very, very angry. Often times relatively little information passed back and forth. This Conference had a lot of solid information. I think that some anger, some irritation, some divergence of point of view is surely critical to any progress. But, we see a sense of cooperation more than a sense of confrontation at this point.

One point that came out in a couple of the sessions that I attended, was the fact that the problem faced in Puget Sound is not unique to this water body. It is a national problem. It is a problem essentially of the unknown, but the fearful. It is a problem that says we are now exponentially developing new products, new chemicals. We are putting them into the air. We are putting them into the water,

into the ground. We don't know the impact of many of those chemicals. Dr. Malins pointed out in the Roundtable that current technology can only analyze a handful of those chemicals, to learn where they are in the environment. And, secondly only a handful of the many potential impacts on creatures, including humans, is known, or provable. And it is the potential for long-term damage that creates that fear, that sometime 20, 30, 50 years from now there won't be any fish, or that humans will have diseases or be susceptible to new diseases. It is that fear of the future unknown which seems to be the major concern.

I think that there is a widespread awareness in the sessions that I attended, about the difference in the economy, the national economy at this time, as between now and the early 1970's. At that time it seemed that we had money to throw at any problem. We could decide we wanted natural water by 1985 regardless of cost. We now know that we only have a limited budget to work with. Maybe some of you would prefer to spend money on water quality rather than ICBM's, or something else, but in fact, whatever your choices, we only have a limited pot of money. And, we know that the first 90% of the cleanup of water can be accomplished fairly cheap by relative terms. But, to clean up the last 10% or the last 5% is very expensive indeed, and thus we must set priorities. There are tougher questions now. We have better measuring devices, and they now show us the existence of toxic substances, hydrocarbons and such, that we didn't realize were there before, or realizing, didn't know their impact. We now realize the importance of non-point discharges from highways, housing projects, and farms. We know that it is exceedingly difficult to relate that scientific information to the policy decisions. As Ernesta Barnes said so graphically, it is just very, very difficult to do.

We know or think that the immediate danger, isn't so great to the population at large, although it may be very great to small segments of the population. And, certainly prompt action in those instances is called for.

Now, I would like to comment on two particular issues that arose in the institutional Roundtable. One is public participation. It is clear that even though a lot of us who participated as members of the public in the early 70's thought that the issues were complex at that time; we know they are more complex now. You saw from the charts, which were very graphically shown here that control of toxics and non-point discharges present exceedingly complex problems; the divergence of views among scientists is considerable. So, to inform the public is a greater challenge to the decision-makers, and to the regulators.

It also means that the problems will not be solved today, or tomorrow, or next year, or by passing a particular bill. The problems are intractable and continuing. Thus, we must develop a process that involves public participation way down the line. There is a greater obligation on decision-makers to continue to inform and involve the public. The public is the consumer of the environment and thus, must participate in the decision process.

The second problem that I would address is that of institutions. There has been a great deal of discussion about the San Francisco Bay Conservation and Development Commission (BCDC) In the

first place, the initial study Commission which operated between 1965 and 1969 performed an exceedingly valuable service by informing the public on the key issues. It was a group of 27 people, chosen not all from one side of any aisle. They were environmentalists, they were industrialists, they were regulators, they were local government, they were the whole range of people, and they sat in a public fish bowl and debated. They thus informed themselves and they informed the public. And, that role is an important one that might be carried out by the new Puget Sound Authority. To the extent that we can involve that Authority, or other agencies, other commissions in that kind of public discussion, it will benefit us all.

But beyond that, I believe there are serious questions about the relevance of the BCDC institutional structure to the water quality problems of Puget Sound. The BCDC was designed to accomplish two fairly simple, straightforward goals. To stop the filling of San Francisco Bay, and to improve the access to the Bay. A super-government was created to control San Francisco Bay and 100 feet inland. However, the BCDC has no jurisdiction over water quality or water pollution, so that it is a different kind of a structure. There was a broadly based consensus that the San Francisco Bay should not be filled anymore.

It is also true, there was a major public organization, the Save The Bay Association, which played a fundamental role in supporting that movement. It was also a fact that you could take off from the airport and fly over the Bay and see where somebody filling there. And so you could rush out and you call a regulator and they could go over there and stop that fill.

It is a very different, more complex, and less visible problem here. How do you know when a new toxic substance is going in Puget Sound from a new chemical plant or a new manufacturing entity? There is less of a general consensus on the goals to be achieved.

It is also true that San Francisco Bay is of much lesser political significance in California than Puget Sound is to the State of Washington. About half of the people in the State of Washington live around Puget Sound and participate in its well-being, and so, it is more appropriate here to think about State action with regard to Puget Sound, than it is to think about a special new governmental entity that might control only Puget Sound.

However, I should add that having said all that, I think there is a latent feeling that if the existing institutional structure (the Department of Ecology, the Shoreline Management Act, under various laws, and the EPA) doesn't pick up and implement the public demand for some action to find out more and to do whatever is appropriate on toxic substances, and non-point pollution, then at some point a special governmental entity will be called for. At this point, though, it seemed that the consensus is more for interagency cooperation, interagency agreements, more action of that sort than creating some new governmental entity.

Finally, just as a final summary, we are now in a different era than the early 1970's. The relatively easy tasks have been completed. We have a legal system, an institutional structure that is now in place, that can accomplish the goals of controlling the pollution from

toxic substances and non-point pollution, if we wish to do so. We are confronted, though, by a new science, a better technology, which is in the process of identifying a bundle of new pollutants, toxics and such.

Because of the lack of data, and the complexity of the problem, there is greater difficulty in relating this science to policy decisions. It is not a simple matter. We know that perfect information is not possible, and so the basic issue is the degree of acceptable risk. A lot of people don't like to think about that, but of course every time that you get into your car, you are accepting a certain degree of risk, and the question is the degree of risk that you wish to accept. Put another way, what kind of reduction of risk are you willing to pay for? If you have only so many dollars, either privately or publicly, what are you willing to spend that on? Where can you get the largest environmental bang out of your buck. We can't do everything at all times. We cannot in practical terms, ever reduce the production of toxics and other dangerous substances to a zero level. At what point are we willing to accept that level? What are the priorities? There is a wide consensus that we are facing a long-range problem, a most complex and difficult problem, much more so than the early 1970's, and that there is an urgent need for cooperation among the various entities to solve this problem.

This conference, it seems to me, will provide an excellent background in updating and providing background for these problems for the new Water Quality Authority. Thank you.

ADDITIONAL COMMENTS

Dr. Malins: I don't always have the opportunity to contribute positive thoughts, but I would like to congratulate the Puget Sound Council of Governments for a successful Conference. On the positive side, it seems to be that when you have 400 people from all walks of life interacting, trying to understand pollution and its effect in this area, it is not difficult to view positively for the future and our stewardship of our natural resources.

On the question of risk, and risk assessment, how much do we accept? It is not just risk from death, or shellfish, or how much shorter do we want to make our lifespans, but rather, how much shorter do you want your children to play, and how many birth defects are we willing to accept. It is not simply a question of how many deaths are you willing to accept, because when we think of death we think of older people. However, it is usually younger people who have the susceptibilities. Children have a much more susceptible system to outside influences, and whenever any of these conditions are considered it should be considered as far as looking at children, rather than a nebulous situation of death.

Professor Johnson: I agree basically with what you are saying. Responding to an earlier comment, I was given a couple of examples of parts per million or parts per billion. I was told that if you took a spoonful of botulism and put it into the Seattle water supply, that it would kill everybody in the City of Seattle. Is that roughly correct? That is a very small amount, and dioxin kills guinea pigs at parts per trillion, I think. So I think that Ernesta Barnes, in talking with her later, didn't mean that these are insignificant, but that they are difficult problems of relationships.

The other thing is, I think there should be a distinction made between removing existing pods of toxic substances from the bed of Puget Sound or from Puget Sound which could be exceedingly expensive and might be actually environmentally degrading, as compared to trying our best to stop additional contaminants. And where you can accomplish that even now with uncertain information, at reasonably modest cost, then surely that is what should be done, and I hope that the message is getting through of the public's concern about the continuation of these things -- so that is a different thing than trying exceedingly expensive remedies which have maybe no improvement, and maybe some environmental harm. It is a more sophisticated response to the problem.

Lyle Morris, University of Washington: Speaking as one in a position of having to mediate between scientists and the public, and problems of regulators, planners, and decisionmakers, I for one am encouraged by this Conference and I think that the people that sponsored it, the institutions that sponsored it, the people and the institutes that participated are very likely the core group that are going to be responsible as future mediators for taking action on the questions that they just discussed.

I think that I've seen one contradiction that I am aware of in my daily work, and I think it has been expressed by several of the

speakers in workshops and plenary sessions, which is certainly a contradiction between the scientific tradition that most people are working with, and the political traditions that we are trying to operate through. I think very often it requires a particular kind of political courage for scientists to come out into the public arena and make judgments that cannot be substantiated in a traditional scientific way. It is very difficult I know for scientists to make judgments that cannot be normally established with the scientific method, and yet that is precisely what scientists are being called on to do in our public arena right now, and at this Conference.

I think Ernesta Barnes addressed that problem yesterday, and I think she was reflecting on the frustrations of one who is having to deal with scientists and at the same time being judged by the type of regulation she is responsible for. I would just like to urge the scientists who participated in this Conference to continue to have the courage and the interest to come forward and engage themselves politically. I think that it is not an easy thing for them to do. I think that the problem is that we are faced with highly consequential assessments. Assessments that are going to have consequences in terms of what expense and in terms of regulatory processes, and that we who are not scientists need to recognize the difficulties of that position.

I would like to go on to say that I think that there is a place for a new assessment, we need to have a new definition, of what risk really is. We need to have a new process that will include the possibilities of larger, long range issues. There are currently institutions that are making information available for the public (public libraries, academic libraries, etc.). I would also like to encourage scientists to take a strong role in interpreting and publishing insights. As long as people publish and continue their work, we will have a better informed public and a public that is more capable of responding intelligently to the problems we are facing.

Dr. John Vandermeulen: Mr. Chairman, Professor Johnson, Mr. Clark, colleagues, ladies and gentlemen, friends. This has really been a very interesting marathon. It began for me not yesterday morning, but the day before with a very lively discussion in my hotel room with my own Roundtable discussion group.

Several speakers here this morning have expressed the timeliness of the Conference. By coincidence, the New York Times of yesterday, September 30, 1983, Friday. (on page 14) reports that the EPA is now seriously considering a \$20 million cleanup of the Hudson River vis-a-vis contaminated sediments. That is, provided (a) they can find where these are and (b) where they are going to put them. Those are big riders on a cleanup program. But it does suggest to the very pragmatic business man, a price tag attached to our activities and wastes, at some future time. That is not to say that Puget Sound, in my opinion, is polluted in the sense that the Hudson River is. But, if I were that business man, and if I received some hint that something was wrong in the stock room, I would say "let's take stock." I would suggest to you that at this meeting these last two days, we have heard considerable indication that there are problems in Puget Sound.

As I said yesterday, these problems are not unique, and they occur in any number of places in our world's oceans. The North Sea, along the European coastline, has for several years been the recipient for a range of materials that simply cannot be put on land. But in recent years, a number of dump sites have now been closed by European governments, through common agreement, based simply on the suspicion that things are not quite right because fish are turning up dead or diseased.

I don't think that we are in that same serious situation here, based on what I have read and heard over the last eight years as I have kept track of Puget Sound, since I met Don Malins and have become friends with that whole research group. On the other hand, I think that there is enough of a warning there that if I were you, I would go out and take stock. I would measure more accurately the extent of the problem. Here I must sympathize with Mr. Clark. One can keep measuring and can keep analyzing, and just how far does one go on. I am sure that you will continue to find new compounds each time. But, that answer we can't give now. It is just not fair. Not before we have delineated and defined the extent of the problem. That comes first.

I was impressed with the people participating in the Conference. I can only speak from my own Roundtable panel, which I am sure was representative of Roundtables in the other rooms, and of the audience. Dr. Stewart spoke to us in the Roundtable discussions in a very informed and informative way about the transport and flow of water through Puget Sound.

Perhaps the most remarkable point of information, for myself and those of the audience who came to our panel discussion, was his demonstration that Puget Sound does not flush as nicely as was thought. In his illustration, using a picture of ten particles of water, or of contaminant, moving north from Seattle, only three will go out through Admiralty Inlet, but seven will return to recycle through the Sound. This is based on scientific fact. This is not hypothesis.

At the other end of the scale of our panel-members, I enjoyed the exchanges with Betty Tabbutt and Representative Fisher. Mrs. Tabbutt is a sharp lady with a very good grasp of the problems you are facing here. Ruther Fisher turned out to be very interested, and, for me most remarkable, willing to listen to any and all points that were raised.

However, apart from this congeniality that marked much of this Conference, the main point of the Conference, to my view, was the question of an acceptable "end-point"--that is, the degree of acceptable risk, as it was phrased by Professor Johnson. It is that point where we draw the line, where we say that enough is enough, where we say that up to that point we don't worry but beyond that point things are critical.

Ultimately, we will have to define that end-point, that acceptable risk. But what is it? There are many end-points. There are economic end-points, dictated by cost. There are ecological end-points, human value end-points. To some of us, we talk about the generations to come. The end point may be a very selfish one--"I don't care what happens to those fish, I don't care what happens to the water, I don't care what happens to the sediments, as long as I don't get sick." That is one view of how we occupy this world.

The economic end-point focusses on the costs of environmental control or management. We have all heard the statement that "Well, we can only afford to pay so much." Is that your end-point? If you accept that end-point then you would follow up that statement with "I will continue to support this program up to, say, \$75 on my taxes--but beyond that, no." In other words, if the costs go beyond that, then simply flush everything down the river and into Puget Sound. That is the economic end-point.

Or do we use the human end-point. Do we consider the whole of Puget Sound, the health of it, the life of fish and their well-being? And with that, the whole notion of man and of future generations--our children and our children's children. You have to decide what your end-point is going to be, and that cannot be decided in one conference. That has to come and percolate over the years.

It has been a marvelous "town-hall meeting." I have met friends. It is nice to come from far away and find friends. Nova Scotia, in many ways, is like the Puget Sound area. Several of you have been to Nova Scotia, you have been to conferences that we have held there. Nova Scotia is older than the Northwest in terms of civilization. In settling this confinement, our forefathers and came to Nova Scotia before they came here, but this settlement kind of leapfrogged over Nova Scotia, and it went west on and developed Ottawa and the New York areas, and it went west to Seattle. In many ways, Nova Scotia reminds me very much of what Seattle and the whole Puget Sound area is like. We have the same kind of coastline, the same kind of environment, and the same individualistic people who wouldn't want to live anywhere else. We can grow tomatoes in Nova Scotia in the wintertime, if you try hard enough, just as you can here.

I have made new friends--Peter Beaulieu, a very personal thanks to you. Bill Mahan, as our gracious chairman; Mart Kask, who is generous enough to allow me to take these few minutes. People like Ben Shuey. It has been very pleasant for me. I am reminded of a sculpture that a friend of mine has in his home. It is a wooden sculpture, it stands about 20 inches high, and it depicts a group of standing figures. It is essentially a large family group of figures, holding hand and turned inward. I was reminded of that sculpture during the course of this morning, of this congregation, this townhall meeting, inwardly together, working together, discussing a problem. Of course, there are going to be diverging points of view. But if you can only have that dialogue that we have been talking about; that we have not done this is as much the scientist's fault as it is the businessman's fault, or the legislator's fault. Ultimately, we are all citizens, we just happen to have different specialties, but we have got to get together and discuss those things.

I would like to make one suggestion, that you do this again in maybe five years from now. Get the same people together. See if we have learned anything from it.

Thank you very much for asking me out.

APPENDIX
PUGET SOUND WATER QUALITY AUTHORITY

Four-Year Term Members

Charles J. Henry, Jr., Director, Water Pollution Control
Department, Municipality of Metropolitan Seattle

The Honorable Jack H. Hyde, Ph.D., Tacoma City Councilman

The Honorable Lois North, King County Councilmember

Lester L. Smith, Manager, Operations, Atlantic Richfield Company

Sheri J. Tonn, Ph.D., Associate Professor of Chemistry,
Pacific Lutheran University

Katherine Fletcher, Director, Environmental Affairs Division,
Seattle City Light

Three-Year Term Members

Frederick E. Ellis, Ph.D., informed citizen

Gary S. Kucinski, Director of Planning and Research,
Port of Tacoma

David C. McMillin, Manager and Vice President,
Olympia Oyster Company

Virginia F. Stout, Ph.D., Utilization Research Division,
National Marine Fisheries Service

Michael R. Thorp, Attorney at Law

Two-Year Term Members

Bruce Bowden, O.D., informed citizen

Pam Crocker-Davis, informed citizen

Thomas P. Czepiel, Scott Paper Company

Andy Fernando, Chairman, Upper Skagit Tribe

Claris Hyatt, M.D., Snohomish Health District

One-Year Term Members

David L. Fluharty, Ph.D., Institute for Marine Studies,
University of Washington

The Honorable Bruce K. McKnight, Commissioner, Southwest
Suburban Sewer District and King County Water District No. 49

Peg Newman, Vice President, Fisher Properties, Inc.

Jo Yount, informed citizen

Chris Smith, Office of the Governor