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TIDINGS PACIFIC

Atmospheric Balance

The earth's surface is warmed by about 35 degrees Celsius — a warming created by a natural greenhouse effect. It makes life on earth possible.

The warmth is created because carbon dioxide (CO_2) and other greenhouse trace gases in the atmosphere absorb solar radiation, capture that energy and prevent it from escaping to outer space.

During much of the history of human life, the level of these gases was relatively stable and, until the last century, human activity had little or no affect on the atmosphere.

But with the Industrial Revolution came changes — huge population increases, the clearing of forests for agricultural land, and the beginnings of an economy based on the burning of fossil fuels. All these dramatically increased carbon dioxide levels in our atmosphere — about 20 to 30 percent since 1860 — and that rate of increase is accelerating. Other greenhouse gases, including the man-made Freon, have also increased.

Many scientists believe that high concentrations of CO_2 and other greenhouse gases will bring on a global warming that will cause extensive change in climatic patterns.

Global warming: Effects on B.C. Fisheries

SOLAR RADIATION

Global warming. Two small words with huge implications for our future.

"In my experience as a scientist, this is probably the first time we have so much agreement on the eventuality of a climate change," says Dr. Richard Beamish, Director of Biological Sciences at the Pacific Biological Station in Nanaimo, B.C.

"When it occurs, I think it will be the most serious environmental issue we've ever had to deal with."

Do we know enough to determine the possible effects this will have on Canada's west coast fisheries?

"Our staff are putting together a report that guesses at the effects on fishes," says Beamish, "and I have to say they are guesses at this point, at the consequences of climate change within the 1990s."

"We can expect a three- to five-degree increase in sea-surface temperature by the year 2050."

More importantly, Dr. Beamish reports that they're guessing there will be a one-degree increase in average sea-surface temperature by the year 2000. That's only 11 years from now.

Just over a year ago, scientists and staff at the Pacific Biological Station formed a working group to address the issue of global warming and the possible consequences on Canada's Pacific coast fisheries.

A one-degree increase may not sound like a lot — most of us are used to the type of temperature fluctuation we get on land throughout the year— but in fact, it will have a tremendous affect on our fisheries.

"We can expect to

INSIDE

Storing CO_2 in the Ocean

Fish farm donates chinook

Sockeye run largest in years

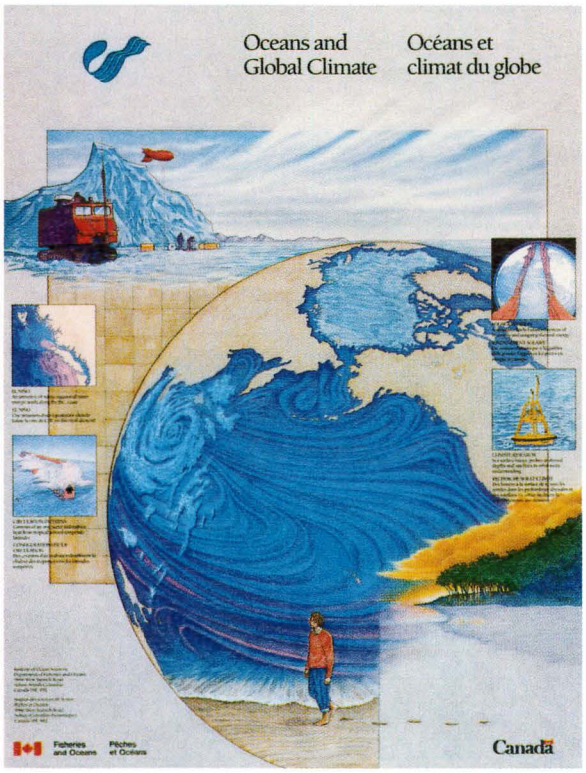
Fisheries and Oceans Pêches et Océans

Canada

see changes in run-off, changes in precipitation, and changes in the melting of snow pack," says Beamish.

"And as a result we expect to see major changes in the discharge patterns of our rivers, particularly Fraser and Skeena rivers, and in the oceanography off British Columbia."

Dr. Beamish isn't about to guess what those changes will be but he believes there's agreement that changes will occur and that these will affect the survival of species important to the fisheries.



Posters are available from ; Fisheries & Oceans, Communications Branch, 555 West Hastings Street, Vancouver, B.C. V6B 5G3

"The science of fisheries management really started in the 1950s and if you can accept that fisheries science is a young science, then you can accept that our theories and hypotheses are going to change," states Beamish.

"In my opinion, one of the changes occurring now is the recognition that the environment has a major effect on the recruitment of fish. In the last few years we've become more aware of the importance of understanding how the environment controls or affects the survival of young fish."

"Some scientists think the effect will be minimal and others think it will be great. I think it is an important factor affecting the size of stocks."

Dr. Beamish thinks the major concern for fisheries in Canada is for salmon. Salmon must return to freshwater to spawn and here the Fraser River is a particularly critical area. Both pink and sockeye salmon are the major species in this river, and they are at the southern end of their distribution.

What will happen to them as the temperatures increase? Will it be too warm for the sockeye to live in fresh water?

The other effect of changes in discharge patterns may mean there's more water in the winter and less in the summer.

Regional staff are considering the possibility of enhancing sockeye because the future might present a situation where sockeye may have to be moved from one river to another.

Herring and groundfish will also be affected. If temperatures increase even two degrees, groundfish species such as Pacific cod could move right out of Canadian west coast waters. The young cod have an optimal survival temperature and can't survive in warm waters. Changes in temperature and discharge patterns will influence whether sockeye travel through Johnstone Strait or through Juan de Fuca Strait.

Another effect of global warming is a projected increase in sea level of one metre by the year 2050. That's within the lifetime of our children.

There are huge gaps in our knowledge about what is likely to happen as a result of global warming and it's important we act now — working not only in the national arena, but on an international level — to prepare for a new and different future.

"We are considering the possibility of holding a major international symposium, Effects of Climate Change on Sub-Arctic Fisheries," says Beamish.

As a first of its kind, the symposium would attract a large number of participants. A preliminary response from scientists around the world shows support for it.

Beamish believes that global warming is not necessarily bad news.

"We're going to see changes that once occurred over evolutionary time occurring in the lifetime of our children. We're looking at a planet that's changing dramatically. No one is saying this is going to wipe out civilization, but the planet is changing more quickly than it has in the past because of the things that we've done to it in the past 100 years."

Farm donates chinook

When Ron Smeal of Saltstream Engineering Ltd. donated his juvenile chinook salmon to Fisheries and Oceans, he solved a surplus problem at his own farm and, at the same time, contributed to the rebuilding of chinook stocks and future fisheries.

This year, fish farms along the B.C. coast had a large surplus of chinook salmon smolts. An initial request to DFO to purchase the surplus stock was declined. Ultimately, an agreement was reached whereby farms could choose to donate their smolts and DFO, along with the provincial Ministry of Agriculture and Fisheries, would cover costs of moving the fish to designated release sites.

Transplanting the domestic fish from farm to wilderness was not just a simple matter of opening nets and releasing fish. The operation was a cautious one.

"We wanted to be sure there was no impact on natural stocks," says Ted Perry, biologist with the Salmonid Enhancement Program (SEP). "And so we set up guidelines, and before any fish were accepted they had to meet very specific criteria."

"We didn't want to risk introducing diseased fish or fish that were not normal. We also decided we would not introduce fish which were foreign to a geographical area. And fish would be released only into locations where they wouldn't have any impact on wild fish when they returned to spawn."

Twin Otter aircraft is specially equipped to transport juvenile salmonids.

Ron Smeal offered the smolts from his Saltstream hatchery at Doctor Bay, West Redonda Island in Toba Inlet. Over 400,000 fish were given a clean bill of health after examination by DFO's diagnostic team from the Pacific Biological Station in Nanaimo.

"These chinook originally came from what we call Big Qualicum stock — one of the key stocks that we're using in our enhancement facilities to re-populate rivers running into Georgia Strait. So in a sense, they are a generation removed from enhanced wild stock and are not at all foreign to the area we've released them," says Ted Perry.

The smolts travelled about 50 air miles by plane and helicopter from the farm to Vancouver River, Jervis Inlet.

"There are no natural chinook stocks in this area, so there was no impact on wild stock," says Perry.

Two-thirds of the fish were transported by a Twin Otter plane specially equipped for transporting juvenile salmonids, and the rest travelled by helicopter. Saltstream Engineering staff volunteered time and labour loading all the fish for transport.

Don Bailey, also a biologist in SEP operations, describes the release strategy used: "We wanted the best survival possible and if one release method didn't work, we wanted others to fall back on."

"We were concerned about their size, which was about seven to ten centimetres long. Research in other hatcheries showed survival rates decrease when fish are that small. We weren't sure if they were completely ready for salt water and our strategy allowed them to

To ensure survival rates, one group of the donated juvenile farm chinook are released into Vancouver Bay estuary.

adapt to that environment in their own time."

Basically the smolts were divided into three groups.

The first group were released at the Vancouver Hatchery — a joint venture between the Community Programs Division of SEP and Fletcher Challenge Ltd.

Hatchery staff and volunteers from Hardy Bay Seafarms (another private hatchery) unloaded 130,000 smolts from the plane to oxygenated tanks for the trip to the hatchery where they were put in Capilano rearing troughs.

A group of juvenile chinook farm salmon are released into rearing troughs at Vancouver Hatchery.

These smolts were fed for a few days to recover from the stress of transport and to imprint on the hatchery water supply, hopefully ensuring a return of adults directly to the hatchery for future brood stock. They were then released into Jitco Creek which enters into the bay.

The second group were released directly from the plane into the estuary of Vancouver Bay.

"This water is low in salinity," says Bailey, "and gives the fish time to adapt to the new salt water environment and imprint to the area."

The third group of smolts were released directly from helicopter transport into three pools in the lower Vancouver River, where they can voluntarily leave fresh water for the estuary.

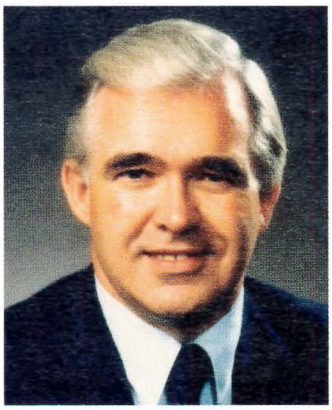
As part of the survival strategy the hatchery has kept about 20,000 smolts for release in late fall of this year or early spring of next.

"The success of the transplant will be monitored," says Ted Perry. "Both federal and provincial governments have shared costs to mark about 25,000 of the released smolts. In four years, we'll get information on the percentage of returns and where they return to." ■

New program to study aquaculture

"A $484,000 program to investigate potential impacts of aquaculture on fisheries resources will ensure that the continued orderly growth of B.C.'s aquaculture industry is done responsibly and in a way that is complementary to the well-being of our wild fisheries," says Tom Siddon, Canada's Minister of Fisheries and Oceans.

The program, funded jointly by the federal Department of Fisheries and Oceans and the B.C. Ministry of Agriculture and Fisheries, will examine the interaction between aquaculture and wild fish populations.



Tom Siddon, Minister, Department of Fisheries and Oceans

One of the research projects to be undertaken will examine whether flesh pigments or antibiotic marks on scales can be used to distinguish escaped farm fish "spawners" from wild fish. An ability to tell wild from farmed will help determine the genetic impact of any interbreeding between the two populations.

Researchers will also assess potential for transmission of disease from farm to wild populations, and will look at the impact of fish farms on seabed communities and fish habitat.

The program will also review predation by farm salmon on wild salmon and herring stocks and will be done in conjunction with a DFO study examining the effects of salmon farming on herring reproduction. The information will be used, if found to be necessary, as the basis for revised farm siting and operational guidelines. ■

Fraser River sockeye run best in years

They had returned to spawn in the millions and they were beautiful.

This year's Fraser River sockeye salmon run was one of the largest in recent memory.

Fraser River Panel members within the Pacific Salmon Commission are responsible for achieving Canadian sockeye and pink conservation and escapement goals (sufficient fish for spawning).

They allocate the total allowable catch to Canada and U.S. fishermen. In addition, they are responsible for domestic in-season allocation, on a run by run basis. They determine the catch limits for each of the commercial gear-types; troll, seine or gillnet; and for the Indian food fisheries and recreational fisheries, monitoring to ensure that pre-season domestic allocations are being met.

This year, the pre-season prediction for sockeye in the Fraser River was set at 13 million fish and of this, 9 million were predicted for the Horsefly River — the backbone of the Fraser run.

The first sockeye runs started in July with the early Stuart River run. Normally there are conservation difficulties for these sockeye and hardly enough for the Indian food fishery, but this year was the dominant one in the sockeye's four year cycle. Over a million fish came in. Predictions were right on target, fishing was strong, and escapement goals were reached.

Sockeye returning to spawn in the Horsefly River came in the greatest numbers since the Hell's Gate slide in 1913.

Sockeye of the early Stuart run are highly prized and fishermen say you haven't eaten sockeye until you've tasted one of these. The fish are in prime condition, high in oil and fat content and ready for their long journey up the Fraser River beyond Prince George and into the Stuart Lake system.

The next run, and this year's big surprise, were the sockeye heading for the Horsefly River. They were expected to peak towards the end of July as they entered Juan de Fuca Strait. Six days later they should have been in the lower Fraser River.

At first, the reports were not good. Trollers off the west coast of Vancouver Island and the net fisheries in Johnstone Strait both had very low catches. Was the run that much smaller than predicted? Or was it simply very late in the season?

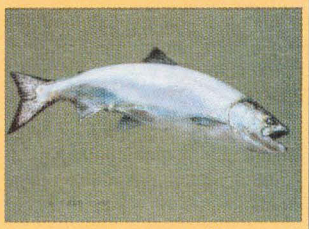
In the end, it proved to be late—as much as two to three weeks. The fish peaked in Juan de Fuca Strait in mid-August. Allocation and conservation decisions were up-dated and run size estimates soared to 20 million—the largest for this stock since the Hell's Gate slide in 1913.

By August 20, the run had dropped off, requiring a revised estimate of 19 million and as of early September, the run appeared to be less than 18 million sockeye. Still a record number of fish on this cycle. ■

Chinook Conservation

Limited Edition Prints

As part of the 1989 chinook conservation program, limited edition prints and stamps from the original chinook pastel by artist Robert Field, have been produced by the Pacific Salmon Foundation . Sales revenue generated will benefit habitat rehabilitation and salmonid enhancement projects.



Orders can be placed with the Pacific Salmon Foundation, 119 - 255 West 1st Street, North Vancouver, B.C. V7M 3G8.

Prices :

(includes 6% sales tax)

A) Signed (by the artist) print $206.70

B) Signed print and mint stamp: $209.88

C) Signed print and signed stamp: $216.24

D) Signed print, mint stamp and signed stamp: 219.42

Payment can be made with Visa, Mastercard (must include signature and expiry date of card), or cheques payable to the Pacific Salmon Foundation.Order deadline: November 30, 1989.

New focus on sport fishing

A fishing pole, a line, and a hook — images of young boys, straw hats, and sunny days.

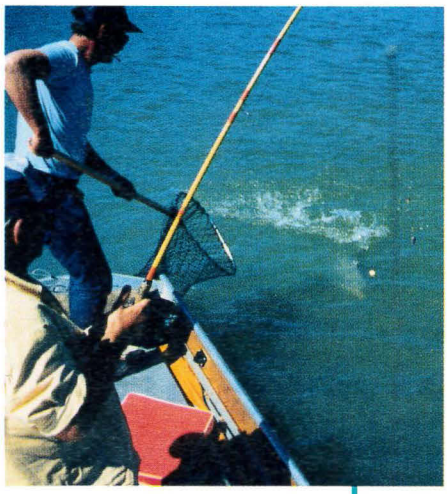
With the decade of the nineties fast approaching, that image has changed but the romance of the angler is stronger than ever. Sport fishing has become a pursuit for thousands of men, women, and children.

"As in all of North America, the growth of recreational fishing in British Columbia has been phenomenal," says Tom Bird, acting chief of the new Recreational Sport Fish Division within Fisheries and Oceans.

That's all changed. People with more leisure time are looking at sport fishing to fill it.

The new sport fish division is a response to and recognition by DFO of the unique needs of the recreational fishing community. Whether they are individual fishermen or large operators, they have different kinds of requirements than do the commercial and Native sectors.

The new division, which will be fully staffed by the end of the year, includes three coordinators who work within the same geographical areas as fisheries management — the south coast, north coast and the Fraser River. In addition, two staff members continue to maintain the licence distribution to the 600-plus vendors throughout the province.

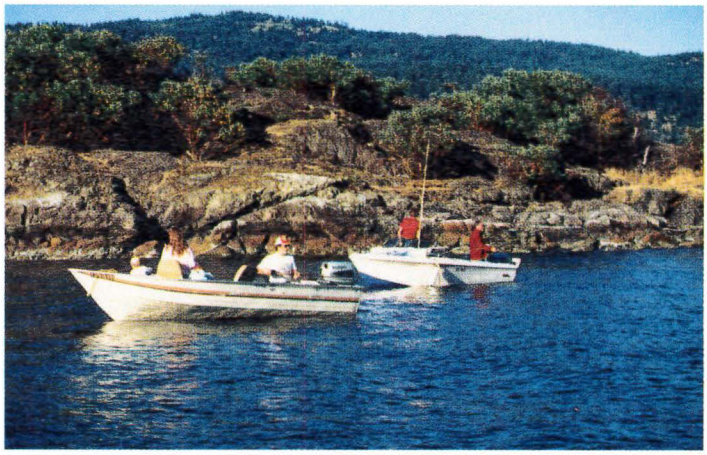


"Initiatives currently being developed include a manual for the licence vendors," says Bird. "I don't think we can over emphasize the importance of our vendors. After all, they're the first contact for those setting out on their fishing adventures."

The manual describes how to fill out the licence and helps with logistics and the business of handling a licensing service — things like the number of licences sold, and stamps purchased.

Continues Bird, "We've been getting out and meeting as many people as we can — everyone in the sport fishing community and those that support the industry. We want to know their concerns, their problems and their needs."

In a new video produced by the division, sport fishermen learn more about catch and release — how it works and what the survival rate is. An accompanying video currently being developed shows how to release fish for even higher survival rates.



"We're also working on a series of identification cards and posters to assist anglers," says Bird.

Numerous opportunities also exist for the development of cooperative programs within the sport sector.

"During the coming year we'll be working with the Sport Fish Advisory Board on a number of initiatives. We have also had discussions with the provincial government to explore possible joint programs."

The new division reflects Canada's national policy for recreational fisheries *(July 1988 Pacific Tidings)*.

Fishing opportunities need to be provided to the recreational sport fish community, and one of the goals of the national policy is to look at redirecting fishing pressure from over-exploited fisheries to areas which can support more activity.

"As well as a key part of the Pacific coast lifestyle, it's an integral part of our fisheries" says Bird, "and will be a major player in the departmental planning and management processes. ■

The ocean as a carbon dioxide "sink"

Approximately 300 billion tons of carbon as carbon dioxide (CO_2) have been released to the atmosphere during the past century. This is from the burning of fossil fuels and the clearing of forests and other ecosystems for agricultural land.

Each year fossil fuel burning puts five billion tonnes of carbon into the atmosphere. Deforestation contributes one billion tonnes.

"But when we measure it in the atmosphere, we can only detect a 3.6 billion tonne increase per year," says Dr. C.S. Wong, ocean chemist at Fisheries and Oceans' Institute of Ocean Sciences. "Forty percent of it is gone."

Only when science understands the global carbon cycle — the movement of carbon between the atmosphere, land, and ocean—can we improve our ability to predict the ocean's role in controlling future levels of CO_2 in our atmosphere.

Together with scientists from DFO's Bedford Institute of Oceanography in Nova Scotia, Dr. Wong and his colleagues are putting together a five to ten year national plan in which the Canadian national climatic chemistry program within Fisheries and Oceans will study the carbon cycle in the ocean.

"We want to know how fast the ocean absorbs CO_2," says Dr. Wong, "and how long it takes to be transferred between the atmosphere, the upper ocean, mid-ocean, and the deep ocean floor.

"The ocean, unlike the atmosphere, is not very homogeneous with respect to its CO_2 content and distribution. Part of the surface ocean gives off CO_2 and other parts absorb it."

"The ocean is not very homogeneous. Part of it gives off CO_2 and other parts absorb it."

The biological pump process — phytoplankton acts as a pump through the process of photosynthesis — moves the surface oceanic CO_2 to the deep ocean. For example, copepods eat phytoplankton which are then converted into fecal pellets which fall to the deep ocean floor eventually becoming sediment or dissolved CO_2 and organic carbon.

Absorption of CO_2 varies from place to place and depends on water temperature. In warm equatorial waters CO_2 is released into the atmosphere. However, in the so-called "carbon" area around Hawaii the reverse is true. The water evaporates quickly, becoming highly alkaline and able to absorb CO_2.

The sub-arctic waters in the north east Pacific absorb and release CO_2 depending on the seasonal temperature of the waters. Waters of the Arctic and Antarctic absorb CO_2 because colder water holds more gas. Winter waters around Greenland and Labrador are chilled up to 5,000 metres deep and are a significant factor in CO_2 removal and transfer to the deep ocean.

"Part of Canada's Pacific plan includes a future agreement with Russia and the United States for an ocean climate study of sub-arctic waters," says Dr. Wong.

In 1991 there will be a four month research cruise in the sub-artic waters of Vladivostok, Russia and sub-tropical waters of Hawaii.

Future plans include two additional research cruises per year, each 90 days long, in waters between British Columbia and Vladivostok. Russia, supplying ships that can carry as many as 65 scientists, will zig-zag across these waters, perhaps all the way to Port Alberni and Prince Rupert. The contribution from Russia is considerable. Costs vary between $8,000 and $15,000 per day to operate one ship, depending on its size.

Physical oceanographers and climate chemists from the Institute of Ocean Sciences will study temperature distribution, salinity structure, and water mass to find out how the sub-arctic front shifts seasonally, changes that affect ocean

CURRENTS

Al Lill, formerly chief of the engineering division within the Salmonid Enhancement Program, has taken on the duties as director of Fisheries Branch within DFO's Pacific Region.

Alan Gibson, formerly chief of the conservation and protection division, has been appointed chief of resource, allocation and industry liaison within Fisheries Branch.

temperature and climate and its ability to absorb CO_2.

It's a very complicated process. The interplay of currents from different parts of the world — Californian water and the warm Kuroshio Current from Japan (also known as the North Pacific Drift) — all affect CO_2 distribution in the water.

The immediate waters off the east coast of Russia carry a lot of CO_2," says Wong. "One of our tasks is to look at how much CO_2 moves from one side of this part of the Pacific to the other."

The world oceanographic community has programs in place to address the problem of climate change and the oceans. One of these, and one that Canada is planning to be part of, is WOCE (World Ocean Circulation Experiment), concerned with ocean circulation with relation to ocean climate. To construct a mathematical model of the circulation of the world's oceans WOCE needs more data and Canada plans to help provide that.

Plans include measuring amounts of CO_2 in water samples taken every 50 kilometres in the Pacific Ocean from north to south, 170 degrees West from the Aleutian Islands to 20 degrees south. In the North Atlantic Basin, researchers will collect data from the cold waters of Labrador and Greenland seas.

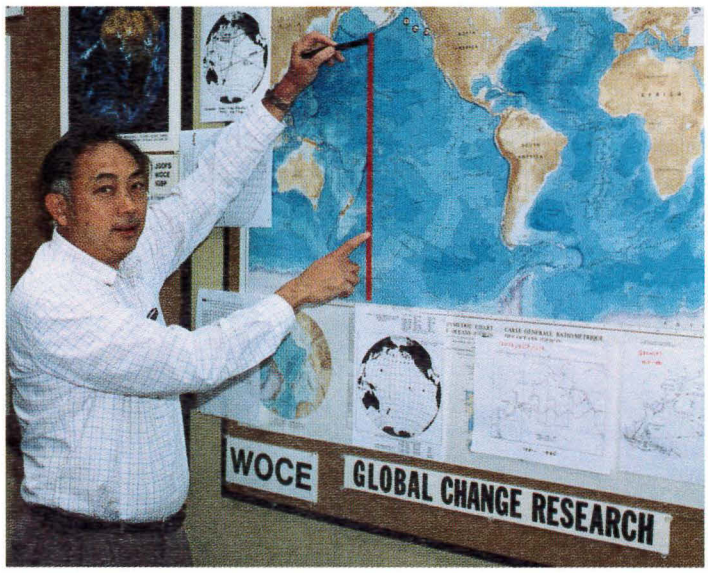
Information on time-series changes in water properties collected at Canada's Ocean Station P in the Gulf of Alaska will also be contributed.

"The global carbon problem is an international problem," says Wong.

To that end, Canada is a participant in the Joint Global Ocean Flux Study (JGOFS) which will investigate the flux (movement) of carbon compounds in the ocean and the extent to which oceans may affect climatic change by absorbing CO_2.

An important benefit of our participation will be the access Canada will gain to the world bank of information and models needed to anticipate the consequences of global warming.

Says Dr. Wong, "The key to better knowledge of the global carbon cycle will likely lie in the oceans. As shown in the historical past, we must again look to the sea beyond—to secure a brighter future." ■



Illustrating where water samples will be examined (along the red line) for the World Ocean Circulation Experiment is Dr. C.S. Wong, head of Ocean Chemistry and the Centre for Ocean Climatic Chemistry at the Institute of Ocean Sciences in Sidney, British Columbia.

TIDINGS PACIFIC

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