PESTICIDE WORKSHOP PROCEEDINGS

November 26, 1998

at
Pacific Environmental Science Centre
North Vancouver, B.C.

Regional Program Report 99-01

Prepared by:

Jen-ni Stroh
Environment Canada
Environmental Protection Branch
Pacific and Yukon Region

January, 1999

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DISCLAIMER

The presentations in these proceedings are the conclusions of the respective authors'. Ideas and critique expressed herein do not necessarily reflect the opinions of Environment Canada.

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EXECUTIVE SUMMARY

The DOE Regional Pesticide Committee was established by the Pacific and Yukon Region in 1995, and is composed of representatives from all operational Branches in the P&Y Region. The purpose of the committee is to deal with the overall coordination and exchange of information on pesticides matters pertaining to research, evaluation, monitoring and pollution control activities, and to effect this coordination through the development of a management system. The elements of the management system include: a regional departmental mechanism for sharing information on pesticides; the identification of emerging issues, strategic approaches and priorities for regulatory action to senior management in the Region and HQ; a coordinated communication strategy, technical guidance on monitoring programs and regular reports on progress to the regional toxics table and other management bodies.

The third annual workshop was held on November 26, 1998 to exchange information on the pesticides work being carried out by the members and facilitate communication among members and discuss collaboration on projects. The work being carried out by the P&Y Region was reported and the presentations covered a diverse array of pesticide work, including laboratory techniques available for analysis of various pesticides and toxicity studies, research into new methods of measuring toxicity and its technology transfer, investigation of bird kills resulting from pesticide use, and measurement of levels in various media such as surface water, groundwater, agricultural runoff, sediment, and invertebrate. The Clean Water Action Plan, Clean Air Action Plan, surface and ground waters, and wildlife aspects of Georgia Basin Ecosystem Initiative were also introduced. As well, the Memorandum of Understanding between Environment Canada and the Pest Management Regulatory Agency (PMRA), Health Canada was explained. Discussion was also made on the DOE-HQ plan to transfer pesticide lead at DOE-HQ from EPB to ECB. It was concluded that the lead for the P&Y Region stays with EPB.

At the workshop, members concluded that the multidisciplinary aspect of pesticide issues, combined with the clear need for improved understanding of sources, sinks, and effects on ecosystems of these ubiquitous chemicals, called for a more integrated approach by DOE and its partners in the future. Pesticides are but one of many stresses on the biota, and therefore assessments of pesticide impacts require links to other agencies assessing climate change, habitat loss, eutrophication, and the cumulative and/or synergistic effects of exposure to a number of contaminants.

Action items arising from this workshop are the production of the workshop proceedings, the improvement of coordination on pesticides issues with partners in federal, provincial, and other government agencies by organizing an annual pesticide information exchange session.

Bryan Kelso

1998 Pesticide Workshop
Environment Canada, Pacific and Yukon Region

November 26, 1998

Pacific Environmental Science Centre
2645 Dollarton Hwy, North Vancouver, B.C.

Format:	Pesticide Workshop	0900 - 1200
	Lunch	1200 - 1230
	Pesticide Workshop	1230 - 1500
	Member meeting	1500 - 1530

Facilitator: Bryan Kelso

Agenda:

9:00 Opening remarks - B. Kelso

9:00 Georgia Basin Ecosystem Initiative: Clean Water Action Plan - L. Walls

9:25 Assessing the effects of agricultural activities on the aquatic ecosystem (surface and ground waters) - T. Tuominen

9:40 Air component of GBEI - W. Belzer

9:55 CWS component of GBEI - L. Wilson

10:10 National Pesticides Program and current issues regarding pesticides - B. Sebastien

10:30 ***COFFEE BREAK***

11:00 The Environmental Assessment Division of PMRA - new directions - P. Delorme

11:15 The evaluation of potential impacts of DDAC & IPBC in the Fraser Estuary - C. Gray

11:30 The use of Glomus intraradices and Vesicular-arbuscular Mycorrhizae for assessing the environmental impact of Azadirachtin - M. Wan

11:45 Development of laboratory inhibition bioassay techniques - R. Watts

12:00 ***LUNCH***

12:30 Atrazine and metolachlor in silage corn test plot runoff - first year and second year trial experience - G. Derksen

12:45 Impact of agricultural pesticides on wintering birds in the lower mainland area - L. Wilson

13:00 MS/MS Scan on pesticide in birdcrop - C. Wong

13:15 Recent Environment Canada and US Geological Survey investigations of pesticides in ground waters - Abbotsford Aquifer - H. Liebscher

13:30 Pacific Environmental Science Centre Laboratory Quality Assurance / Quality Control - A. Soo / R. Strub

13:45 Soil and sediment toxicity - G. van Aggelen

14:00 Exposure of California Quail to organophosphorus insecticides in apple orchards in the Okanagan Valley - L. Wilson

14:15 Nitrate levels in Clayburn Creek in relation to rainfall - an indicator of potential windows for pesticide monitoring? - G. Derksen

14:30 Regional Pesticide Programs - B. Kelso

14:45 Pesticides assessment and the use of TOMES Plus CD ROM - J. Pasternak

14:45 ***MEMBER MEETING***

15:30 Summary of Action Items - B. Kelso

Attendance List: (in alphabetical order)

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DISCUSSION

Membership and Format of the P&Y Regional Pesticide Workshop - group discussion

In the past two years, the issue of extending the Workshop membership to other agencies was discussed and no consensus was reached. However, the participation of PMRA, Ottawa this year had generated positive response. At the end of the Workshop, it was agreed by all participants that the presence of the PMRA, Ottawa at the Workshop was beneficial. Hence, it was agreed that the participation of other agencies and departments in the Workshop would be beneficial and should be sought.

Discussion

It was decided that future DOE Workshops would be open to other speakers, who study pesticides and are willing to share results, engage in discussions and consider collaborating on projects regarding pesticide issues in the Lower Mainland/Georgia Basin and in other areas of B.C. and Yukon. Potential issues addressed by the Workshop could include but are not restricted to: health aspects, agricultural issues, wildlife problems, regulatory information, public information dissemination, public education.

Invited agencies may include (but are not restricted to):

- Agriculture and Agriculture/Food Canada (AAFC),
- Pesticide Management Regulatory Agency (PMRA),
- BC Ministry of Environment, Land and Parks (BCMELP),
- BC Ministry Agriculture and Food,
- BC Ministry of Fisheries,
- Department of Fisheries and Oceans (DFO),
- Health Canada,
- Greater Vancouver Regional District (GVRD).

It was also agreed that sensitive issues for DOE members should be presented in a separated time slot, that this function should bear the name of Information Exchange rather than Workshop, and that it would occur annually, likely in the fall.

Action Items

- Speakers to submit abstracts and overheads used at this workshop.
- CCD to set up agenda and invite participants annually.
- CCD to produce a Pesticide Workshop Proceedings which includes *Executive Summary, presentation abstracts and overheads, and group discussion notes.*

PRESENTATIONS

ABSTRACTS AND OVERHEADS

(in order of presentation)

GEORGIA BASIN ECOSYSTEM INITIATIVE

CLEAN WATER ACTION PLAN

Presented by **Lisa Walls**
Environmental Protection Branch,
Environment Canada, Pacific and Yukon Region

ABSTRACT

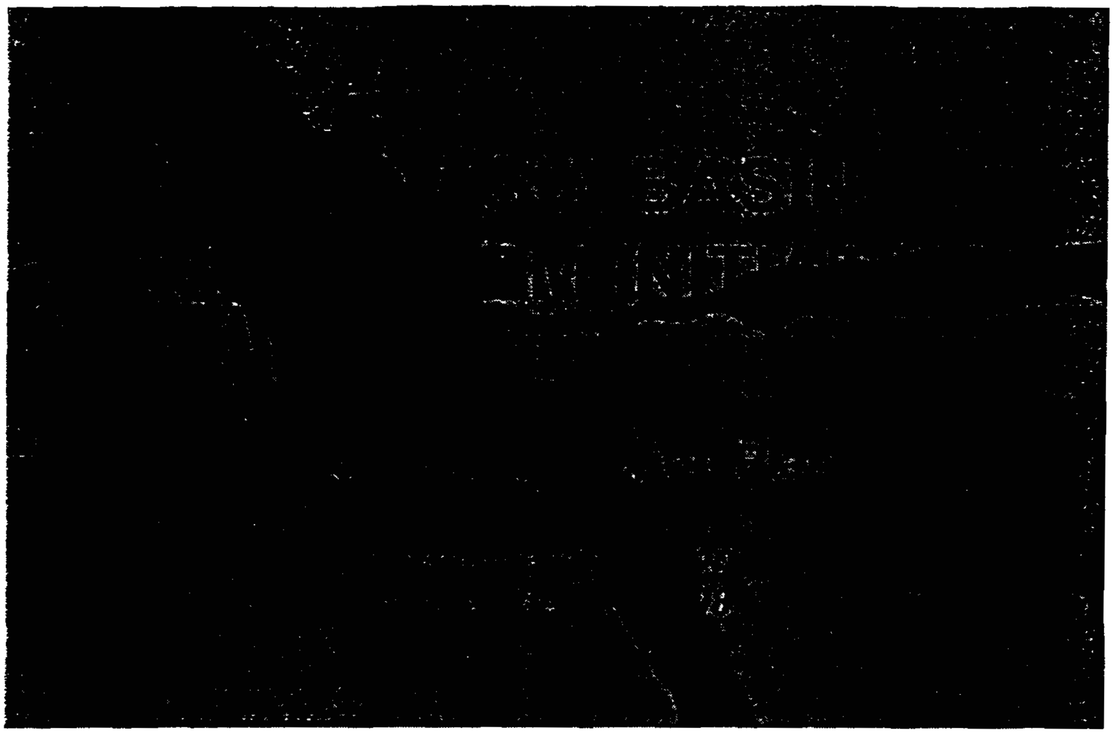
This presentation provides an overview of the Clean Water Action Plan of the Georgia Basin Ecosystem Initiative (GBEI). The overall goal for the Clean Water Action Plan is:

> **Clean water to protect and improve aquatic ecosystem health and human well-being in the Georgia Basin.**

Long-term goals or environmental outcomes have been described in four priority areas:

- **TOXICS - Georgia Basin ecosystems are not adversely affected by toxic chemicals,**
- **SHELLFISH - productive shellfish harvesting areas are maintained and restored to ensure a sustainable shellfish resource for the benefit of commercial, recreational and First Nation users,**
- **LIQUID WASTE MANAGEMENT - liquid waste management programs are developed and implemented to arrest and reverse pollution, and minimize public health risks in the Georgia Basin, and**
- **NON-POINT SOURCE POLLUTION - fresh, marine and ground water ecosystems are protected from effects of non-point source pollution.**

The presentation outlines the goals and strategies for each of the four program areas, and highlights some of the early results or deliverables expected in the first year of action.



VISION & FRAMEWORK

Shared Vision

Managing Growth to Achieve Healthy, Productive and Sustainable Ecosystems and Communities

- Enhancing Environmental Health
- Building Sustainable Communities
- Enhancing Human Well-being (Health Canada)
- Integrated Coastal Zone Management (DFO)

MANAGEMENT STRUCTURE

STEERING COMMITTEE
RDG-EC/DM MELP

Secretariat
(EC and MELP
Coordinators)

MANAGEMENT COMMITTEE
WORK GROUP CO-CHAIRS AND DIRECTORS/ADM'S

- Clean Air
- Clean Water
- Habitat and Species
- Community Resource
- Knowledge

ACTION PLAN

Enhancing Environmental Health

- Achieving Clean Air
- Achieving Clean Water
- Conserving and Protecting Habitat and Species
- Building Sustainable Communities

CLEAN WATER ACTION PLAN

Enhancing Environmental Health

Achieving Clean Water

GOALS:

- Aquatic ecosystems and wildlife are not adversely affected by toxic chemicals
- Productive shellfish harvesting areas are maintained and restored
- Liquid waste management plans are implemented to arrest and reverse pollution and minimize public health risks
- Fresh, marine and groundwater ecosystems are protected from effects of non-point source pollution

ACHIEVED THROUGH:

- Environmental studies, source inventories and control/management options for toxic substances and non-point source pollution
- Community-based shellfish clean-up programs
- Improved management practices, treatment system optimization, and pollution prevention projects
- Targeted inspections and compliance promotion
- Stewardship and education programs

CLEAN WATER ACTION PLAN

Enhancing Environmental Health

Achieving Clean Water

RESULTS:

- Management strategy for priority toxics (2003)
- 65% reduction in DDAC discharges at Vancouver Island antisapstain facilities (2003)
- Impacts of EDCs and POPs assessed in select components of the aquatic ecosystem and key wildlife species (2002)
- 25% of closed shellfish areas in selected areas (Parksville Bay, Baynes Sound, Cowichan Bay, Nanaimo) reopened through community-based shellfish stewardship plans (2005)
- 50 "no discharge" zones selected for designation (1999)
- On-site sewage system training centre established (2001)
- Sewage plant inventory and compliance assessment completed (1999); optimization studies at 4 plants (2003)
- Pollution prevention programs implemented for printing and auto repair industries (2003)

Toxics

Goal: Aquatic ecosystems and wildlife in Georgia Basin are not adversely affected by toxic chemicals

ACHIEVED THROUGH:

- Cooperative approaches with partners, eg. Puget Sound/Georgia Basin International Task Force
- Assessment of impacts of EDCs and POPs in selected components of the aquatic ecosystem
- Assessment of impacts of EDCs and POPs in selected wildlife species
- Source characterization and inventories and development of management strategies for priority toxics defined through assessments
- Early action to reduce contaminants through targeted inspections and compliance promotion, for perchlorethylene and DDAC

Toxics

Year 1+ Results:

- Puget Sound / Georgia Basin Toxics Work Group (established)
- Nominating List of Toxic Substances in Lower Fraser/Georgia Basin
- Inventory of information on sources, concentrations, and loadings of priority toxic substances in wastewater discharges into the Georgia Basin
- Compendium of Water Quality Objectives for Puget Sound/Georgia Basin
- 400 site inspections for perchlorethylene
- DDAC inspections at 4 Vancouver Island antisaptstain facilities
- Study of EDC effects in the aquatic ecosystem in Elk Creek watershed
- Sampling of otter scat and mink and otter liver for chlorinated hydrocarbons and mercury
- Examination of mink and otter carcasses for biological effects of contaminants
- Collection of selected seaduck blood/feather to measure exposure to heavy metal and organo-metallic contaminants

Shellfish Growing Area Restoration

Goal: Productive shellfish harvesting areas are maintained and restored

ACHIEVED THROUGH:

- Cooperative approaches with three communities for restoration and remediation of areas closed to shellfish harvesting
- Increased number of marine designated areas for protection from boat sewage under the Federal Pleasure Craft Sewage Pollution Prevention Regulations
- Increased number of pump-out facilities for boaters in the Georgia Basin
- A consultative process for identification and creation of Shellfish Reserves
- Increased boater awareness of boat waste impacts on shellfish growing area contamination through the Canadian Coast Guard Green Boat Program
- Community based approach for Liquid Waste Management Planning consistent with the provincial LWMP Process Guidelines (eg. Sooke, Halfmoon Bay, Union Bay)

Shellfish Growing Area Restoration

Year 1+ Results:

- Inventory of poorly-flushed water bodies containing shellfish resources at risk from boat sewage contamination
- Recommendation of 50 new water bodies for designation as "no dump zones" under the federal Pleasure Craft Sewage Pollution Prevention Regulations
- Stakeholder workshops to develop projects for remediation of areas closed to shellfish harvesting in 2 pilot watersheds (eg. Halfmoon Bay and Nanaimo Estuary)
- Ambient water quality and shoreline monitoring from Secret Cove to Sargeant Bay to reduce shellfish closures and assess impacts of non-point source and permitted discharges in the Halfmoon Bay area

Liquid Waste Management

Goal: Liquid waste management plans are implemented to arrest and reverse pollution and minimize public health risks

ACHIEVED THROUGH:

- On-site sewage systems technology transfer seminars and training centre
- Increased implementation of water conservation measures
- Improved stormwater management
- Effective biosolids (sewage sludge) management
- Assessment and optimization of sewage treatment at selected small to medium sewage treatment facilities
- Implementation of pollution prevention programs by municipalities and small businesses

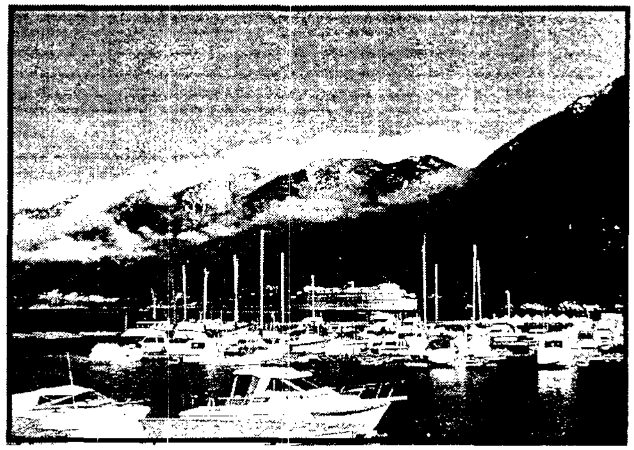
Liquid Waste Management

Year 1+ Results:

- Sponsorship of the BC Onsite Sewage Association's first conference (October 1998)
- STP inventory and effluent loadings estimate
- STP biosolids inventory and characterization for dioxins, furans and mercury
- Initiation of a printing and graphics industry pollution prevention program
- PROPOSED: Support for establishment of an on-site sewage systems training centre at Royal Roads University

Non-Point Source Pollution

- Stormwater runoff and groundwater
  - Urban/rural watersheds
- Agriculture
- Boating and marine facilities



Non-Point Source Pollution

Goal: Fresh, marine and groundwater ecosystems are protected from effects of non-point source pollution

ACHIEVED THROUGH:

- Integrated watershed studies in pilot watersheds impacted by NPS pollution, eg. Elk Creek
- Improved management practices for agricultural waste and agro-chemicals
- Promotion of green development practices
- Assessment of the effects, and major sources, of NPS pollution on surface and ground water ecosystems in pilot watersheds
- Inspections at target fuel/chemical storage facilities and marinas/small boatyards
- Stewardship and improved public awareness

Non-Point Source Pollution

Year 1+ Results:

- Sponsorship of a CD-ROM-Internet training tool for community groups on urban watershed management
- Stormwater Management Workshop (January 1999)
- Elk Creek wateshed:
  - Groundwater well, benthic macroinvertebrate, surface water characterization, fish/crayfish and run-off sampling
  - Multi-stakeholder workshop to design a pilot ecosystem study for Elk Creek watershed (January 1999)
- Storage tank audits at 10 facilities
- Marina and small boatyard BMP inspections
- Educational materials completed and distributed, eg. Green Boating Kits, Groundwater Keeper Newsletter, Forage Production Guide

Assessment of the Effects of Agricultural Runoff on the Aquatic Ecosystem

presented by Taina Tuominen, Aquatic Sciences Section, AASD, ECB

The effects of agricultural runoff on the aquatic ecosystem are being assessed in a study conducted in the Lower Fraser Valley from 1998 to 2001 as part of the Georgia Basin Ecosystem Initiative. The Lower Fraser Valley is one of the most intensively used areas in Canada for agriculture; and therefore it provides an excellent study area for such an assessment. The watershed focus is Elk Creek in Chilliwack, with sampling also occurring in Clayburn Creek/Matsqui Slough, south Abbotsford and reference watersheds on the north and south sides of the Fraser River. The objectives of the study are to:

1. determine the condition/health of biota in streams affected by agricultural run-off, relative to reference areas;
2. investigate the presence of endocrine disruption in selected aquatic biota exposed to agricultural run-off;
3. determine the potential for endocrine disruption in run-off and water (surface and groundwater);
4. determine the presence and concentration of selected contaminants, including pesticides and other potentially endocrine disrupting chemicals in agricultural run-off, surface water, ground water and possibly sediment;
5. determine the presence and concentration of selected contaminants in biological tissues.

The study will focus on biological effects, and these will be assessed in crayfish, fish (three-spine stickleback, cutthroat trout and prickly sculpin) and benthic invertebrate communities. Crayfish and fish will be sampled from replicate reference streams and from test stream reaches that are in agricultural areas. We propose to assess endocrine disruption by measures such as plasma steroid levels, vitellogenin induction, gonadosomatic index and incidence of intersex. General organism condition will be assessed by measures such as incidence of abnormalities, mixed function oxygenase induction and metallothionein induction. We also propose to collaborate with PESC and University of Victoria in developing a vitellogenin bioassay technique using rainbow trout eggs that can be applied in *in situ* and laboratory settings. Benthic invertebrate community structure will be assessed relative to that expected for the sites, based on the site's physico-chemical features.

Contaminant exposure in the waterways will be investigated by analysing crayfish tissue, surface water and ground water samples for the following variables: metals, organochlorine pesticides, acid extractable herbicides, PAHs and PCBs. As well, the water samples will be analysed for hormones, semi-volatile compounds, nutrients, general variables and estrogen and androgen screening assays. Contaminant sources to the waterways will be investigated by sampling runoff from sample fields applied with manure. The runoff will be analysed for the entire suite of variables, listed above, including the screening assays for estrogen and androgen effects. Sampling will be coordinated with sampling for atmospheric deposition.

As the planning and sampling started this year results are not yet available.

Acid Extractable Herbicides

2,4,5 - T
2,4,5 - TP
2,4 - D
Dicamba
Dichloroprop
Dinoseb (DNBP)
Picloram
Trichlopyr

Semi-Volatiles

Hexachlorobutadiene
1,3-Dichlorobenzene
1,4-Dichlorobenzene
1,2-Dichlorobenzene
1,3,5-Trichlorobenzene
1,2,4-Trichlorobenzene
1,2,3-Trichlorobenzene
1,2,3,5/1,2,4,5-Tetrachlorobezene
1,2,3,4-Tetrachlorobenzene
Pentachlorobenzene

Organochlorine Pesticides

Hexachlorobenzene
alpha HCH
beta HCH
gamma HCH
delta HCH
Heptachlor (a)
Aldrin (i)
Oxychlordane
trans-Chlordane
cis-Chlordane
trans-Nonachlor
cis-Nonachlor
o,p'-DDE
p,p'-DDE
o,p'-DDD
p,p'-DDD
o,p'-DDT
p,p'-DDT
Mirex
Heptachlor Epoxide (b)
alpha-Endosulphan (I)
Dieldrin (ii)
Endrin
beta-Endosulphan (II)
Endosulphan Sulphate (III)
Methoxychlor

Organophosphate Pesticides

Azinphos Methyl
Chlorpyrlfos
Demeton O
Demeton S
Diazinon
Dimethoate
Ethion
Malathion
Methidathion
Mevinphos
Naled 1
Naled 2
Parathion
Triphenyl Phosphate

Carbamates

atrazine
metolachlor
oxamyl

Air Component of GBEI

Wayne Belzer
AASD, Environment Canada

For more information please contact me at (604) 664-9125 or e-mail at wayne.belzer@ec.gc.ca

Introduction

- GBEI has 2 main components
  - Air
  - Water
  - Nature
- Aquatic & Atmospheric Sciences Division
  - Air Unit
  - Water Unit

The interaction of different aspects of the ecosystem need to be considered at one time. Because these are all in different jurisdictional components there is a need to "bring them together" for an overall view and to appreciate the connectivity.

For example, chemicals in the air deposit on land and water. These substances wash into creeks and rivers where they can bio-accumulate and affect insects, fish and birds. In short the possibility of a "food chain" effect exists. Some chemicals can be transported great distances, and this needs to be assessed.

Currently an interaction exists between the air and water units in AASD, EC. There needs to be more linkage with biological impacts and health impacts.

Topics of Discussion

- Eco-system approach
- Select representative watersheds
- Select substances that impact environmental quality

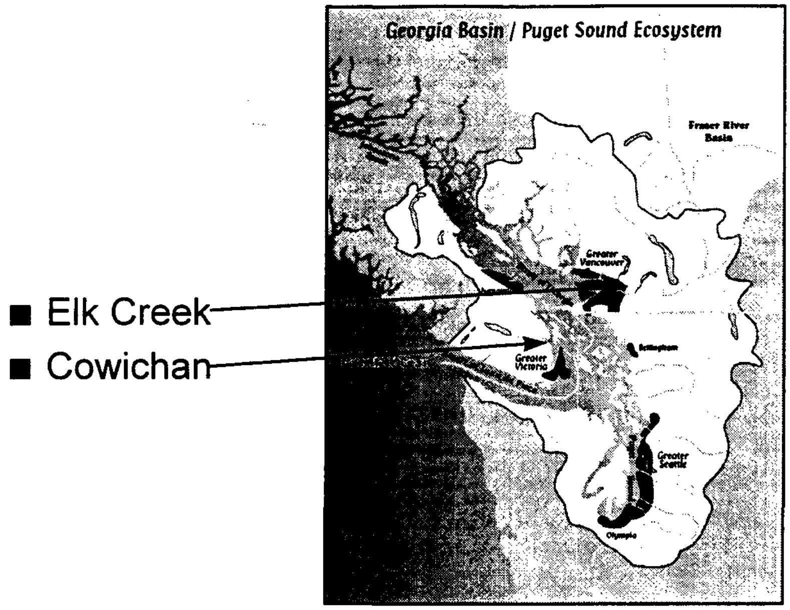
Proposals to do assessments in the different environmental "compartments" have been made. Efforts to encourage mutually useful sampling and assessment programs have been made. It is an ECOSYSTEM!

In order tomaximize the return of information for the investment, "representative watershed" areas have been selected as examples for the whole GBEI area. The intent is to project this ecosystem assessment to other areas within GBEI.

What to assess has been the subject of numerous meetings. We have developed a list of substances that will be assessed in air and rainfall. This data will be joined with information from the water assessments to provide a picture of these ecosystems. We hope that the information will also be useful in fish, bird and human health impacts and look forward to being able to provide this information to those concerned.

Year 1: (1998-1999) Plans & Development

- Consultation
- Details
  - Site selection
  - Importance of substances
    - EDCs
    - respirable matter
- Support for water, wildlife and health
- Pesticides are a part of this project



Sites selected so far are the Elk Creek watershed and the Cowichan River estuary area.

These two areas appear to be representative of island and mainland ecosystems.

Other areas may be selected for later investigation: drinking water reservoirs, forestry impacts near urban areas; etc..

Year 2: (1999-2000) Elk Creek

- Site - unique wateshed on mainland
- Sampling
  rainfall, dry air - year long
- Analyses
  pesticides (OCs, OPs), metals, particles, nutrients
- Connections
  aquatics, fisheries, wildlife, health

Sampling will be for dry air gases and particulate matter, as well as rainfall washout. Analyses will include physical parameters, and organic and inorganic analyses.

Sampling will be on a weekly basis for a year (April 1999 through March 2000).

Analyses will likely include:

Physical: (particulate mass, particulate size, pH) , **TIC/TOC**.

Inorganic:

anions (NH4, NO3, PO4, SO4, Cl, F**)**, Low Level **Cations** (Hg, Cu, Zn, Pb, Cd, As, Se, Ca, Ba, Sr, Mg, Mn, Na, V, Ag, Pd, Pt, Sn, Sb, B, Be, K, Mo, Ni, Al, Fe), specific ions (Cr+6, Cr+3).

Organics:

Dioxins & Furans**, Nonylphenols Sums** (4NP, NPEO1-O2, NPEO3-20, **Phthalates** (dibutyl, di-2-ethylhexl, butylbenzyl), **Haloacetic acids**, **PolyBrominated BiPhenyls**, **PCBs** (arochlors + congeners), **Phenol/ chlorophenols**, **PAHs (regular:** acenaphthalene, acenaphthene, anthracene, chyrsene, fluorene, fluoranthene, naphthalene, perylene, phenanthrene, pyrene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(c)phenanthrene, benzo(j)flouranthene, benzo(k)fluoranthene, benzo(ghi)perylene, benzo(a)pyrene, benzo(e)pyrene,

Year 3: (2000-2001) Cowichan Estuary

- Site - unique wateshed on the Island
- Sampling
  rainfall, dry air - year long
- Analyses
  pesticides (OCs, OPs), metals, particles, nutrients
- Connections
  aquatics, fisheries, wildlife, health

indeno(123-cd)pyrene, dibenzo(a,c)anthracene, dibenzo(a,h)anthracene, dibenzo(ghi)perylene, dibenzo(ae)pyrene, dibenzo(ah)pyrene, dibenzo(ai)pyrene, dibenzo(al)pyrene; **nitrated:** dibenzo(ah)acridene, dibenzo(aj)acridene, 7h-dibenzo(cg)carbazole, 1,6-dinitropyrene, 1,8-dinitropyrene, 3-nitrofluoranthene, 1-nitropyrene, nito-benzo(a)pyrene, 9,10-epoxide-nitrobenzo(a)pyrene; **alkyl:** 5-methyl-chrysene, 7,12,-dimethyl benzo(a)anthracene; **methylated:** C1-C5 naphthalenes, C1-C5 phenanthrenes/anthracenes, C1-C5 fluoranthenes/pyrenes; Retene; **OCs:** aldrin, dieldrin, chlordane, oxychlordane, chlordecone, DDT, DDE, DDD, dicofol, 1,4-dichlorobenzene, endrin, endosulfan I & II, endosulfan sulfate, heptachlor, heptachlor expoxide, HCH-a,d,g, Hexachlorobenzene, methoxychlor, mirex, toxaphene; **OPs:** diazinon, dichlorvos, dimethoate, fonofos, mevinphos, malathion, parathion, phorate, turbufos; **Triazine Herbicides:** Atrazine, simazine; **Other:** azamethophos, carbaryl, captan, carbofuran, 2,4-D, dinoseb, mancozeb, metiram, synthetic pyrethrins, trifluoralin, vinclozolin.

Year 4: (2001-2002) Special Projects

- **Site**
  reservoirs, snow pack, unique sites (CRD?) for short periods
- **Sampling**
  rainfall, dry air
- **Analyses**
  pesticides (OCs, OPs), metals, particles, nutrients
- **Connections**
  aquatics, fisheries, wildlife, health

What This Means

- Connections?
- Impacts?
- Ecosystem data
- Extrapolation to other similar areas
- An assessment of the "health" of the GBEI

Reports written in consultation with other agencies and disciplines.

Next Steps

- Develop connections
- Develop partnerships
- Develop detailed plans

- DO IT!

Canadian Wildlife Service - Georgia Basin Ecosystem Initiative

Toxics Action Plan - Endocrine Disruptors

Presented by Laurie Wilson, CWS, ECB

Industrial / urban context

- EDC exposure on physiology of mink/otter
  - 47 otter scat samples collected
  - 4 treatment sites (Victoria, Crofton, Nanaimo, Powell R) & reference site (Clayoquot Sound). Burrard Inlet was targeted, but no samples found.
  - samples currently being analyzed for OC/PCB/PCDD/PCDF (NWRC)

  - mink carcasses will be collected over the winter from same study areas. Trappers currently being contacted.

- Chlorinated hydrocarbons & effects on Vitamin A & thyroid hormones in bald eagles
  - 40 nestlings at 3 treatment sites (Delta, Crofton, Nanaimo) & 2 ref. Sites (Clayoquot, Barkley S)
  - 18 adults (10 - Nanaimo, 8 Clayoquot)
  - blood - chemical / biochemical analyses (NWRC)

- Contaminants in surf scoters
  - sample times: early & late winter
  - 2 sites: Burrard (treatment), Barkley S (ref)
  - carcasses: necropsied, tissues collected & analyzed (IOS, NWRI, NWRC)
  - 2-5 birds will be mounted with satellite transmitters to locate breeding ground
  - funding: Nature Plan, PCJV

- trends in contaminants in wildlife indicators
  - egg monitoring program: heron (UBC), cormorant (Mandarte I)

  - alkylphenol ethoxylates - spatial, temporal trends, multiple species (M. Ikonomou, IOS)
  - butyl-tins - similar study (J. Maguire, NWRI)

- cumulative effects of contaminants & habitat destruction on Am. Dipper
  - survey dipper habitat, bird/nest locations (4 north shore watersheds)
  - currently determining populations along Tsolum R, additional study site?
  - SFU grad student, Christy Peterson (L. Bendell-Young) (Nature Plan)

Agricultural context

- impact of agricultural drainage on amphibians in Sumas-Chilliwack area
  - none of 3 native species (spotted frog, red-legged frog, northwestern salamander) able to breed (3 year study)
  - lab dose-response studies with ammonia & nitrate/nitrite inconclusive
  - grad student, Ryan Loveridge (C. Kennedy) - EDC effects in Elk Creek

- impact of agricultural pollutants on avian species in LFV
  - SFU grad student, E. Birmingham (T. Williams) - EDC effects on avian reproduction
  - focus - effects of selected priority chemicals for GBEI, multi-generational lab experiments (Zebra Finches, Tree Swallows?)

National Pesticides Program Summary- Bob Sebastien, Commercial Chemicals Evaluation Branch November 18, 1997

Memorandum of Understanding/Implementation Strategy

A Memorandum of Understanding (MOU) between Environment Canada (EC) and the Pest Management Regulatory Agency (PMRA) was officially signed by Claire Franklin Executive Director of the PMRA, Health Canada (HC), and Francois Guimont Assistant Deputy Minister Environmental Protection Service, EC on April 8, 1998. The purpose of the MOU is to establish mechanisms that facilitate the exchange of information and advice, and to promote strong working relationships between EC and the PMRA with respect to pest control products, pest management and related activities, concerning the conservation and protection of the environment. An implementation strategy has been established that broadly outlines mechanisms and contacts for items of mutual interest which are identified in the MOU. Copies of these documents are available on request. Activities that I have been involved with regarding the implementation strategy include participation in the Working Group on the National Pesticide Sales Data Base, and the Fisheries Act (FA)-Pest Control Products Act (PCPA) Working Group. A brief description of the mandate and activities of these Working Groups follows.

Working Group on the National Pesticide Sales Data Base

Canada is one of the few developed countries that does not have a national pesticide data base. In November 1996, EC and HC formally agreed that information on releases of pesticides will not be collected by EC under the Canadian Environmental Protection Act (CEPA) for the National Pollutant Release Inventory (NPRI), but will instead be collected by the PMRA under the PCPA, and that this information could be shared with EC as permitted by law. Major uses of the data base would include: providing information for registration, reevaluation and special reviews, publication of national pesticide sales/use information on an annual basis, development of pesticide risk indicators, documenting risk reduction trends, and meeting international commitments/harmonization.

The Working Group is composed of representatives from the pesticide industry, grower organizations, the provincial and federal governments, and environmental non-governmental organizations. The objectives of the working group include 1) determination of the data required for the data base (litres or kilograms of sales, PCP#, for all pesticide products for each province/territory), 2) determination of data base outputs including consideration of the protection of confidential business information, 3) determination of the methods and procedures for the collection of data from registrants, and 4) determination of how frequently and when the data should be updated. An initial pilot project is planned to collect sales data from registrants on two groups of active ingredients, the organophosphates and the carbamates.

Fisheries Act - Pest Control Products Act Working Group

The Fisheries Act (FA) and the Pest Control Products Act (PCPA) can conflict when a pesticide although in compliance with the PCPA-approved label is deposited directly or indirectly in water frequented by fish. The ADMs of the Department of Fisheries and Oceans (DFO) and EC, together with the Executive Director of the PMRA, convened a Working Group to "produce a document that identifies options, including an analysis of legal and practical issues, and provides recommendations on the means to address the conflict between the PCPA and the FA with respect to the direct and indirect deposit of pesticides to waters frequented by fish." Seventeen options, both new and previously identified were discussed of which four were chosen for a more detailed evaluation against four identified criteria: protection of fish and fish habitat, respect for departmental mandates, recognition of the concerns of stakeholders, and the degree to which users would obtain greater legal certainty. The four options include 1) Status quo, 2) No legislative or regulatory change; control use of pesticides through Best Management Practice (BMP) agreements and Memoranda of Understanding (MOUs) between DFO, EC and the PMRA, 3) Create regulations under the FA to exempt and/or authorize the deposit of pesticides under Section 36(5), and 4) A combination of BMPs (Option 2) and of regulations under the FA (Option 3). The discussion document will be used to present options to the ADMs of EC and DFO, and the Executive Director of the PMRA on the means of addressing the "conflict" between the PCPA and the FA. A Directors' Committee with representatives from EC, DFO and the PMRA will be responsible for approving and submitting the document to their respective ADMs/Executive Director.

Current Issues Regarding Pesticides

<u>Carbofuran - Use of Granular Formulation on Canola</u>

Following the special review of carbofuran in 1991, the Canadian Wildlife Service (CWS) informed Agriculture Canada (the regulatory authority at that time) that the use of corn-cob granular formulations of carbofuran used at seeding in canola represented a serious and unacceptable threat to birds. In December 1995, the PMRA (the new regulatory authority) banned a sand-based granular formulation of carbofuran but postponed a decision on the acceptability of the corn-cob granular formulations of carbofuran pending further studies. Continuation of the corn-cob granular formulation registration on canola was allowed on the condition that the registrant agreed to undertake a field study to assess avian mortality. A Technical Committee was formed which had representation from the provinces, the Canola Growers Association, the World Wildlife Fund and the CWS to assist in the design and supervision of the studies, and to comment on the results. In the summer of 1997 the registrant (FMC corp.) conducted a field study in the Canadian prairies to examine the impact on birds. The results of the field monitoring study conducted by FMC corp. were made available to the Technical Committee in mid December 1997. The Committee concluded that the results demonstrated treatment related bird kills that were significant for some species. Many small mammals were also found dead with extremely high residue levels. These carcasses pose a serious risk to predators and scavengers including two endangered species, the Burrowing owl and Loggerhead shrikes which may be present in pastures and non-crop areas adjoining treated fields. A final regulatory decision on the use of the granular formulation of carbofuran on Canola is expected to be made by the PMRA by December 31, 1998.

Cypermethrin - Used for Controlling Sea-Lice in Salmon Farms

Cypermethrin is currently being evaluated by the PMRA for use in controlling sea lice in salmon farms. EC recently cooperated with the DFO to conduct studies on the toxicology and environmental fate of several pesticides including cypermethrin which are used to treat sea lice in salmon farms. The studies were conducted in southwestern New Brunswick over the past two years. Results indicate that the use of cypermethrin will result in toxicity to non-target marine organisms, some of which are important to local fisheries (i.e., lobsters), however, population effects remain to be determined. Pesticide plumes from a single cage treatment were observed to be above lethal concentrations for some marine invertebrates for up to five hours after release and to move distances of up to 1 km while still above those concentrations.

The PMRA conducted a consultation meeting in Fredericton, New Brunswick on September 11, 1998. The purpose of the meeting was to present the environmental risk assessment for cypermethrin to provincial governments and other federal departments, and seek input on issues of risk acceptability and potential risk mitigation measures. Participants at the meeting included representatives from New Brunswick Environment, New Brunswick Fisheries and Aquaculture, Nova Scotia Environment, Nova Scotia Fisheries and Aquaculture, Newfoundland Environment and Labour, DFO, EC, and the PMRA. The consensus by all the stakeholders at the meeting was that the proposed use of cypermethrin for the control of sea lice was not acceptable. It was agreed that some form of containment of the treatment solution provides the only scenario under which the product could be acceptably used. The PMRA will now prepare a Proposed Regulatory Decision Document (PRDD) which will include the proposed decision on the registration of cypermethrin for the control of sea lice. This document will be distributed to a wider stakeholder list for comments before a final decision is made.

MOU/Implementation Strategy

- MOU between EC and the PMRA officially signed April 8, 1998
- To establish mechanisms that facilitate exchange of information and advice and promote strong working relationships
- Implementation strategy outlines mechanisms and contacts for items of mutual interest identified in the MOU

Working Group-National Pesticide Sales Data Base

- Canada currently does not have a national pesticide data base
- Major uses would include: providing information for registration, reevaluation and special reviews, publication of national pesticide sales/use information, development of pesticide risk indicators, documenting risk reduction trends

- Working Group composed of representatives from the pesticide industry, grower organizations, provincial and federal governments, and environmental NGOs
- Objectives include 1) determination of data required for the data base, 2) determination of data base outputs including consideration of CBI, 3) determination of methods and procedures for collection of data from registrants, 4) determination of how frequently and when the data should be updated.
- Pilot project planned on the organophosphates and the carbamates

Fisheries Act-Pest Control Products Act Working Group

- Working group to "produce a document that identifies options, including an analysis of legal and practical issues, and provides recommendations on the means to address the conflict between the PCPA and the FA with respect to the direct and indirect deposit of pesticides to water frequented by fish."

- Options 1) Status quo,2) Control use of pesticides through Best Management Practice agreements and MOU between DFO, EC, and the PMRA, 3) Create regulations under the FA to exempt and/or authorize the deposit of pesticides under section 36(5) and 4) Combination of options 2 and 3.
- Four criteria: protection of fish and fish habitat, respect for departmental mandates, recognition of the concerns of stakeholders, and the degree to which users would obtain greater legal certainty.

Carbofuran

- PMRA postponed decision on the acceptability of corn-cob granular formulation on Canola pending results of a field study conducted in 1997 by the registrant (FMC corp.) in the Canadian prairies to examine the impact on birds.
- Technical Committee with representation from the provinces, the Canola Growers Association, the WWF and the CWS formed to assist in the design and supervision of the study, and comment on results.

- Committee concluded that there were treatment related bird kills that were significant for some species.
- Many small mammals were also found dead which could pose a serious risk to predators and scavengers including two endangered species, the Burrowing owl and Loggerhead shrikes
- A final regulatory decision is expected to be made by the PMRA by December 31, 1998.

Cypermethrin - Sea-Lice

- Cypermethrin being evaluated by the PMRA for use in controlling sea lice in salmon farms.
- EC and DFO conducted studies in New Brunswick which indicated that the use of cypermethrin will result in toxicity to non-target marine organisms.
- Pesticide plumes from cage treatment above lethal concentrations for up to five hours at distances of up to 1km .

- PMRA conducted consultation meeting in Fredericton NB on Sept. 11, 1998 to seek input on issues of risk acceptability and potential risk mitigation measures from provincial governments and other federal departments.
- Consensus was that the proposed use of cypermethrin for the control of sea lice was not acceptable. Containment of treatment was the only acceptable scenario.
- PMRA will now prepare a PRDD which will include the proposed decision. It will be distributed to a wider stakeholder list for comments before decision is made.

MEMORANDUM OF UNDERSTANDING
BETWEEN
ENVIRONMENT CANADA
AND
THE PEST MANAGEMENT REGULATORY AGENCY, HEALTH CANADA

PURPOSE

The purpose of this Memorandum of Understanding (MOU) is to record agreement on principles and the intent to establish mechanisms that facilitate the exchange of information and advice, and to promote strong working relationships between Environment Canada (EC) and the Pest Management Regulatory Agency (PMRA) with respect to pest control products, pest management and related activities, concerning the conservation and protection of the environment.

BACKGROUND

The government decision on pest management regulation, February 1995:

provided the authority for the establishment of the PMRA within Health Canada and for its relationship to other departments which retain responsibility for areas that affect, and are affected by, Agency operations;

transferred to the Minister of Health, the responsibility for registration and regulation of pest control products under the *Pest Control Products Act* (PCPA), and transferred to the PMRA all resources and activities related to the regulation of pest control products in Health Canada (HC), Agriculture and Agri-Food Canada (AAFC), Environment Canada (EC) and Natural Resources Canada (NRCan);

recognized that the Agency, in reaching regulatory and policy decisions, would consider scientific and other expert advice from federal departments and others;

recognized that the Agency would have the opportunity to advise on the programs and policies of these other departments and on policies related to health, environment, agriculture and forestry.

Environment Canada continues to carry out environmental research and monitoring of the presence and fate in the environment of pest control products, and the impacts on the environment of pest control products, of pest management strategies, and of pesticide risk reduction measures. In addition, EC continues to develop national environmental quality guidelines.

The PMRA and Environment Canada have independent but related mandates in regard to the protection of the environment. Activities carried out under their respective mandates have the potential to affect the programs and responsibilities of the other.

The PMRA administers the *Pest Control Products Act* (PCPA) and has the mandate to protect human health and the environment by minimizing the risks associated with pest control products, while enabling access to effective pest management tools, namely, these products and sustainable pest management strategies.

EC has the responsibility for the preservation and enhancement of the environment pursuant to the *Department of the Environment Act*, and other Acts that have the potential to be affected by or overlap with the PCPA, including the *Canadian Environmental Protection Act*, the *Migratory Birds Convention Act*, the *Canada Wildlife Act*, the *Wild Animal and Plant Protection and Regulation of International and Interprovincial Trade Act*, the *Canada Water Act*, the proposed *Canadian Endangered Species Act,* and *Section 36* of the *Fisheries Act*. EC is therefore interested in pest management regulatory decisions as they affect its responsibilities for environmental conservation and protection, and sustainable development.

PRINCIPLES

EC and PMRA, in carrying out their respective mandates, will cooperate and support each other, as appropriate, in meeting their responsibilities in relation to environmental conservation and protection and sustainable development, and in other areas of mutual interest.

EC and PMRA will ensure, to the extent that is reasonably possible within, and consistent with, their respective mandates, that their environmental protection policies and measures are complementary and designed to provide effective environmental protection.

EC and PMRA will provide each other the opportunity to advise on policies and programs that may affect the mandate of the other, in a manner that allows for timely and substantive advice.

EC and PMRA will foster strong working relations by establishing mechanisms and links to share information, taking into account constraints imposed by statutory and common law on the sharing of confidential business information.

IMPLEMENTATION

PMRA and EC will give to each other the opportunity to provide guidance, information and advice concerning the development and implementation of policies and programs that may affect the mandate of the other.

PMRA and EC will inform each other in a timely fashion regarding proposed and final significant regulatory decisions that may affect the mandate of the other.

For pesticide registration decisions that are preceded by publication of a Proposed Regulatory Decision Document (PRDD), the PMRA will provide an opportunity for EC to present, in writing and in person, concerns that EC may have about the environmental impact of the regulatory decision being considered, as soon as is practicable within the public comment period.

In accordance with its mandates, EC will continue to carry out a program of research and monitoring activities with respect to the presence and fate of pest control products in the environment, and the impacts in the environment of pest control products, pest management strategies, and pesticide risk reduction measures, and will:

provide the results and conclusions of these activities to the PMRA in a timely manner,

discuss with the PMRA, priorities for research and monitoring in these areas, on a regular basis, and as needed, and

provide expertise and scientific advice to the PMRA to help guide the design of research and monitoring programs that are to be undertaken by other organizations.

PMRA will consider the results and conclusions of EC research and monitoring programs in decision-making, in establishing priorities for special reviews, during special reviews, during re-evaluations or for label changes. Results and conclusions of EC's research and monitoring will be considered by PMRA during the regulatory decision-making process.

EC and PMRA will inform, consult and consider each others' methodology and expertise, as appropriate, in the development of environmental risk assessment methodology, data requirements and test guidelines.

In order that EC can provide advice and design and implement research and monitoring studies to support the regulatory decisions of the PMRA, and in order that EC can fulfill its mandate, the PMRA will:

provide EC access to confidential registration data taking into account constraints imposed by statutory and common law;

provide EC access to information in the databases which the PMRA will establish on pesticide use and releases into the environment, taking into account constraints imposed by statutory and common law.

In addition to the formal mechanisms and links for implementation of this MOU, EC and PMRA will encourage participation of staff on various task forces and working groups as appropriate.

EC will support PMRA efforts to achieve long-term solutions, within the context of sustainable development, for the reduction of risks of harm to the environment and for the attainment of sustainable pest management.

EC and PMRA will provide to each other, in a timely manner, documents and related media materials on issues of common interest specific to pest control product regulatory matters and sustainable pest management strategies.

EC and PMRA will provide to each other, on request, information to support briefing and correspondence needs of Ministers and senior management.

The PMRA will take the lead in providing authoritative federal communication on pest management regulatory matters. EC will take the lead in providing authoritative federal communications on areas concerning environmental conservation and protection. In matters related to mandates of both parties, EC and PMRA agree to cooperate before communications are issued and will discuss communications strategies on a case-by-case basis.

Where appropriate, EC and PMRA will inform and consult each other and will work cooperatively on the development and delivery of Canadian positions and contributions to international fora and cooperative projects that may affect the programs and mandates of the other.

Where new international activities of mutual interest and conc ern arise, EC and PMRA will discuss their respective roles and responsibilities.

ACCOUNTABILITY

Accountability for the success of this MOU rests with the Executive Director of the Pest Management Regulatory Agency, Health Canada and the Assistant Deputy Minister of the Environmental Protection Service, Environment Canada, who will meet annually during the normal planning process.

The primary points of contact under this MOU, who shall be responsible for its administration, are the Director of the Alternative Strategies and Regulatory Affairs Division, PMRA, HC and the Director of the Commercial Chemicals Evaluation Branch, Toxics Pollution Prevention Directorate, Environmental Protection Service, EC.

TERMS OF THE MOU

This MOU will come into effect on the date of the last signature and can be amended at any time by the agreement of both parties.

EC and PMRA will review this MOU after 24 months of signing to determine its adequacy.

Participation in this MOU can be terminated by mutual consent or by one party giving three months written notice.

Signed:

Date: Date:

C.A.Franklin
Executive Director
Pest Management Regulatory Agency
Health Canada

F.Guimont
Assistant Deputy Minister
Environmental Protection Service
Environment Canada

IMPLEMENTATION STRATEGY

MOU between
Environment Canada and the Pest Management Regulatory Agency

This implementation strategy broadly outlines mechanisms and contacts for items of mutual interest which are identified in the Memorandum of Understanding between the Pest Management Regulatory Agency and Environment Canada (April 9, 1998). The implementation strategy is expected to be a dynamic document, reflecting the needs of both parties. More detailed mechanisms for interaction on each item will be developed by the contacts listed below.

Item		Mechanism and Time Frame	Contacts
I POLICIES AND PROGRAMS			
General Policy and Program Issues		regularly scheduled meetings between contacts	Frank Wandelmaier / Karen Lloyd
Specific Issues			
Toxic Substances Management Policy (TSMP)	- participation in implementation of TSMP	membership on Interdepartmental Forum on TSMP	
Canadian Environmental Protection Act (CEPA)	- coordinate exchange of information on substances under evaluation	meetings and correspondence as required	
	- adverse effects reporting (e.g. S17)	written communication	
	- biotechnology issues	membership on appropriate committees, such as Subgroup on Safety and Regulation in Biotechnology	
	- Strategic Options Process	participate in issue tables	
Pest Control Products Act	- discuss proposed amendments	*ad hoc* meetings	Frank Wandelmaier / Karen Lloyd
	- access to PMRA National Pesticide Sales Database, as allowed by law	EC committee membership in establishing PMRA dbase, PMRA membership in NPRI federal caucus	

Sustainable Development	- Integrated Pest Management - Pollution Prevention/Risk Reduction	participate in working groups, and *ad hoc* meetings, as required	
National/Regional Programs	- Federal/Provincial /Territorial Committee on Pest Management and Pesticides - Canadian Council of Ministers of the Environment - Canada-Ontario Agreement	linkages	
II REGULATORY DECISIONS			
Coordinate EC input into pesticide registration decision (PRDD process, input during comment period)		written communication	Frank Wandelmaier / Karen Lloyd
Information on proposed and final significant regulatory decisions affecting the mandate of the other		written communication	
Research Permits for pesticides		case-by-case	PMRA regional officers / EC regional officers
III RESEARCH AND MONITORING			
Planning of EC research and monitoring program		PMRA participation in existing planning periods, and *ad hoc* meetings, as required	Charalyn Kriz / Keith Marshall
Exchange of research and monitoring results (e.g. incident mortality reports, other adverse effects reporting)		*ad hoc* meetings as required	
Exchange of methodology and expertise in environment risk assessment		*ad hoc* meetings as required	
Information exchange (CBI) on specific substances, as allowed by law		written communication	
IV INTERNATIONAL ACTIVITIES			
Coordinate Canadian positions		*ad hoc* meetings as required	Bill Murray / John Buccini
Lead for existing and new international activities			
Information exchange			

V COMMUNICATIONS		
Exchange of documents and media materials	*ad hoc* meetings as required	Joan Butcher / Stefania Trombetti
Information for briefings of ministers and senior officials		
Lead in communications cross cutting issues		

Date: April 9, 1998

Init.: ____________
Wendy Sexsmith
Director, ASRAD, PMRA

Init.: ____________
John Buccini
Director, CCEB, EC

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The Environmental Assessment Division of PMRA -New Directions

Presented by Peter Delorme, PMRA, HC - HQ

Abstract - The Pest Management Regulatory Agency and other regulatory authorities are moving towards a more harmonized approach to pesticide regulation. This activity will result in changes in how environmental assessment of pesticides are approached. The recent signing of the MOU between PMRA and Environment Canada will allow for cooperation between PMRA and researchers in research and monitoring activities relevant to pesticide issues. The Environmental Assessment Division will also identify relevant research areas. Currently the PMRA is in the planning stages of a major reevaluation program. The general direction and focus of this proposed program will be discussed.

Data, Protocols and Harmonization

Environmental Data requirements for have changed slightly since the pre-Agency period. The PMRA has identified 33 use site categories (USC) for pest control products. For each USC there are a series of required and conditionally required studies that companies need to submit.

Under the NAFTA Technical Workig Group on Pesticides, the PMRA has harmonized environmental data requirements for pesticide submissions with the US- EPA for use site category 14, terrestrial food crops. Work is underway towards harmonizing environmental fate and toxicology data requirements for the other 32 use site categories. Protocols for the various studies have largely been harmonized between Canada and US-EPA.

Data requirements are not necessarily static, new data guidelines, requirements and/or protocols can and will be added as the need arises. Examples of on going work which could result in changes to data requirements are development of testing strategies for non-target plants and the ongoing international effort to address the question of endocrinedisruptors.

In the near future PMRA and US-EPA will begin harmonization efforts on risk assessments.

Changing World of Risk Assessment

The science of environmental risk assessment is changing rapidly. EAD is currently starting to assess models as a way to refine our exposure assessments and hence our environmental risk assessments. We are actively using three drift models to help in the assessment of buffer zones. We are also investigating and developing Canadian scenarios for PRZM/EXAMS to help in the assessment of contamination in surface and ground water.

The US EPA through the Ecological Committee on FIFRA Risk Assessment Methods (ECOFRAM) has led an initiative to identify, develop and validate tools and methodologies for predicting the magnitude and probabilities of adverse effects in tonontarget species under the current EPA framework for assessing pesticides. Both PMRA (BobSebastien) and CWS (Alain Baril) are active participants in this process. EAD will be examining the results of this initiative for future implementation.

EC/PMRA MOU Implementation - Research and Monitoring

An initial meeting was held in late October between PMRA and EC to discuss mechanisms which will facilitate the exchange of information and advice with regards to research and monitoring on the environmental fate and effects of pest control products under the MOU. The MOU also has provisions (under section 16) for the PMRA to shareconfidental information under certain circumstances. Information can be shared in cases where it will enable EC to provide advice to PMRA concerning a product and/or to enable EC researchers to design and implement research and monitoring studies to support the regulatory decisions of the PMRA concerning a product.

Those considering research on a pesticide and likely to require information from PMRA should contact EAD in the planning/design stages of the project. The initial contact should be by phone to Charalyn Kriz the Director, EAD, who will refer the caller to an evaluation officer, as appropriate.

PMRA was recently able to share information on several fungicides used on potatoes with an EC researcher to help design a field study.

Other Relevant Activities

- Endocrine Disruptors
- Research Permits
- Re-evaluation

The Environmental Assessment Division of PMRA -New Directions

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Data Requirements

- Agency Developed 33 Use Site Categories - Sets out data required for specific use types

Use Site Categories

Number	Use-Site-Category
1	Aquaculture
2	Aquatic Non-Food Sites
3	Empty Food Storage Areas
4	Forests and Woodlots
5	Greenhouse Food Crops
6	Greenhouse Non-Food Crops
7	Industrial Oil Seed Crops and Fibre Crops
8	Livestock for Food
9	Livestock Non-Food
10	Seed Treatments Food and Feed
11	Seed Treatments Non-Food
12	Stored Food and Feed
13	Terrestrial Feed Crops
14	Terrestrial Food Crops
15	Indoor Hard Surfaces
16	Industrial and Domestic Vegetation Control For Non-Food Sites
17	Industrial Process Fluids
18	Material
19	Other Indoor Surfaces, Water and Air
20	Structural
21	Structures and Surrounding Soil
22	Underwater Structures and Materials
23	Wood
24	Companion Animals
25	Human Habitat and Recreational Areas
26	Human Skin, Clothing and Proximal Sites
27	Ornamentals Outdoor
28	Indoor Plants and Plantscapes
29	Swimming Pools
30	Turf
31	Various Indoor and Outdoor Sites
32	Various Outdoor Sites
33	Residential Outdoors

Data Requirements

- Environmental Data required now harmonized with US-EPA requirements for USC 14, Terrestrial Food Crops
- Data requirements have some flexibility
- Not Static
  - New data requirements can & will be added as need dictates. e.g. - testing strategies for non-target plants, endocrine disruptors

Risk Assessment

- Science of Environmental Risk Assessment changing rapidly
- EAD wants to move away from "one size fits all" type of scenarios
- Working towards refining exposure assessments
  - Drift - Aerial - Agdrift
    - Ground - Nordby & Skuterud
    - Air Blast - Ganzelmeir
  - *Surface & Ground Water - PRZM & EXAMS*
- Harmonization of Risk Assessment Approaches with EPA - Work starting in 1999

Probabilistic Risk Assessment

- ECOFRAM - Ecological Committee on FIFRA Risk Assessment Methods
- Identify, develop & validate tools and methods for prediction of probabilities of effects on non-targets
  - PMRA - Bob Sebastien
  - EC-CWS - Alain Baril
- EAD will examine results for future implementation

EC/PMRA MOU - Research & Monitoring

- Initial Meeting for implementation held late October
  - EC - Keith Marshall
  - PMRA - Charalyn Kriz
- Facilitate exchange of information and advice
- Information can be shared with EC under certain circumstances:

  Information can be shared in cases where it will enable EC to provide advice to PMRA concerning a product and/or to enable EC researchers to design and implement research and monitoring studies to support the regulatory decisions of the PMRA concerning a product

Information Exchange

- Those considering research on a pesticide and likely to require information from PMRA should contact EAD in the planning/design stages of the project.
- The initial contact should be by phone to Charalyn Kriz, Director, EAD, who will refer the call to an evaluation officer, as appropriate.
- Have successfully shared information with EC researcher doing work on potato fungicides

Research & Monitoring Areas

- Post application monitoring
  - temporal, spatial, different media
- Effects on amphibians - Is there a problem?
- Long term sublethal exposures
- Effects of Repetitive pulse dosing
- Toxicity of Mixtures

Other Activities

- Endocrine Disruptors
  - *Participate in* 4NR++ *Committee*
  - Actively following EDSTAC & OECD
- Re-Evaluation
  - Agency developing approach
  - Will Consult with Stakeholders
- Research Permits
  - For some need site specific information - Agency considering using PMRA Regional personnel as focal point for gathering this information

Potential Impacts of DDAC & IPBC in the Fraser River Estuary

by Colin Gray
Head, Research Coordination & Applications
Aquatic & Atmospheric Sciences Division
Environmental Conservation Branch

The following slides provide selected facts and observations generated during the Fraser River Action Plan on DDAC and IPBC, two chemicals used in significant quantities by the lumber mills on the coast to prevent sapstaining by molds and fungi during export.

- ***Slide one*** provides the chemical formulae and class, as well as some typical content percentages in antisapstain formulations.

- ***Slide two*** lists the *draft interim guideline* for DDAC which has been recommended to CCME for adoption. It also provides the critical value, from the test and associated organism showing toxicity at the lowest concentration (an invertebrate in this case) , and the safety factor used to calculate the guideline value. The CCME protocol uses 0.05 when a compound demonstrates some persistence. Lower critical values were observed for early life stages of White Sturgeon (Bennett & Farrell 1998) but these were not adopted by the CCME technical panel because another study (TRS 1997) did not corroborate these findings. It also lists the *benchmark concentration* for IPBC which indicates that this chemical is still in the review stage of the CCME process. The critical value for IPBC was observed for the Fathead Minnow.

- ***Slide three*** demonstrates the strong adsorption of DDAC to particles in effluent and river water with recovery of added DDAC starting at only 70 % in effluent and declining to less than 10% in a 10:1 dilution with Fraser River water. It also demonstrates the completely un-adsorptive behavior of IPBC.

- ***Slide four*** summarizes the results of toxicity tests with sediments as the media of exposure. Two invertebrates were evaluated; Hyalella being the species that borrows in the surface of the sediment and Daphnia being the species that maintains itself in the water column. Toxicity for Daphnia is expressed in both concentrations in sediments and in the overlying water. The 456 ug/L NOEL for Daphnia in water over sediment is an order of magnitude higher than that observed in lab water in the absence of sediment (30 ug/L, Farrell & Kennedy, 1998). Some concentration ranges from limited sampling of river sediments downstream of mills using the chemicals are provided. It was surprising to find levels of IPBC similar to DDAC as much less is used and it is not very adsorptive. (Szenasy et al 1998).

- ***Slide five*** presents a comment on the zone of potential impact for each chemical and points out that sediment toxicity tests on more organisms are required before sediment guidelines can be developed. It also recommends that a third toxicity test with White Sturgeon be conducted to ensure ourselves that the critical value used for calculating the water quality guideline is adequate to protect this threatened species which is so ecologically significant in the Fraser. If the water & sediment guidelines were developed and confirmed it will be important to develop objectives for the estuary and to re-assess the effluent guidelines to ensure the new guidelines can be met outside of the immediate mixing zones.
- ***References:***

Bennett & Farrell. 1998. Aquatic toxicity testing with juvenile white sturgeon (*Acipencer transmontanus*). Water Quality Research J. of Canada 33(1): 95-110

Farrell, A.P. and C. Kennedy. 1998. Toxicity of the antisapstain fungicides,didecyldimethylammonium chloride (DDAC) and 3-iodo-2-propynyl butyl carbamate (IPBC), to fishes and aquatic invertebrates. In: C. Gray and T. Tuominen, eds. *Health of the Fraser River Aquatic Ecosystem: A Synthesis of Research conducted Under the Fraser River Action Plan.*. Environment Canada. Vancouver, BC. DOE FRAP 1998-11.

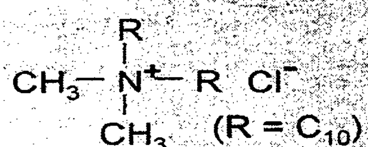
Szenasy, E., C. Gray, D. Konasewich, G. van Aggelen, R. Englar, V. Furtula, R. Kent, L. Juergensen, P.-Y. Caux. 1998. Assessing the impact of the antisapstains DDAC and IPBC, chemicals of concern in the Fraser River. DOE FRAP 1998-07. Fraser River Action Plan, Environmental Conservation Branch, Environment Canada. Vancouver, BC.

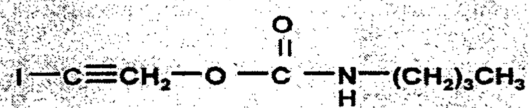
TRS. 1997. DDAC Information Document. Toxicology/Regulatory Services. Report prepared for Environment Canada. November 11, 1997

Potential Impacts of DDAC & IPBC in the Fraser Estuary

Presented by Colin Gray - ECB, DOE

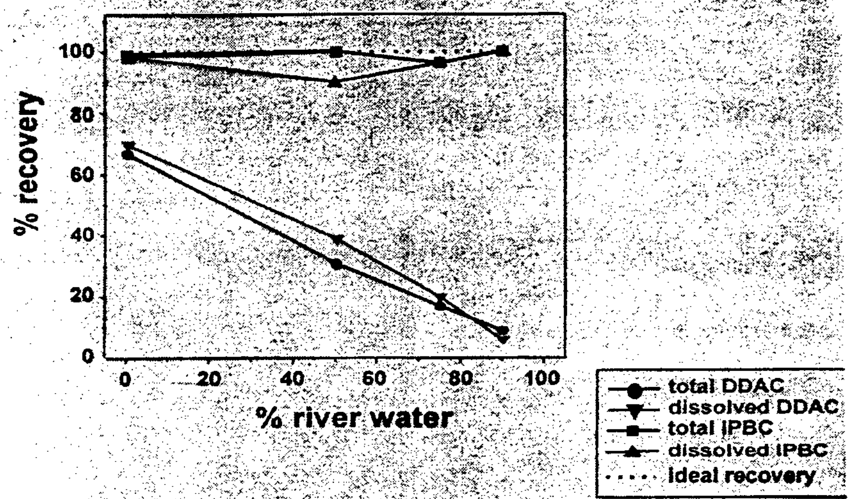
DDAC	IPBC
• didecyl dimethyl ammonium chloride • cationic surfactant; QAC • NP1 (65%), F2 (11%), Timbercote 2000 (28%), Ecobrite (2%), QC2 (28%), QC3 (30%)	• 3-Iodo-2-propynyl-butyl carbamate • carbamate • NP1 (8%)





	DDAC	IPBC
guideline	1.5 µg/L	1.9 µg/L
critical value	29.5 µg/L	19 µg/L
safety factor	0.05	0.1
organism	Daphnia Magna	Pimephales promelas
test	48h-LC_{50}	35 day LOEL

RIVER WATER EFFECTS ON NP1



Toxicity of DDAC in Sediments

- undertaken at PESC
- Fraser sediment used as substrate
- test animals - Hyalella azteca & Daphnia magna

	Hyallela	Daphnia in overlying water	
14d LC_{50}	1,100 µg/g	2,250 ug/g	1,033 ug/L
LOEL	1,000 µg/g	3,000 ug/g	1,610 ug/L
NOEL	750 µg/g	1,500 ug/g	456 ug/L

µg/L	H_2O	<DL	<DL	260	3000
µg/g	Sed	375	500	750	6000

Local Sediments DDAC 0.5 - 1.3 µg/g
IPBC 0.2 - 0.6 µg/g

Conclusions and Recommendations

DDAC: - *zone of impact is small*
- 3rd sturgeon toxicity test recommended
- sediment guideline needed

IPBC: - zone of impact is larger
- sediment toxicity tests recommended
- sediment guideline needed

Other issues
- synergism?
- impact in marine systems?
- Re-assess Provincial effluent guidelines?
- develop ambient water & sediment objectives?

The use of the symbiotic fungus *Glomus intraradices* for assessing the environmental impact of toxic chemicals

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ABSTRACT: There is a need to include the symbiotic fungi in the existing battery of toxicity tests as an option to further enhance the value of the over-all ecological risk assessment of toxic chemicals, including pesticides. Vesicular-arbuscular mycorrhizal (VAM) fungi, e.g., *Glomus* species, are symbiotic fungi that could be used for this purpose. Geographically cosmopolitan, they are commonly found in soils and roots of plants growing in the arctic, temperate, and tropical regions. Besides their symbiotic function in promoting plant growth and survival, they also play a key role in enhancing eco-sustainability. Accordingly, the presence and abundance of the VAM fungi in the soil provides an indication of the well-being of the terrestrial ecosystems. The VAM fungi are presently not, but should be, represented in the eco-risk evaluation of toxic chemicals. A short term toxicity test has been successfully developed to determine the IC50 (inhibition concentration of 50% of fungal growth and development) values of reference solvents and pesticides on *Glomus intraradices,* using Ri T-DNA transformed *Daucus carota* roots as the host symbiont. The potential short term terrestrial eco-toxicological impact of toxic chemical contaminants can simply be evaluated by comparing their IC50 values with those of reference toxic materials.

A SHORT UPDATE ON 'THE DEVELOPMENT OF LABORATORY INHIBITION BIOASSAY TECHNIQUES'. *Presented by Ron Watts*

At last year's Pesticide Workshop, Mike Wan presented findings detailing a new use of symbiotic fungi to 'further enhance the value of the over-all eco-risk assessment of azadirachtin and other pesticides'. This novel technique involved the use of the vesicular-arbuscular mycorrhizal (VAM) fungi *Glomus intraradices* and Ri T-DNA transformed *Daucus carota* roots as the host symbiont cultured in a minimal medium system.

With the support of Dr. Leslie Churchland and Mr. Bryan Kelso, Dr. Mike Wan agreed to transfer his recently developed technology to the Aquatic Toxicology Section of the Pacific Environmental Science Centre. It is intended that over the next six months, the technique will be developed into a verified 14day Standard Operating Procedure which will then be offered to clients for their assessment of applicable environmental situations involving samples such as technical and formulated pesticides, toxic chemicals and contaminated soils, and complement such terrestrial toxicity testing as the 7day earthworm survival test, and the 5day lettuce seed germination and root tip elongation test.

The proposed Standard Operating Procedure will be titled '2-WEEK INHIBITION CONCENTRATION BIOASSAY USING *GLOMUS INTRARADICES* and Ri T-DNA TRANSFORMED *DAUCUS CAROTA* ROOTS'. It will fully describe a) the preparation of the minimal (M-) medium, b) the culture of the symbiotic fungi, and c) the bioassay of samples under test. The format for the documentation will follow requirements described in the PESC Quality Manual and will eventually be available in electronic form for use by others.

Atrazine and Metolachlor in Silage Corn Test Plot Runoff - First Year and Second Year Trial Experience

G. Derksen, Laurens van Vliet, Sony Szeto, Bernie Zebarth

Background

Tests plots were set up at the Agriculture Agri-Food Canada, Pacific Agri-Food Research Centre (PARC) in Agassiz B.C. to evaluate runoff quantity and quality (nutrients, sediment and pesticides) from silage corn test plots. In year 1, the test plots were managed using "conventional" practices (Plot #2 and #4) which consisted of the fall application of manure on bare ground without incorporation *vs* an improved management practice of a fall manure application with incorporation and establishing a fall cover crop (Plot # 3 and #5). The goal was to conduct the study over a 3-year period starting in fiscal year 1995/96.

The plot dimensions were 6.1m wide by 20.5m long. Collection tanks were sized to contain the total volume equivalent to 30mm of runoff. The primary collection tank was 950L and the secondary tank was 2900L.

The plots were treated with two herbicides atrazine and metolachlor in the spring. Herbicide application was by broadcast application.

The pesticide analytical method adopted at PARC was the same as that described by Young, 1995. Samples were treated to remove suspended particulates by centrifugation and then followed by filtration under aspiration through Whatman glass fiber filter paper. Atrazine and metolachlor in year one were determined on a Hewlett-Packard Model 5880 gas chromatograph equipped with a nitrogen/phosphorus detector (NPD). The detection limits were 0.1ppb for atrazine and 0.2ppb for metolachlor.

"What Happened" or "Put it Down to Experience"

Plans were to include the pesticide component over the full 3-year period of the study. However, PARC lost their inhouse pesticide research scientist shortly after year-one of the study. This aspect of the project was curtailed to a few observations in subsequent years. In year two, two control plots were added and rather than using a fall planted grass cover crop, a relay grass crop which is seeded at the 5-leaf stage of corn development was used.

The collection system ended up being undersized and wasn't able to retain all of the runoff during some of the extreme events, so quantifying a loading for all events wasn't possible. The total rainfall during 1995/96 was about 300mm greater than the 1961-90 normal and largely due to the fall extremes (e.g. 508 mm in November compared to a normal 235 mm). Collection tanks from two of the plots actually lifted (floated) and had to be reset. The plot areas were subsequently reduced in year two (one corn row removed) in order to accommodate larger rainfall events.

Heavy rains began earlier than anticipated in year one (shortly after manure application and before the fall cover crop seeding) resulting in the establishment of a "poor" cover crop.

Pesticide Results Year One and Two

In year one, he highest loading of atrazine and metolachlor (not shown) occurred during the initial first flush and was greater for the "conventional" practices plots (#2 and #4) than the improved practices plots (#3 and #5) (see Figure 1). However, this likely reflects the differences in plot management where the fall manure application was incorporated in plots #3/#5, but not in plots #2/#4. Both herbicides continued to be present in runoff samples for the duration of the period of monitoring between October 1995 and April 1996. In year one, with the exception of the initial flush period, atrazine and metolachlor concentrations did not exceed 5 ug/L. In year two, the benefit of a relay crop (plots #3/#5) in reducing pesticide loss was evident in the two runoff events samples where samples were collected (Figure 2).

References

Young, M.S.A. 1995. Book of Abstracts. 210th American Chemical Society National Meeting.

Figure 1: Agassiz Silage Corn Test Plots - Atrazine Runoff Loading

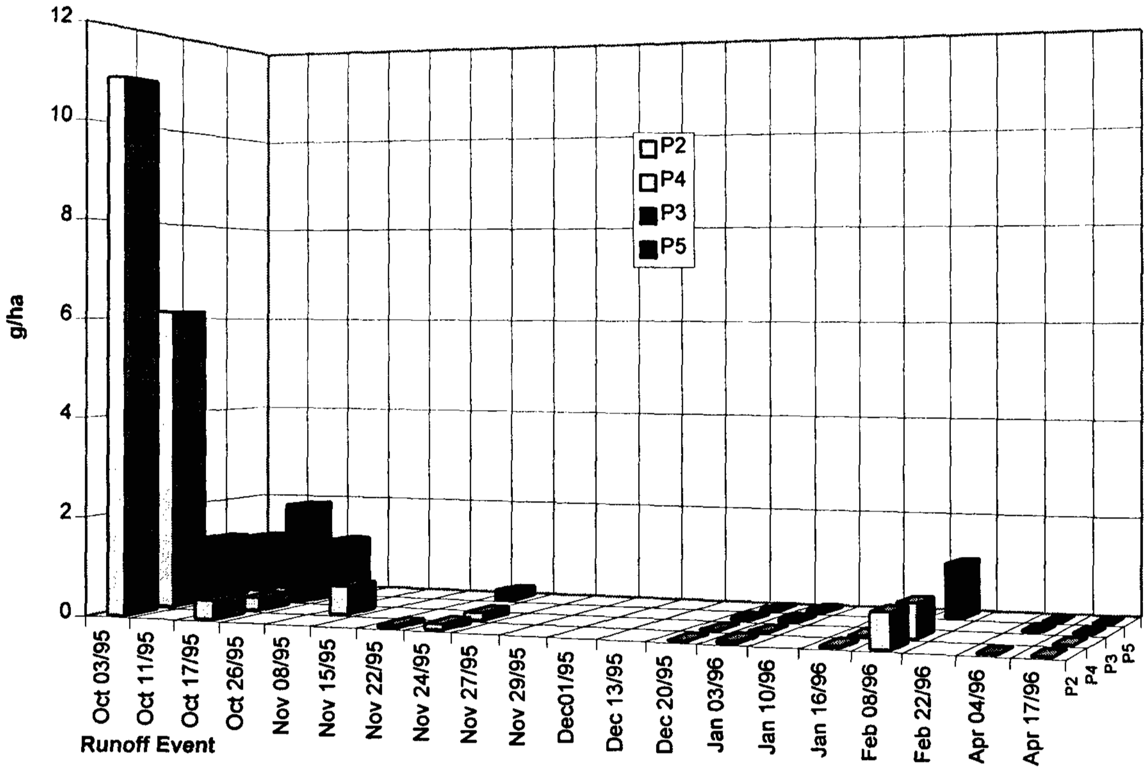
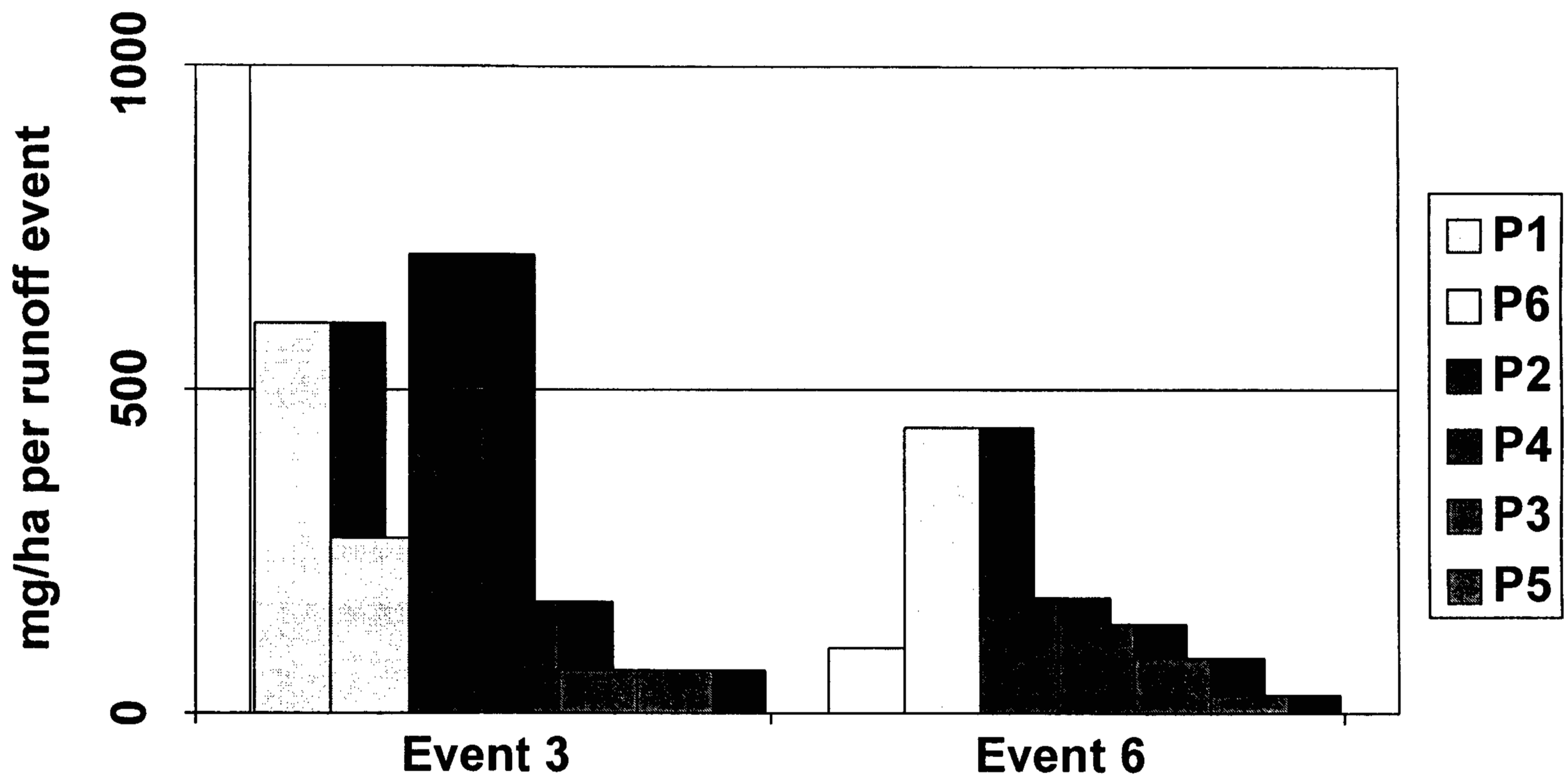


Figure 2: Silage Corn Runoff Plots 1996/1997 - Atrazine



Poisoning of raptors wintering on the Fraser River delta by anticholinesterase insecticides and related studies examining the process of secondary poisoning

Laurie Wilson, John Elliott, Sandi Lee - CWS, ECB
laurie.wilson@ec.gc.ca

The decline of some populations of raptors on the Fraser River delta has been attributed to the accumulation of certain organochlorine insecticides. However, organochlorines have been largely replaced by cholinesterase-inhibiting organophosphorate and carbamate insecticides, which are considered non-persistent, non-bioaccumulative and therefore of low risk for secondary poisoning of raptors. In 1990, the Canadian Wildlife Service initiated a study to determine the cause of mortality of raptors wintering in the lower Fraser Valley. Various species, particularly bald eagles and red-tailed hawks, were obtained, dead or debilitated, from government and non-government sources. All specimens were assayed for plasma and/or brain cholinesterase activity and based on the cholinesterase results, gut contents were analyzed for pesticide residues. From 1990 to 1998, a total of 855 raptors were collected, of which at least 57 birds were poisoned by anticholinesterases, the majority being from the Fraser River delta, a major raptor wintering area. Seven insecticides (carbofuran, fensulfothion, phorate, fonofos, terbufos, parathion, fenthion) have been implicated, resulting, to-date, in the withdrawal of two compounds (carbofuran, phorate) from the Lower Mainland. Production of fensulfothion was halted in 1991 by the manufacture, due to concerns about its environmental toxicity. The manufacturer of fonofos discontinued production in 1998, however, use of existing stocks is expected to continue for several years. The majority of these insecticides were registered for use in BC as granular formulations at the time the incident occurred.

Studies have also been initiated on the process of secondary poisoning in relation to winter foraging behaviour and the correlation with bald eagle and other raptor population trends:

A 2-year study to determine the incidence of waterfowl poisoned in fields treated with granular dyfonate for wireworm control was recently completed. A total of 29 waterfowl carcasses were collected; approximately equal number were found in 'treated' and 'non-treated' fields. Brain cholinesterase levels were severely depressed and chemically reactivated in five ducks, suggesting exposure to organophosphate insecticides. Ingesta are currently being analyzed for pesticide residues. All of the ducks with depressed cholinesterase levels were found individually in a number of different fields; all of the fields had been treated with granular fonofos the previous spring.

The scavenging behaviour of raptors in agricultural areas was investigated by placing 30 duck carcasses in fields and monitoring them using still and time-lapse video technology. Most of the carcasses were found by raptors within 72 hours, and 78% were rapidly scavenged with 24 hours. Of the species identified by this technique, bald eagles were the first species to find carcasses about 22% of the time. Other scavengers including northern harriers, red-tailed hawks and northwestern crows were also observed.

The relationship of bald eagle roosting sites in the Fraser River delta to carcass finding and poisoning risk was assessed using telemetry. Results revealed that all radio-tagged migrant birds, both juvenile and adult, made daily visits to the Burns Bog landfill, but resident eagles remained on their territory and do not use the landfill. No eagle poisoning or deaths were recorded during any landfill observations.

Results from these studies will be used to develop guidelines to incorporate wildlife toxicity concerns in pesticide use decisions such as site-specific integrated pest management programs.

References:

Elliott, J.E., Langelier, K.M., Mineau, P. and Wilson, L.K. 1996. Poisoning of bald eagles and red-tailed hawks by carbofuran and fensulfothion in the Fraser Delta of British Columbia, Canada. *Journal of Wildlife Diseases* 32(3):486-491.

Elliott, J.E., Wilson, L.K., Langelier, K.M., Mineau, P. and Sinclair, P.H. 1996. Secondary poisoning of birds of prey by the organophosphorus insecticide, phorate. *Ecotoxicology* 6:219-231.

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Peterson, C.A., S.L. Lee, J.E. Elliott. Scavenging of waterfowl carcasses by avian predators in agricultural fields of the Fraser River Delta, British Columbia. J. Field Ornithology (submitted)

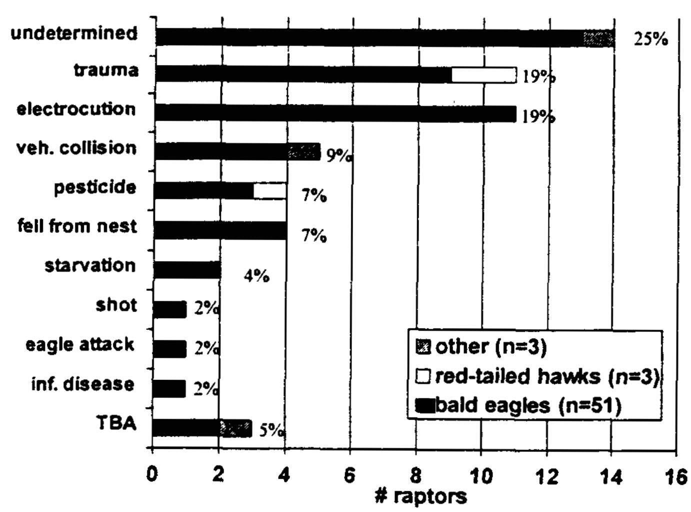
Wilson, L.K., M. Harris, J.E. Elliott. Impact of agricultural pesticides on birds of prey in the Lower Fraser Valley. Fraser River Action Plan: Technical Summary Chapter 3.2.8 Environment Canada, Vancouver BC (in press)

Wilson, L.K., IE Moul, JE Elliott, K Langelier. 1995. Summary of bird mortalities in British Columbia and Yukon, 1963-1994. *CWS Technical Report Series No. 249*. Canadian Wildlife Service, Pacific and Yukon Region, British Columbia.

Pesticide Poisoning of Raptors, south-western BC, 1990-98

Laurie Wilson, John Elliott, Sandi Lee
Canadian Wildlife Service

Causes of death, Raptors, 1997/98 (n=57)



Raptors confirmed of pesticide poisoning, BC/Yukon, 1997/98 (n=4)

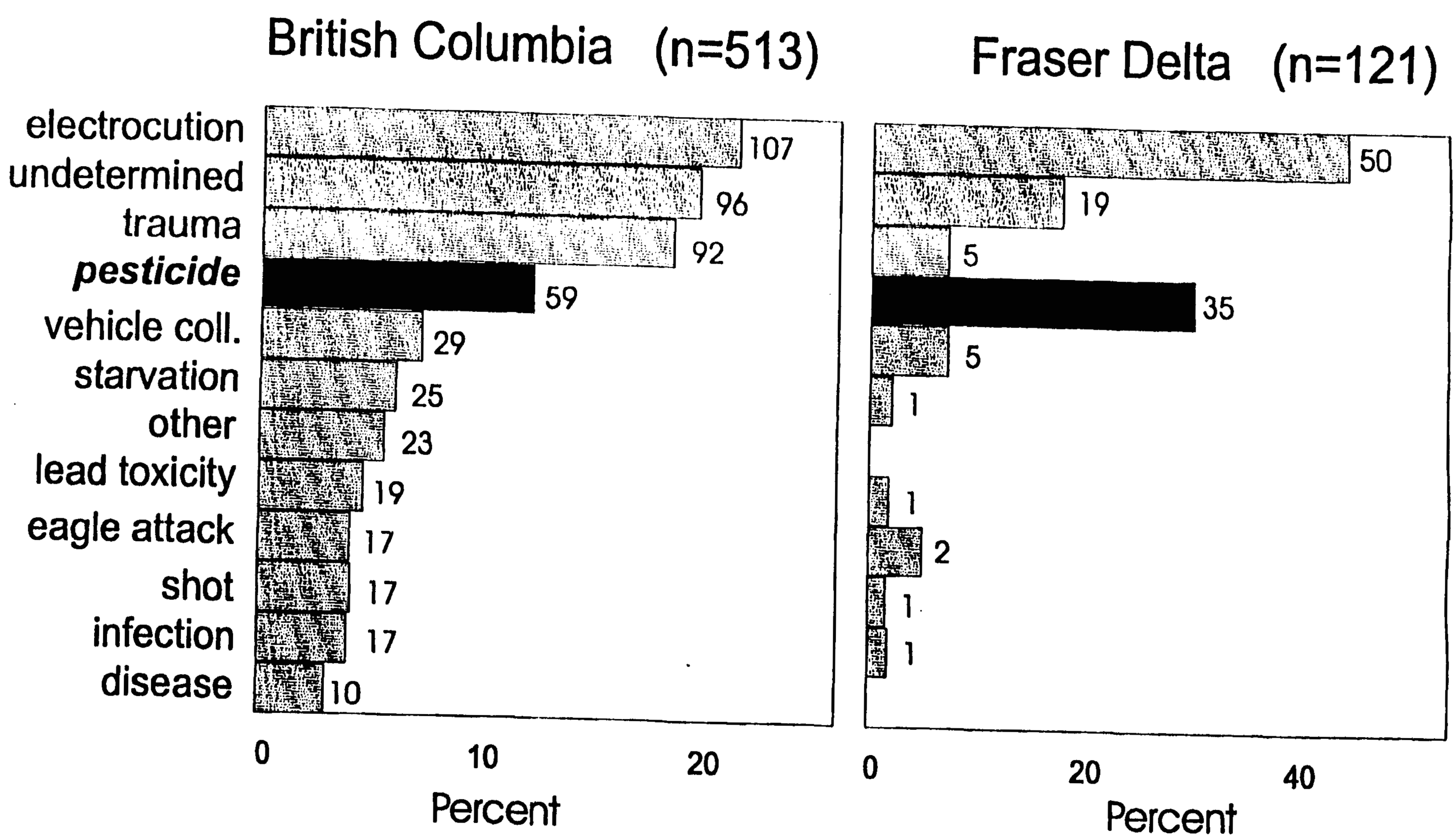
Species	Age	Sex	Location	Date	Pesticide Residues (mg/kg)	plasma ChE [(a)] (umol/min/l)	brain ChE (umol/min/g)	clinical symptoms [(b)]
RTHA	A	M	Ladner	16 Nov 97	Naled 73, Dichlorvos 28, Fonofos 14 (crop)	743.5, day 8	NA	1,2,5
BAEA	J	M	Burns Bog	19 Jan 98	Fonofos 0.87 (crop)	ND *P, day 1 react: 511 chem	NA	1,2
BAEA	A	F	Nanaimo	28 Feb 98	TBA (crop)	TBA	TBA	1,3,4
BAEA	A	M	Courtena y	11 Jul 98	TBA (gizz/provent)	TBA	TBA	2,3,4

(a) ND = not detected (pChE detection limit: 50 umol/min/l)
P = plasma or brain ChE < 50% of 'normal' , indicating 'poisoning' of raptor (death attributable to pesticides)
E = inhibition of plasma or brain ChE < 2xSD but > 50%, indicating possible 'exposure' of raptor (death not attributed to pesticides)
Reactivation: reactivation chemically indicates exposure to OP pesticides; spontaneous reactivation indicates exposure to Carbamate insecticides

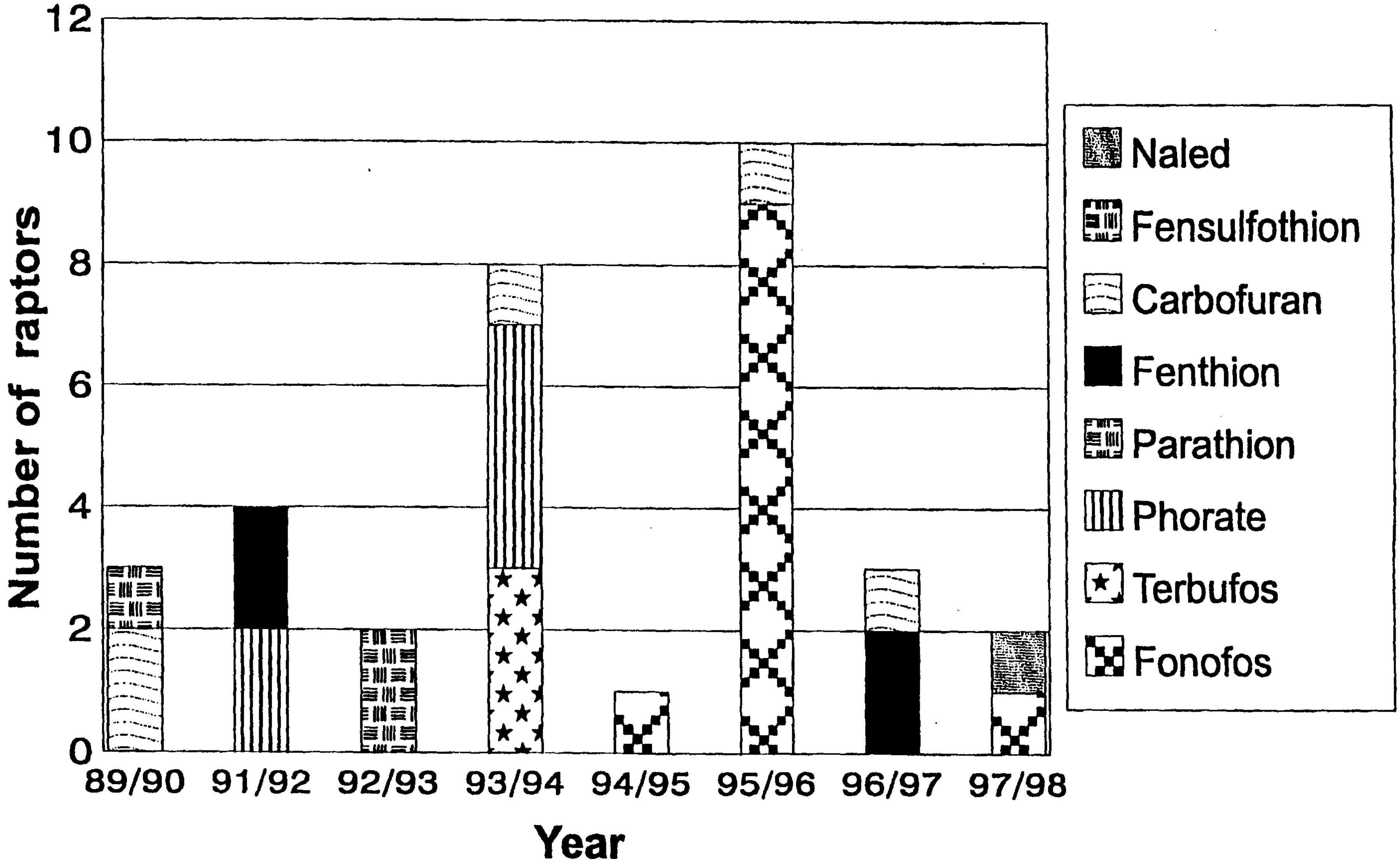
(b) Clinical Symptoms:
1. Swollen crop
2. clenched talons
3. neurological problems
4. depression
5. foul odor from mouth

NA = not available
NT = not tested
TBA = to be analyzed

Causes of death, Eagles, 1990 - 98



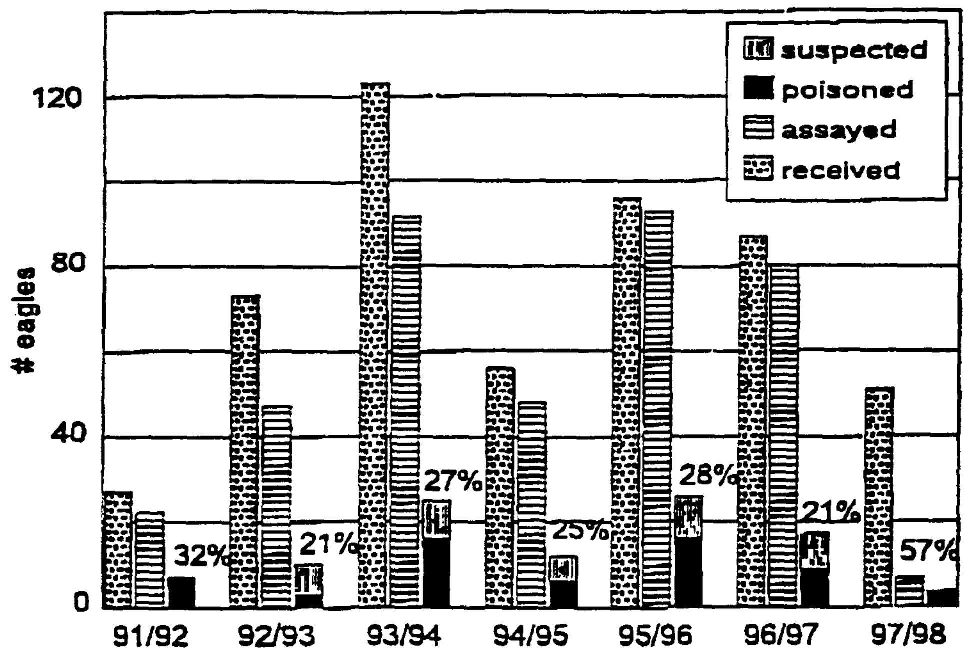
Confirmed Pesticide Residues, B.C. Raptors, 1990 - 98



Eagles collected from B.C., 1990 - 98

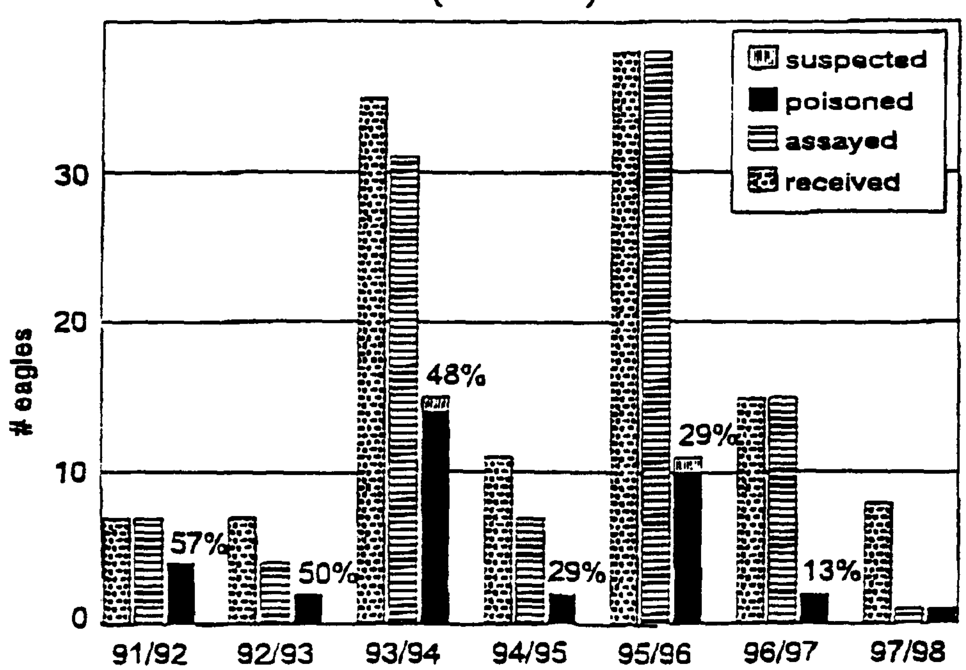
British Columbia

(n=513)



Fraser River Delta

(n=121)



Waterfowl Mortality -Agricultural fields, Delta

1/2 fields treated with Dyfonate G (fonofos)

1/2 fields not treated with Dyfonate G

- search potato fields (1048 acres) for intact carcasses & scavenged remains
- determine cause of death
- assess exposure to pesticides (brain ChE, residue analyses)
- estimate bird use of fields prior to search to determine population impact

Waterfowl Mortality - Agricultural fields, Delta

1996/97: 15 bird carcasses: treated fields = 4
non-treated fields = 7

brain ChE: Green-winged teal 3.4 umol/min/g

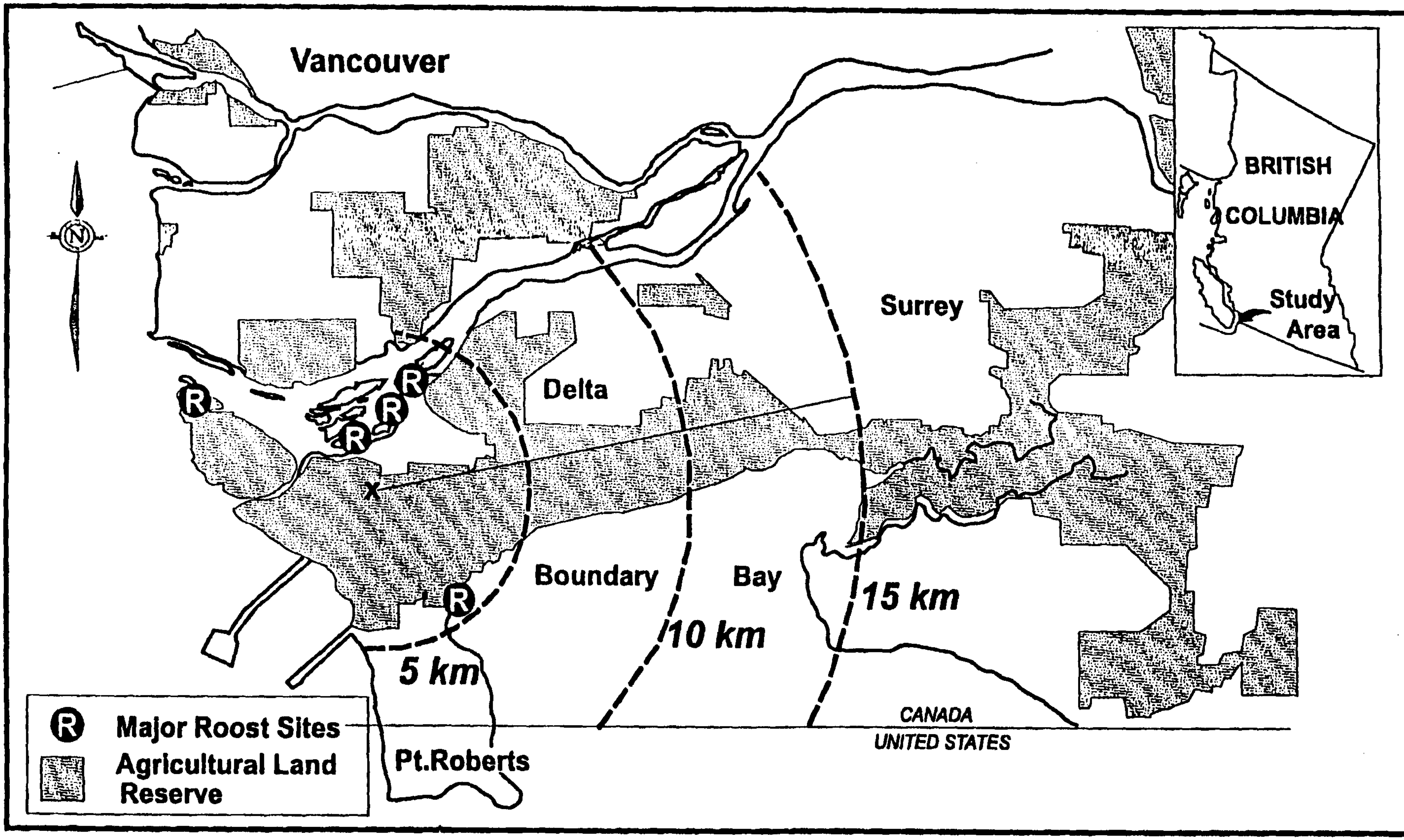
1997/98: 12 bird carcasses: treated fields = 12
non-treated fields = 0

brain ChE:

Mallard	5.1 umol/min/g
Mallard	3.7 umol/min/g
Green-winged teal	3.7 umol/ming
Mallard	5.2 umol/ming

Normal brain ChE - Teal 14 umol/ming
- Mallard 18 umol/ming

Raptor Scavenging Study



Duck carcasses found by scavengers Fraser Delta

	Carcasses found (%)		
	1996	1998	Combined
0 - 24 h	80	75	78
24 - 48 h	13	13	13
48 - 72 h	7	4	6
> 72 h	0	8	4
	n=30	n=24	n=54

First species to arrive at carcasses (%)

	still lapse 1996	video 1998
bald eagle	27	17
northwestern crow	17	50
northern harrier	13	17
red-tailed hawk	3	0
glaucous-winged gull	0	4
none	0	8
unknown (error/malfunction)	40	4

GC/MS/MS Analysis of Pesticides in Bird Crop

Celia Wong
PESC, ECB, Environment Canada

An analysis method using High Resolution Gas Chromatography /Mass Spectrometry / Mass Spectrometry was developed for five pesticides in bird crop. The pesticides are Diazinon, Fenthion, Chlorpyrifos, Disulfoton and Famphur. These are pesticides involved in bird kills and are of interest to the Canadian Wildlife Service and the US Fish and Wildlife Service involved in bird kills.

The method development process will be described as well as an overview on GC/MS/MS technology. A comparison between analysis results using other analytical instruments will be presented. The benefits of GC/MS/MS will be discussed.

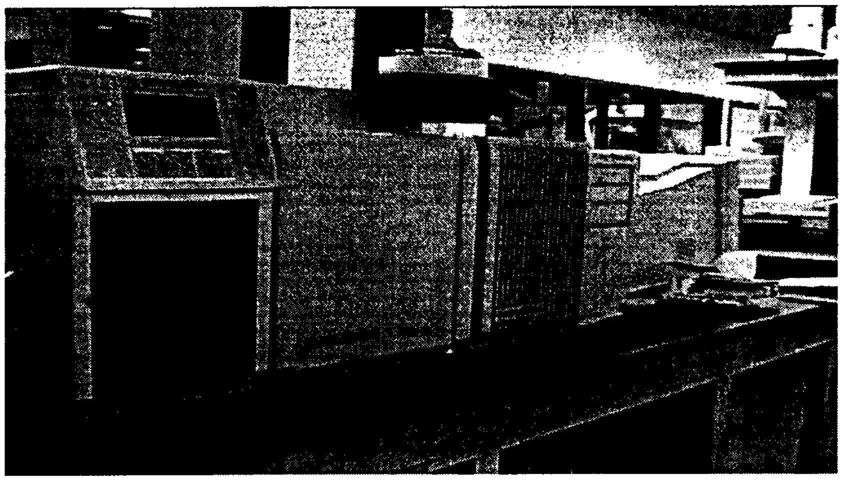
GC/MS/MS Analysis of Pesticides in Bird Crop

Celia Wong / Brad McPherson
Organic Chemistry Section
Pacific Environmental Science Centre

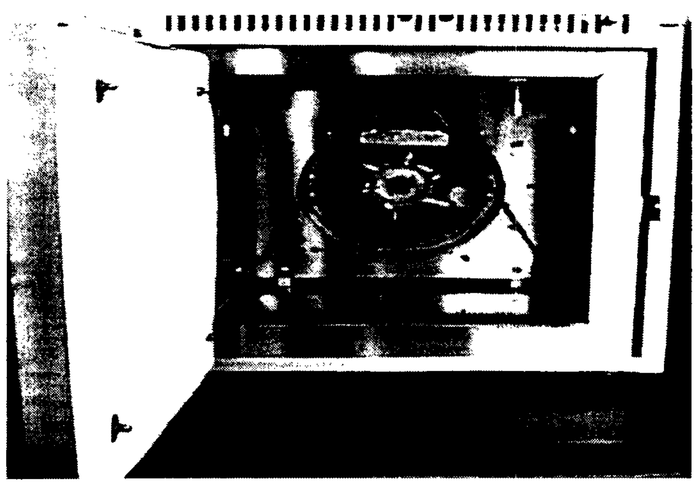
Objectives:

- Develop an analysis method for Pesticides using the most current and advanced technology available in our laboratory - ***GC/MS/MS***
- Identify Pesticides at **ppb** levels in ***Bird Crop*** Samples
-

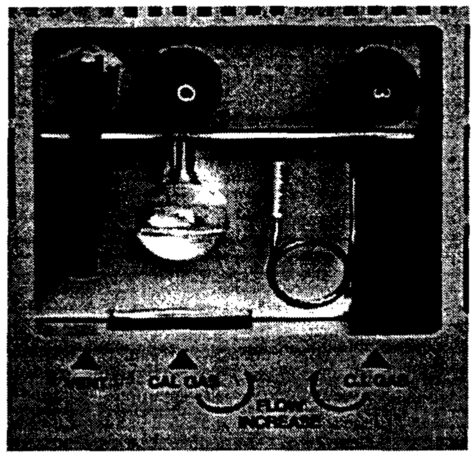
Saturn 2000 GC/MS/MS



GC Oven



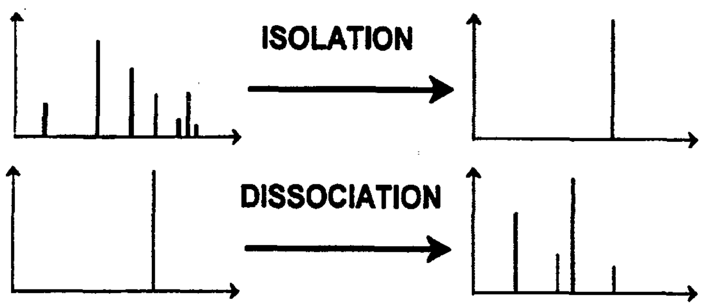
MS Calibration/CI Gas Controls



Principles of Mass Spectrometers

- Charged particles moving through a magnetic field or electric field can be separated according to their mass-to-charge ratios.
- The mass spectrum is produced by scanning the magnetic or electric fields.
- The intensity of the ions measured at the detector corresponds to the number of ions reaching the detector.

What is MS/MS?



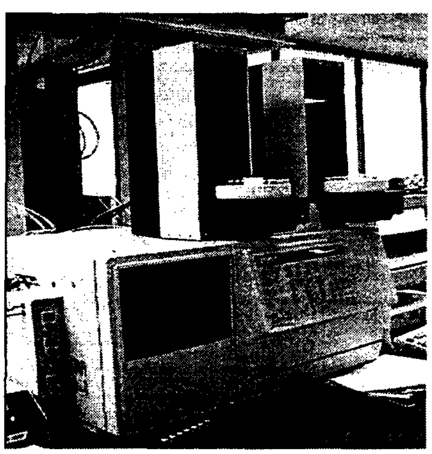
Advantages of GC/MS/MS

- Selectivity in a Difficult Matrix
- Spectral Clarity
- Unambiguous Identification
- Lower Detectivity

MS/MS Process

- Select Single Ion
- Energetically Dissociate Ion
- Full Scan Analysis of Product Ions

Specific Detectors

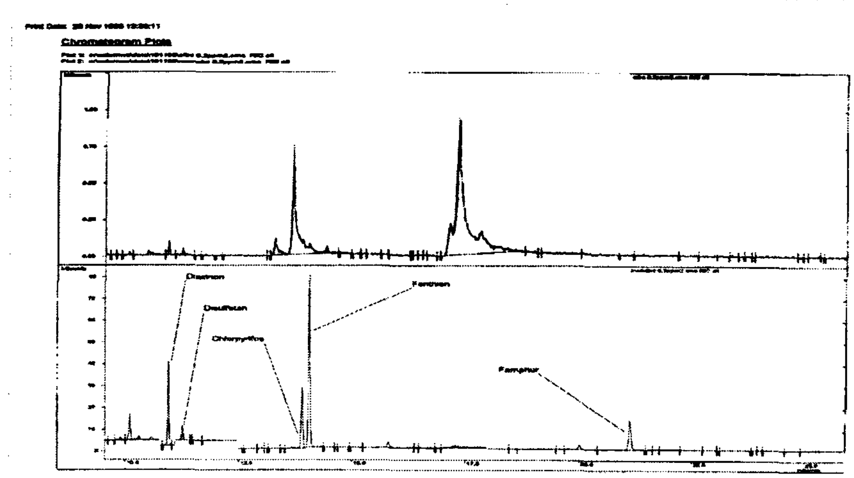


- GC/*NPD* - Nitrogen or Phosphorus sensitive
- GC/*PFPD* - Phosphorus or Sulfur sensitive
- Very sensitive detectors
- Requires sample cleanup
- Cannot confirm identification

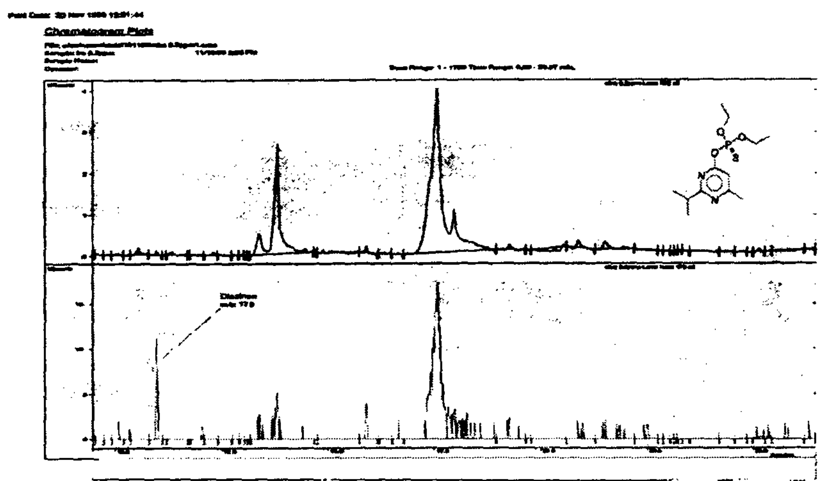
Organophosphate Pesticides

- ***Diazinon***
- ***Disulfoton***
- ***Chlorpyrifos***
- ***Fenthion***
- ***Famphur***

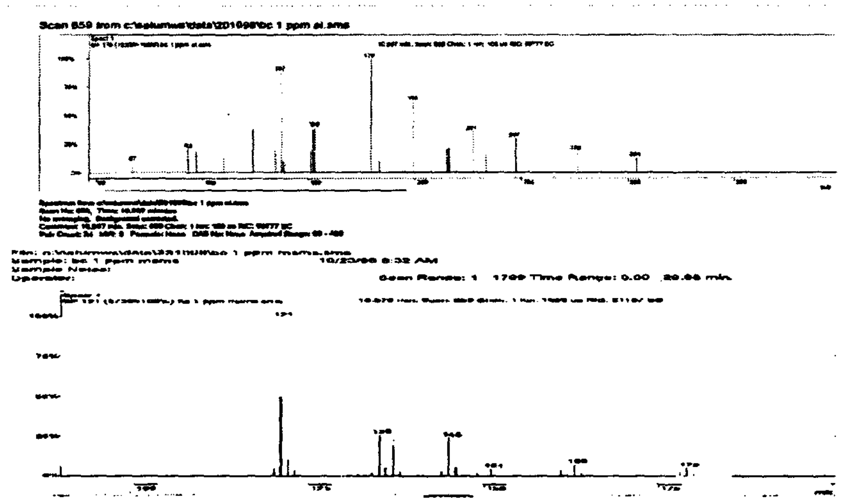
GC/MS vs. GC/MS/MS



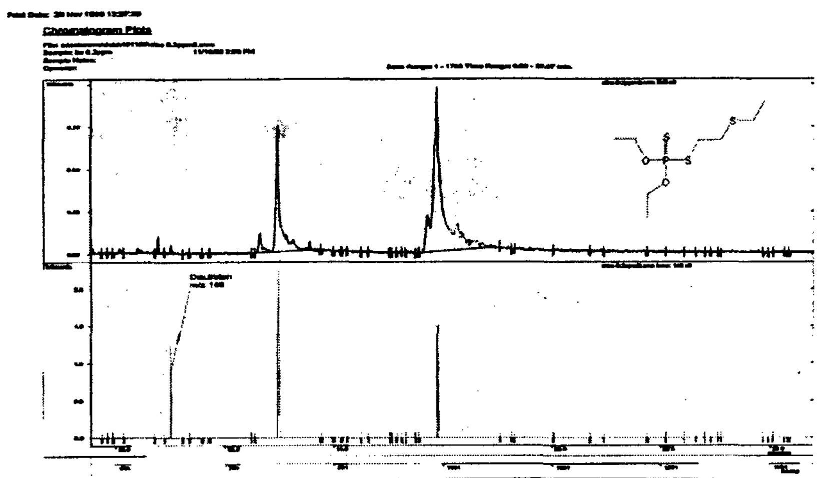
Diazinon



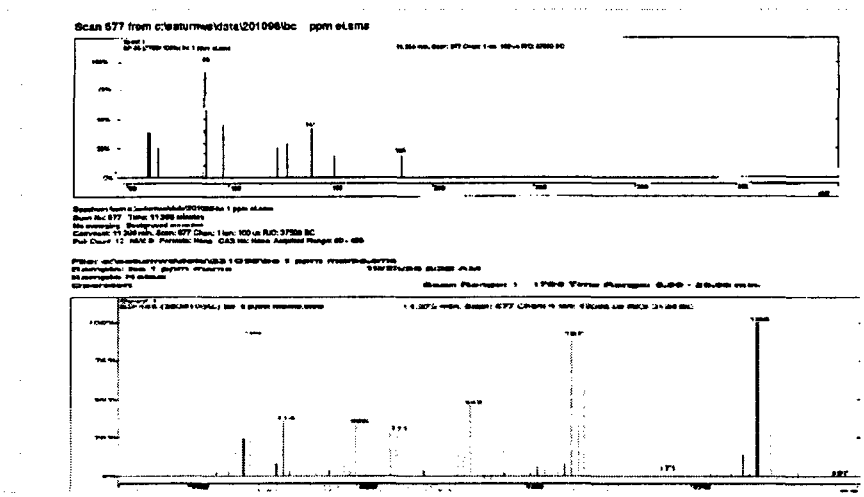
Mass Spectrums of Diazinon



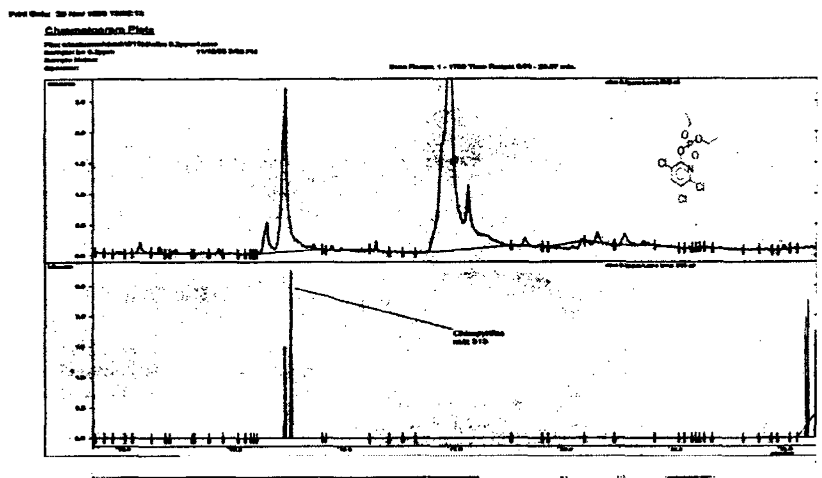
Disulfoton



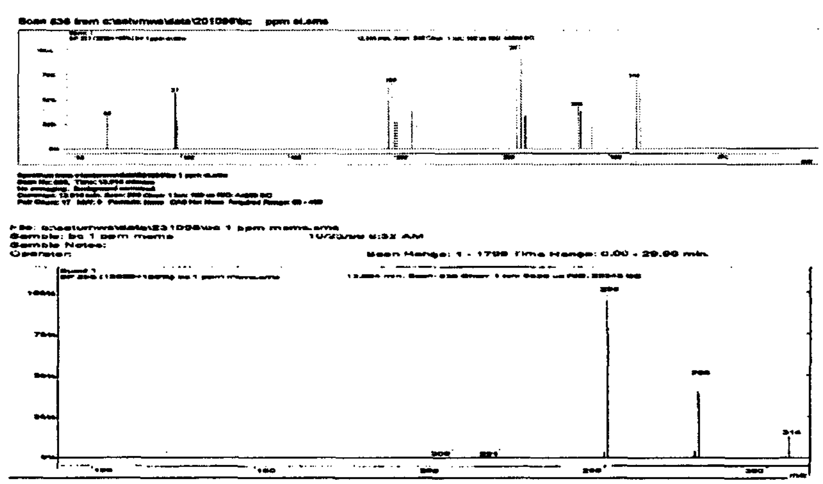
Mass Spectrums of Disulfoton



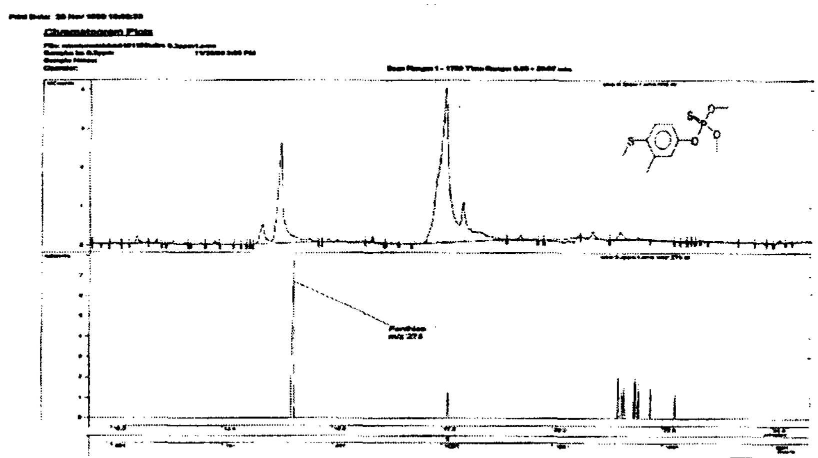
Chlorpyrifos



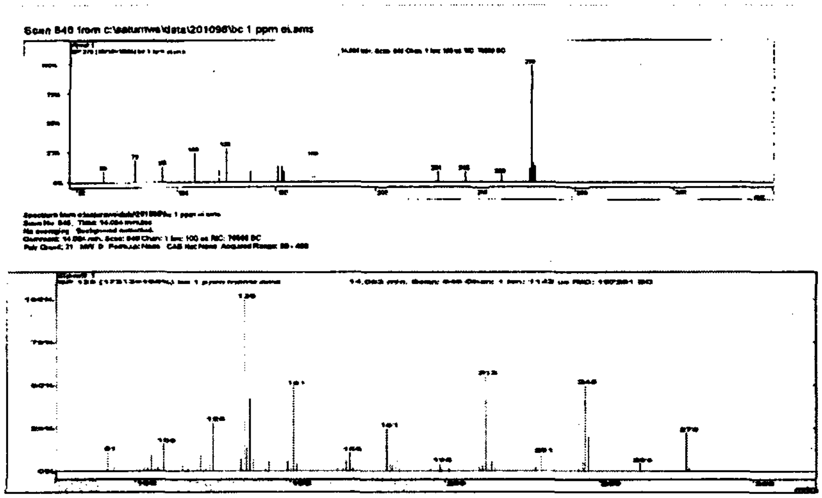
Mass Spectrums of Chlorpyrifos



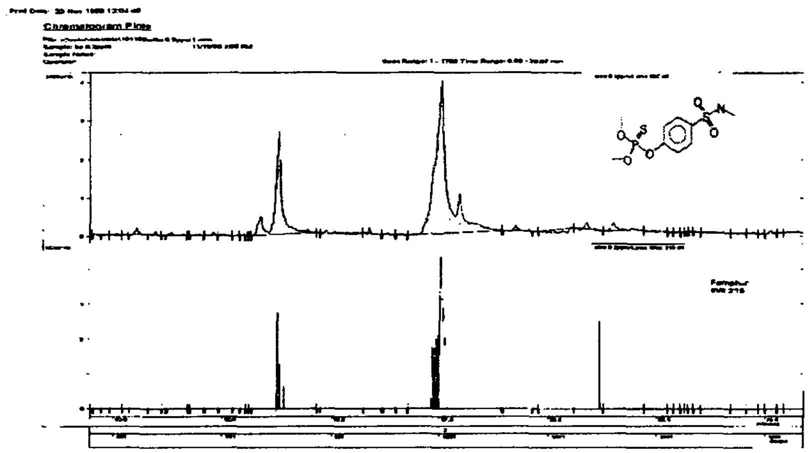
Fenthion



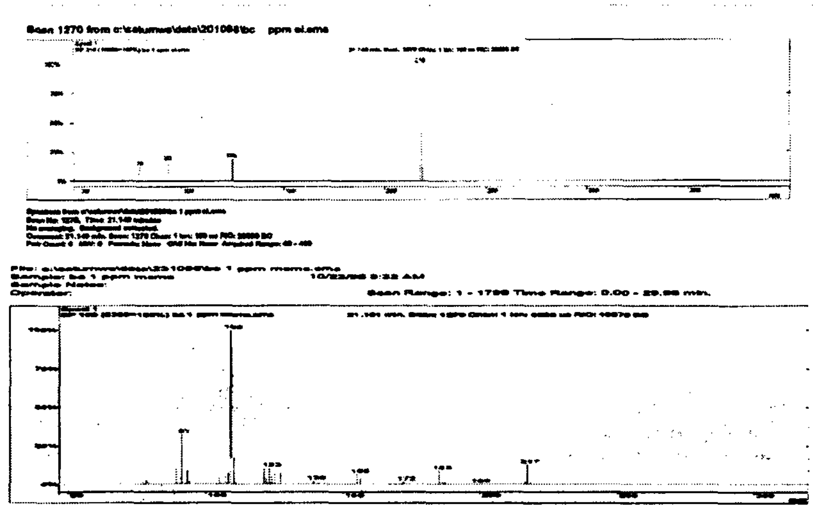
Mass Spectrums of Fenthion



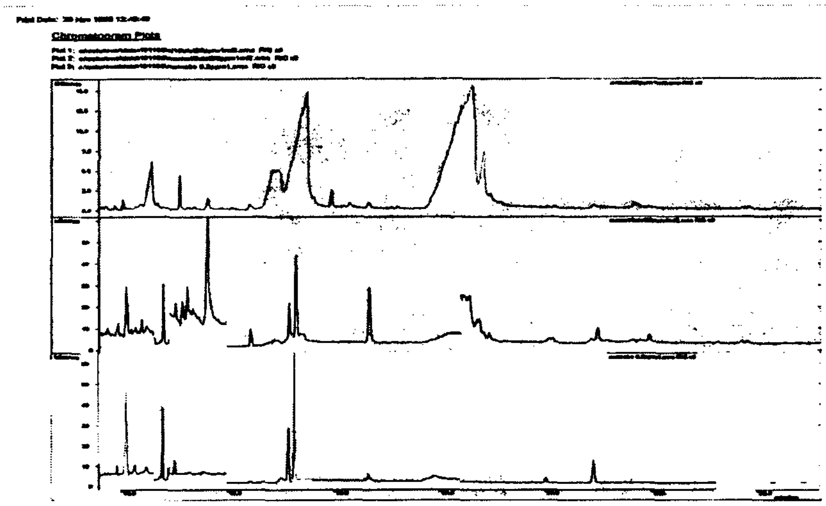
Famphur



Mass Spectrums of Famphur



MS vs. MS/MS



Conclusion

- MS/MS can be used for ***Accurate*** *Screening* of Pesticides
- Low ***ppb*** *Detection* is possible
- ***Minimal*** *Sample Preparation* is necessary

Next Steps

- Further fine tune ***MS/MS Parameters***
- Determine ***Detection Limit*** of pesticides in *Bird Crop* matrix

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- ***Expand*** the list of Pesticides identifiable by GC/MS/MS

Recent Environment Canada and US Geological Survey investigations of pesticides in ground waters - Abbotsford Aquifer

Presented by Hugh Liebscher

Ground-water quality and hydrologic data were collected from 9 wells in the transboundary region of the Abbotsford-Sumas aquifer. The samples were collected to provide detailed evaluation of the quality of ground water moving across the international border from Canada to the United States at a single point in time. Water quality data included the concentrations of selected common ions, trace-elements, pesticides, and volatile organic compounds including three chlorofluorocarbons used to estimate residence times of ground water. Twenty three synthetic organic compounds were detected in the ground water samples with concentrations ranging from 0.01 to 23 μg/L. Three chloroflourocarbons, CFC-11, CFC-12 and CFC-113 were also detected; typically at concentrations greater than the maximum atmospheric concentrations indicating additional sources of CFCs and the impracticality of using CFCs as an estimator of ground water age date in this aquifer.

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Table 3.--*Volatile organic compound, method detection limits and drinking water standards--Continued*

Volatile organic compounds	Common or alternate name(s)	Chemical Abstract Services registry number	Method detection limit (µg/L)	U.S. Drinking water standard or guideline (µg/L)	Canadian Drinking water standard or guideline (µg/L)	U.S. Fresh water chronic criteria for protection of aquatic life (µg/L)	Canadian Fresh water chronic criteria for protection of aquatic life (µg/L)
2-Propanone	Acetone	67-64-1	5				
n-Propylbenzene	1-Phenylpropane	105-65-1	0.05	--			
Tetrachloroethene	Perchloroethylene, PCE	127-18-4	0.2	5			260
Tetrachloromethane	Carbon tetrachloride	56-23-5	0.05	5	5		13
Tetrehydrofuran	--	109-99-9	5				
1,1,1,2-Tetrachloroethane	--	630-20-6	0.05	70			
1,1,2,2-Tetrachoroethane	--	79-34-5	0.1	--			
1,2,3,5-Tetramethylbenzene	Isodurene	527-53-7	0.05				
1,2,3,4-Tetramethylbenzene	Prernitene	488-23-3	0.05				
Tribromomethane	Bromoform	75-25-2	0.2	100			
1,2,3-Trichlorobenzene	--	87-61-6	0.2	--			0.9
1,2,4-Trichlorobenzene	--	120-82-1	0.2	70			0.5
Trichloroethene	TCE	79-01-6	0.2	5	50		20
Trichlorofluoromethane	CFC-11	75-69-4	0.1	2,000			
Trichloromethane	Chloroform	67-66-3	0.05	100			2
1,1,1-Trichloroethane	Methyl chloroform	71-55-6	0.05	200			
1,1,2-Trichloroethane	Vinyl trichloride	79-00-5	0.2	5			
1,1,2-Trichloro-1,2,2trifluoroethane	CFC-113	76-13-1	0.05	--			
1,2,3-Trichloropropane	--	96-18-4	0.2	40			
1,2,3-Trimethylbenzene	--	526-73-8	0.05	--			
1,2,4-Trimethylbenzene	Pseudocumene	95-63-6	0.05	--			
1,3,5-Trimethylbenzene	Mesitylene	108-67-8	0.2	--			
Vinyl Acetate	--	108-05-4	5.0				
Styrene	Vinyl benzene	100-42-5	0.2	100			
meta & para Xylene	--	108-38-3	0.05		300*		
ortho Xylene	--	95-47-6	0.05				

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Table 3.--*Volatile organic compound, method detection limits and drinking water standards--Continued*

Volatile organic compounds	Common or alternate name(s)	Chemical Abstract Services registry number	Method detection limit (µg/L)	U.S. Drinking water standard or guideline (µg/L)	Canadian Drinking water standard or guideline (µg/L)	U.S. Fresh water chronic criteria for protection of aquatic life (µg/L)	Canadian Fresh water chronic criteria for protection of aquatic life (µg/L)
1,2-Dichloroethane	Ethylene dichloride	107-06-2	0.05	5	5		
cis-1,2-Dichloroethene	cis DCE	156-59-4	0.05	70	5		100 total DCE
trans-1,2-Dichloroethene	trans DCE	156-60-5	0.05	100			100 total DCE
1,1-Dichloroethane	Ethylidene chloride	75-34-3	0.05	--			
1,1-Dichloroethene	--	75-35-4	0.1	7			
Dichloromethane	Methylene chloride	75-09-2	0.1	5	50		98
1,2-Dichloropropane	Propylene, dichloride	78-87-5	0.05	5			
1,3-Dichloropropane	--	142-28-9	0.2	--			
1,1-Dichloropropene	--	563-58-6	0.2	--			
2,2-Dichloropropane	--	594-20-7	0.05	--			
cis-1,3-Dichloropropene	--	100-61-015	0.1	10			
trans-1,3-Dichloropropene	--	100-61-026	0.1	10			
Diethylether	Ethyl ether	60-29-7	0.1				
Diisopropylether	--	108-20-3	0.1				
Ethylbenzene	--	100-41-4	0.05	700	2.4*		700
Ethyl-t-butyl ether	ETBE	637-92-3	0.1				
2-Ethyl Toluene	o Ethyl Toluene	611-14-3	0.05				
Ethyl Methacrylate		97-63-2	1.0				
Hexachloroethane	--	67-72-1	0.05				
Hexachlorobutadiene	HCBD	87-68-3	0.2	--			0.1
2-Hexanone	--	591-78-6	5.0				
Iodomethane	Methyl iodide	74-88-4		0.5			
Isopropyl benzene	Cumene	98-82-8	0.05	--			
p-Isopropyltoluene	*p*-Cymene	99-87-6	0.05	--			
Methyl Acrylate	--	96-33-3	2				
Methyl Acrylonitrile	--	126-98-7	2				
Methyl *tert*-butyl ether	MTBE	163-40-44	0.1	20			
Methylbenzene	Toluene	108-88-3	0.05	1,000	24*		300
4-Methyl-2-Pentanone	Methyl isobutylketone	108-10-1	5.0				
Methyl Methacrylate	--	80-62-6	1				
Napthalene	--	91-20-3	0.2	--			
2-Propanol	*Acrolein*	107-02-8	2				

italics

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Table 3.--*Volatile organic compound, method detection limits and drinking water standards*

[µg/L, micrograms per liter; --, data not available; drinking water standards are U.S. Environmental Protection Agency (USEPA) maximum contaminant levels for drinking water from USEPA (1996), unless otherwise footnoted]

Volatile organic compounds	Common or alternate name(s)	Chemical Abstract Services registry number	Method detection limit (µg/L)	U.S. Drinking water standard or guideline (µg/L)	Canadian Drinking water standard or guideline (µg/L)	U.S. Fresh water chronic criteria for protection of aquatic life (µg/L)	Canadian Fresh water chronic criteria for protection of aquatic life (µg/L)
Acrylonitrile	--	107-13-1	2	.6			
tert-Amyl methyl ether	TAME	994-05-8	0.1				
Benzene	--	71-43-2	0.05	5	5		300
Bromobenzene	Phenyl bromide	108-86-1	0.05	--			
Bromochloromethane	Methylene chlorobromide	74-97-5	0.1	10			
Bromodichloromethane	Dichlorobromomethane	75-27-4	0.1	100			
Bromoethane	Vinyl bromide	593-60-2	0.1				
Bromomethane	Methyl bromide	74-83-9	0.1	10			
2-Butanone	Methylethylketone	78-93-3	5				
n-Butylbenzene	1-phenylbutane	104-51-8	0.05	--			
sec-Butylbenzene	2-phenylbutane	135-98-8	0.05	--			
tert-Butylbenzene	2-methyl-2-phenylpropane	98-06-6	0.05	--			
Carbon Disulfide	--	107-05-1	0.05				
Chlorobenzene	Phenyl chloride	108-90-7	0.05	100	80		15
Chloroethane	Ethyl chloride	75-00-3	0.1	--			
Chloroethene	Vinyl chloride	75-01-4	0.1	2			
Chloromethane	Methyl chloride	74-87-3	0.2	3			
2-Chloro-1-methylbenzene	*o*-Chlorotoluene	95-49-8	0.05	--			
4-Chloro-1-methyl benzene	*p*-Chlorotoluene	106-43-4	0.05	--			
3-Chloro-1-propene	--	107-05-1	0.1				
Dibromochloromethane	--	124-48-1	0.1	100			
Dibromomethane	Methylene bromide	74-95-3	0.1	--			
1,2-Dibromo-3-chloropropane	DBCP	96-12-8	0.5	0.2			
1,2-Dibromoethane	EDB	106-93-4	0.1	0.05			
1,2-Dichlorobenzene	*o*-Dichlorobenzene	95-50-1	0.05	600	200		2.5
1,3-Dichlorobenzene	*m*-Dichlorobenzene	541-73-1	0.05	600			2.5
1,4-Dichlorobenzene	*p*-Dichlorobenzene	106-46-7	0.05	75	5		4.0
trans-1,4-Dichloro-2-butene	--	110-57-6	5.0				
Dichlorodifluoromethane	CFC-12	75-71-8	0.2	1,000			

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Table 4.--*Pesticide target analytes, method detection limits, drinking water standards, and observed concentrations*
[µg/L, micrograms per liter; U.S., United States; --, no value]

Pesticide target analyte	Trade or common name(s)	Type of pesticide	Chemical Abstract Services registry number	Method detection limit (µg/L)	U.S. Drinking water standard or guideline (µg/L)[1,4]	Canadian Drinking water standard or guideline (µg/L)[2]	U.S. Fresh water chronic criteria for protection of aquatic life (µg/L)[3]	Canadian Fresh water chronic criteria for protection of aquatic life (µg/L)[4]
			<u>Gas Chromatography/Mass Spectrometry analytical data</u>					
Alachlor	Lasso	H	15972-60-8	0.002	2	--	--	--
Atrazine	AAtrex	H	1912-24-9	[1]0.001	3	60	0.001	2
Azinphos-methyl[3]	Guthion	I	86-50-0	0.001	--	20	--	0.01
Benfluralin	Balan, Benefin	H	1861-40-1	0.002	--	--	--	--
Butylate	Sutan +, Genate Plus	H	2008-41-5	0.002	350	--	--	--
Carbaryl[5]	Sevin, Savit	I	63-25-2	0.003	700	90	0.02	--
Carbofuran[5]	Furadan	I	1563-66-2	0.003	40	90	--	1.75
Chlorpyrifos	Lorsban/Dursban	I	2921-88-2	0.004	20	90	0.041	--
Cyanazine	Bladex	H	21725-46-2	0.004	[4]1	10	--	2
DCPA	Dacthal	H	1861-32-1	0.002	[4]4,000	--	--	--
p,p'-DDE	none	M	72-55-9	0.006	[8]0.1	--	--	--
Desethylatrazine	none	M	6190-65-4	0.002	--	--	--	--
Diazinon	several	I	333-41-5	0.002	0.6	20	0.009	--
Dieldrin	Panoram D-31	I	60-57-1	0.001	[8]0.002	--	--	0.004
2,6-Diethylanaline	none	M	579-66-8	0.003	--	--	--	--
Disulfoton	Di-Syston	I	298-04-4	0.017	0.3	--	0.05	--
EPTC	Eptam, Eradicane	H	759-94-4	0.002	--	--	--	--
Ethalfluralin	Sonalan, Curbit EC	H	55283-68-6	0.004	--	--	--	--
Ethoprop	Mocap	I	13194-48-4	0.003	--	--	--	--
Fonofos	Dyfonate	I	944-22-9	0.003	10	--	--	--
alpha-HCH	none	M	319-84-6	0.002	[8]0.006	--	--	--
gamma-HCH	Lindane	I	58-89-9	0.004	0.2	--	0.02	--
Linuron[5]	Lorox, Linex	H	330-55-2	0.002	--	--	--	--
Malathion	several	I	121-75-5	0.005	200	190	0.008	--
Methyl parathion	Penncap-M	I	298-00-0	0.006	[4]2	--	--	--
Metolachlor	Dual, Pennant	H	51218-45-2	0.002	70	50	--	8
Metribuzin	Lexone, Sencor	H	21087-64-9	0.004	100	80	--	1

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Table 4.--*Pesticide target analytes, method detection limits, drinking water standards, and observed concentrations--Continued*

Pesticide target analyte	Trade or common name(s)	Type of pesti-cide	Chemical Abstract Services registry number	Method detection limit (µg/L)	U.S. Drinking water standard or guideline (µg/L)	Canadian Drinking water standard or guideline (µg/L)	U.S. Fresh water chronic criteria for protection of aquatic life (µg/L)	Canadian Fresh water chronic criteria for protection of aquatic life (µg/L)
Gas Chromatography/Mass Spectrometry analytical data--Continued								
Molinate	Ordram	H	2212-67-1	0.004	--	--	--	--
Napropamide	Devrinol	H	15299-99-7	0.003	--	--	--	--
Parathion	several	I	56-38-2	0.004	--	50	0.0001	--
Pebulate	Tillam	H	1114-71-2	0.004	--	--	--	--
Pendimethalin	Prowl,Stomp	H	40487-42-1	0.004	--	--	--	--
cis-Permethrin	Ambush, Pounce	I	57608-04-5	0.005	--	--	--	--
Phorate	Thimet, Rampart	I	298-02-2	0.002	--	2	--	--
Prometon	Pramitol	H	1610-18-0	0.018	[4]100	--	--	--
Pronamide	Kerb	H	23950-58-5	0.003	[4]50	--	--	--
Propachlor	Ramrod	H	1918-16-7	0.007	[4]90	--	--	--
Propanil	Stampede	H	709-98-8	0.004	--	--	--	--
Propargite	Comite, Omite	I	2312-35-8	0.013	--	--	--	--
Simazine	Aquazine, Princep	H	122-34-9	0.005	4	10	--	10
Tebuthiuron	Spike	H	34014-18-1	0.01	[4]500	--	--	--
Terbacil[3]	Sinbar	H	5902-51-2	0.007	[4]90	--	--	--
Terbufos	Counter	I	13071-79-9	0.013	[4]0.9	1	--	--
Thiobencarb	Bolero	H	28249-77-6	0.002	--	--	--	--
Triallate	Far-Go	H	2303-17-5	0.001	--	230	--	0.24
Trifluralin	Treflan, Trilin	H	1582-09-8	0.002	[4]5	45	--	0.1
High-Performance Liquid Chromatography analytical data								
2,4-D	several	H	94-75-7	0.15	70	100	3	4
2,4-DB	none	I	94-82-6	0.24	--	--	--	--
2,4,5-T	several	H	93-76-5	0.035	[4]70	280	--	--
2,4-5-TP[11]	Silvex	H	93-72-1	0.021	50	--	1.4	--
3-Hydroxy-carbofuran	none	M	1563-38-8	0.014	--	--	--	--

Methyl tert-butyl ether	0.1	–	E.09	E.09	–	E0.01	–	–	–	–	–	–	–
Chloroform	0.05	E.01	E.01	E.01	E.02	–	–	E.02	–	–	–	–	–
1,1,1 Trichloro	0.05	–	E.04	E.04	0.54	–	0.14	E.009	–	–	–	–	–

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Table 4.--*Pesticide target analytes, method detection limits, drinking water standards, and observed concentrations--Continued*

Pesticide target analyte	Trade or common name(s)	Type of pesti-cide	Chemical Abstract Services registry number	Method detection limit (µg/L)	U.S. Drinking water standard or guideline (µg/L)	Canadian Drinking water standard or guideline (µg/L)	U.S. Fresh water chronic criteria for protection of aquatic life (µg/L)	Canadian Fresh water chronic criteria for protection of aquatic life (µg/L)
			High-Performance Liquid Chromatography analytical data--Continued					
Neburon	Neburex, Noruben	H	555-37-3	0.015	--	--	--	--
Norflurazon	Evital, Solicam	H	27314-13-2	0.024	--	--	--	--
Oryzalin	Surflan	H	19044-88-3	0.31	--	--	--	--
Oxamyl	Vydate	I	23135-22-0	0.018	200	--	--	--
Picloram	Tordon	H	1918-02-1	0.05	500	190	--	29
Propham	Chem-Hoe, IPC	H	122-42-9	0.035	100	--	--	--
Propoxur	Baygon	I	114-26-1	0.035	--	--	--	--
Triclopyr	Garlon, Grazon	H	55335-06-3	0.25	--	--	--	--

[1] Unless otherwise noted, guidelines from USEPA October 1996 drinking water regulations and health advisory EPA 822-B-96-002.
[2] Unless otherwise noted guidelines from Guidelines for Canadian Drinking Water Quality, fifth edition 1993 Health and Welfare Canada: Canada Communication Group-Publishing, Ottawa, Canada K1A-059.
[3] Criteria for the protection of freshwater aquatic life are recommended maximum concentrations in water by National Academy of Sciences and National Academy of Engineers from Nowell and Resek (1994).
[4] Guidelines for the protection of freshwater aquatic life are Canadian Water Quality Guidelines from Canadian Council of Ministers of the Environment (1993).
[5] U.S. Environmental Protection Agency lifetime-health advisory for a 70-kilogram adult, from Nowell and Resek (1994).
[6] Analyzed by both gas chromatography/mass spectrometry and high-performance liquid chromatography methods.
[7] Interim guidelines for the protection of freshwater aquatic life are Canadian Water Quality Guidelines from Canadian Council of Ministers of the Environment (1993).
[8] U.S. Environmental Protection Agency risk-specific dose health advisory associated with a cancer risk of 10-6 (one in a million), from EPA1996.
[9] Pesticide target analyte is heat and light sensitive and therefore susceptible to degradation. This may result in poor overall recovery and precision (NAWQA/NWQL Quality Assurance Committee for the Schedule 2050/2051 Pesticide Analysis Method, written commun., 1995).

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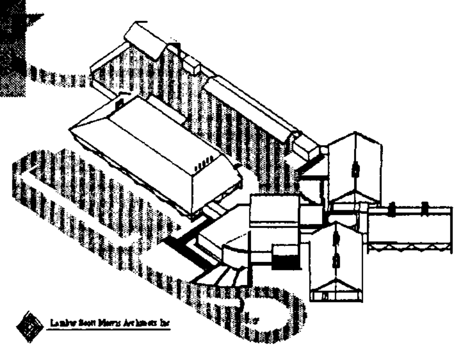
***Table 5.**—Volatile organic compounds and pesticides detected in samples of shallow ground water from the transboundary region of the Abbotsford-Sumas Aquifer, February 1997*

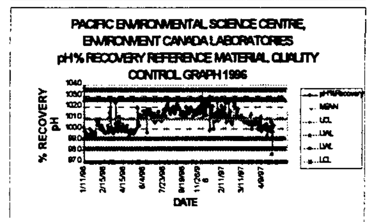
[E, indicates some quantitative uncertainty and thus the value is flagged as estimated; V, indicates potential bias in environmental sample based on quality control data associated with environmental samples. All concentrations in micrograms per liter; µg/L, micrograms per liter; --, constituent not detected]

Organic compound	Reporting level (µg/L)	Pre-trip blank	91-15	91-15	91-13	FT1-24	ABB2	ABB4	ABB5	BCME B-20	LEH 15-18	SHORT ROAD -29	Post-trip blank
Trichlorfluoromethane	0.1	--	0.20	0.19	E.03	--	--	--	--	--	--	--	--
Carbon disulfide	0.05	E.02	--	--	--	--	--	--	--	E.005	E.007	--	--
1,1 Dichloro ethane	0.05	--	--	--	E.07	--	--	--	--	--	--	--	--
Methyl tert-butyl ether	0.1	--	E.09	E.09	--	E0.01	--	--	--	--	--	--	--
Chloroform	0.05	E.01	E.01	E.01	E.02	--	--	E.02	--	--	--	--	--
1,1,1 Trichloro ethane	0.05	--	E.04	E.04	0.54	--	0.14	E.009	--	--	--	--	--
Trichloroethylene	0.05	--	--	E.005	--	--	--	--	--	--	--	--	--
1,2 Dichlorpropane	0.05	--	E.06	E.07	0.11	E.04	0.15	0.14	0.24	0.48	0.37	--	--
trans- 1,3 Dichloropropene	0.1	--	--	--	--	--	--	--	--	--	E.03	--	--
cis- 1,3 Dichloroproene	0.1	--	--	--	--	--	--	--	--	--	E.02	--	--
1,3 Dichloropropane	0.05	--	--	--	--	--	--	--	--	E.08	E.05	--	--
1,2,3 Trichloropropane	0.02	--	--	--	--	--	--	--	--	0.13	E.07	--	--
Tetrachloro ethylene	0.05	--	--	--	--	--	E.01	--	--	--	--	--	--
meta & para Xylene	0.05	--	--	--	--	--	--	--	--	--	E.007	--	--
1,2 Dibromochloropropane	0.5	--	E.07	E.07	--	--	--	--	--	--	--	--	--
Atrazine	0.001	--	E.004	E.004	--	E.006	--	--	--	E.002	--	--	--
Carbofuran	0.12	--	--	E.002	--	--	--	--	--	--	--	--	--
Deethyl atrizine	0.002	--	E.006	E.006	--	E.005	--	--	--	E.004	--	--	--
Dinoseb	0.035	--	0.06	0.06	--	--	--	--	--	--	--	--	--
Napropamide	0.003	--	0.011	0.011	--	--	--	--	--	--	--	--	--
Oxamyl	0.018	--	0.41	0.45	--	--	--	1.2	--	0.45	23	--	--
Simazine	0.005	--	0.084	0.082	--	--	--	--	--	0.021	0.021	--	--
Tebuthiuron	0.01	--	V.012	V.012	--	--	--	--	--	--	--	--	--
COMPOUNDS DETECTED IN SAMPLE WATER MOST LIKELY THE RESULT OF SAMPLING OR ANALYTICAL ARTIFACTS													
Acetone	5.0	E5	--	--	--	VE1.1	VE1.0	--	VE0.8	--	VE0.6	--	E1.
Toluene	0.05	--*	VE.03	VE.03	VE.04	VE.02	VE.03	VE.03	VE.03	VE.01	VE.03	VE.01	E.07
1,1,2-Trichloro-1,2,2-triflouroethane (CFC-113)	0.05	0.12	VE.006	--	VE.01	VE.01	VE.01	VE.02	--	--	--	VE.02	E.04
1,2,4-Trimethyl Benzene	0.05	0.18	V.25	V.37	V.52	V.25	V.20	V.1	V.30	V.29	V.44	V.27	0.35

*Toluene was reported at 0.005 in both laboratory procedure blanks associated with this sample and thus not estimated below the detection level.

Pacific Environmental Science Centre Laboratory Quality Assurance /Quality Control





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- **QC - Quality Control** - is the planned system of activities whose purpose is to provide a quality product (Results).
- **QA - Quality Assurance** - is the planned system of activities whose purpose is to ensure that the quality control program is actually effective.

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- CAEAL - Canadian Association for Environmental Analytical Laboratories.
- SCC - Standard Council of Canada

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LABORATORY PROCEDURES TO DETERMINE QUALITY CONTROL

QC-------------------------->QA------------------------->QM----------------->Accreditation/ Certification

|<-----------------------------|<------------------------------|<--------------------------------|

Quality Control Bench Top	**Documentation Administrative**	**Quality Management**	**Recognition of Quality**
Technologist	**Quality Assurance Officer**	**Responsibility**	**CAEAL**

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LABORATORY PROCEDURES TO DETERMINE QUALITY CONTROL

1. STANDARD REFERENCE MATERIAL
2. BLANKS
3. REPLICATE ANALYSIS
4. SPIKING AND RECOVERY STUDIES
5. QUALITY CONTROL CHARTS
6. INTER-PARAMETER CHECKS

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1. STANDARD REFERENCE MATERIAL

- The use of Standard Reference Material and Certified Reference Materials involves recovery studies on prepared test samples of each type of substrate routinely analyzed by a laboratory.
- Each analyst conducting routine analyses will record recovery results on a table or control chart available for examination by the supervisor, QA Officer or for that matter, lab auditors and clients.
- This helps analyst to take corrective actions before problems occur and erroneous data are reported out of the lab.

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2. BLANKS

- **BLANK** - a response which occurs in the end measurement in the absence of analyte derived from sample.

- **INSTRUMENT BLANK** - determined by measuring the response when the instrument is operating normally but no sample is present.
- - gives valuable information on instrumental deterioration or memory effects.

- **CALIBRATION BLANK** - depend on the chemicals used to make up standards/reagents.
  - used as a potential source of calibration bias.

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2. BLANKS

- **REAGENT BLANK** - determine the background or blank of each of the reagents.

- **METHOD BLANK** - used for the estimation of the detection limit (not in all cases) and overall error in a blank corrected result.

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INSTRUMENTAL DETECTION LIMIT (IDL)

- IDL = 1.645 x Std Dev
- Std Dev = standard deviation of the blank analyses.
- 5 times the signal to noise ratio.

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LOWER LIMIT OF DETECTION

- LLD = (t) x (Std Dev)
- t = Student's t value for a 99% confidence level and a standard deviation estimate with n-1 degrees of freedom [t = 3.29].
- Std Dev = standard deviation of the standards analyses.

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METHOD DETECTION LIMIT

- *MDL = (3.14) x (Std Dev)*

- *Std Dev = standard deviation of 7 replicate sample analyses*

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3. REPLICATE ANALYSIS

- **Replicate analysis** is the most commonly one used. More value could be derived if you conducted the replicate on different days. Replicate provide a measure of results validation but should not be used as the only form of results validation.

- **Check analysis** can be used as a means of result validation. Ideally, check analysis would involve analysis by a different analyst using a different method, but this is not always practical.

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4. SPIKING AND RECOVERY STUDIES

- **SPIKING (or Standard Addition)** is the addition of a known amount of standard to a sample or blank before extraction or analysis. The spiked samples are then processed and analyzed in the same manner as a regular sample. The percent recovery is then determined.

- **LAB MATRIX SPIKE** is a sample created by spiking target analytes into a portion of a sample which is received in the laboratory. This provides an estimate of bias based on recovery; includes matrix effects associated with sample preparation and analysis only.

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5. QUALITY CONTROL CHARTS

- Provides a graphic assessment of accuracy and precision for the analysis of each substrate and instant detection or erroneous data.

- The chart allow quick and easy observation of recovery trends for a particular analysis and have long term value for the self-evaluation of analytical output by staff personnel.

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NAME	VALUE	SENT	Sample ID	Date	Batch ID	Analyst	Fe Value
Sample State:		FW		2-Jan-96	601021	ma	1.95
Sample Descripton:GE				2-Jan-96	601022	ma	2.02
Sample Class:		REF		3-Jan-96	601031	ma	2.00
				4-Jan-96	601041	ma	2.01
Sample Comment				4-Jan-96	601042	ma	2.00
Agency	EC			9-Jan-96	601091	ma	2.00
Method	X170			9-Jan-96	601091	ma	1.99
Filter Size				10-Jan-96	601101	ma	1.99
Units	1			10-Jan-96	601102	ma	1.98
				11-Jan-96	601111	ma	2.01
Batch ID extention:		.ICP		11-Jan-96	601112	ma	1.99
nb_param:	13			15-Jan-96	601151	ma	2.02
Param_codes:		CA-D		15-Jan-96	601152	ma	2.01
CD-D				17-Jan-96	601171	ma	2.00
CO-D				18-Jan-96	601181	ma	2.00
CR-D				18-Jan-96	601182	ma	2.02
CU-D				19-Jan-96	601191	ma	2.01
FE-D				23-Jan-96	601231	ma	2.00
MG-D				24-Jan-96	601241	ma	1.99
MN-D				25-Jan-96	601251	ma	2.00

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- **Mean**- represents the control limit (mean or target value of reference material).
- **LWL** - lower warning limit is the mean minus 2 standard deviations (95% Confidence Limit).
- **UWL** - upper warning limit, mean plus 2 standard deviations (95% Confidence Limit).
- **LCL** - lower control limit, mean minus 3 standard deviations (99% Confidence Limit).
- **UCL** - Upper control limit, mean plus 3 standard deviations (99% Confidence Limit).

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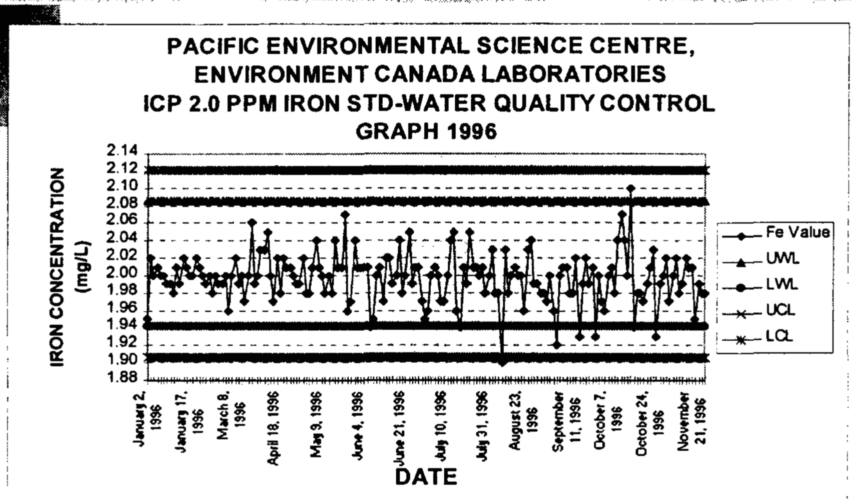

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CHART ASSESSMENT

- *Control Limit: if 1 measure exceeds a CL, repeat analysis, if repeat is within control limit, continue analysis, otherwise stop and correct the problem.*
- *Warning Limit: if 2 out of 3 successive points exceed a warning limit, analyze another sample, if repeat is less than the WL, continue analysis, otherwise stop and correct the problem.*
- *Standard Deviation: If 4 out of 5 successive points exceed 1 s, or are in decreasing or increasing order, analyze another sample, otherwise stop and correct the problem.*

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CHART ASSESSMENT

- *Central Line: if 6 successive samples are above the central line (reference point), analyze another sample.*
  - *if the point is below the central line, continue the analysis.*
  - *if next point is on the same side of central line, stop and correct the problem.*

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SYMPTOMS SEEN ON CONTROL CHART

SYMPTOM	**COMMON CAUSES**
1. Shift in mean	a) Incorrect preparation of standard. b) Incorrect preparation of reagents. c) Contamination of sample. d) Incorrect instrument calibration. e) Analyst error.

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SYMPTOM	COMMON CAUSES
2. Trend of mean upward	a) Deterioration of standard. b) Deterioration of reagents.
3. Trend of mean downward	a) Concentration of standard due to evaporation of solvent. b) Deterioration of reagents.
4. Increase in variability	a) Analyst performance such as poor technique, lack of training, deviation from procedure. b) Instrumentation performance

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6. INTER-PARAMETER CHECKS

METALS QC CHECKS

- Dissolved metal less than Extractable.
- Dissolved metal less than Total.
- Extractable metal less than Total.
- Methyl-Mercury less than Total Mercury.

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INORGANIC QC CHECKS

- Cation/Anion Balance.
- Conductance Check - Conductance vs Dissolved Solids
  - using factor 0.5 to 0.9 (depends on sample).
  - Conductance vs Constituents.
- Partials vs Totals (eg. TDN< TN).

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ORGANIC QC CHECKS

- Dissolved less than Total Carbon
- Hydrocarbon less than Oil & Greases.
- Chloroanisoles less than Chlorophenols.

- If a failure occurs a QA failure report is issued

Soil and Sediment Toxicological Testing
The Forgotten Media

G.C. van Aggelen
Associate Section Head-Toxicology
Pacific Environmental Science Center

Sediments are an integral part of fresh and marine water ecosystems. Their origin stems from the differential settlings of both suspended particles that have been introduced into aquatic systems or by precipitates that have resulted from chemical and biological processes within aquatic systems. Suspended particles entering the aquatic system may already contain contaminants. Alternately, non-contaminated particles suspended in water may accumulate soluble contaminants present in the water. Precipitation processes are also capable of scavenging contaminants. As a result, sediments are often viewed as either a reservoir (e.g. source) or a sink for contaminants in either marine or freshwater systems. In some areas on Canada and more specifically in B.C., sediment contaminant levels have reached levels that are detrimental to benthic life.
As a result of these concerns Environment Canada has developed a number of methods to measure the health and integrity of aquatic sediments.
A review and application of fresh and marine water "tools" will be presented

Terrestrial Testing

To a large extent terrestrial toxicology is a section of the environment that has been overlooked in the past decade. Within the last five years this field has seen considerable attention and resources focused on it. However, it is only now standardized methods are being developed. Much of the science is being driving by the Europeans and work supported by Environment Canada and the CCME. An account of the state of the science will be discussed with a focus on Petroleum Hydrocarbon contaminated soils.

Soil and Sediment Toxicological Testing

- Sediments are an integral part of fresh and marine water ecosystems
- originate from differential settlings of both suspended particles or by precipitates that have resulted from chemical and biological processes
- they may already contain contaminants or may accumulate soluble contaminants from the water column (scavenging)

Soil and Sediment Toxicity

- Sediments can and will be viewed as either a reservoir (source) or a sink for contaminants. (bioavailable=bioconcentrated)
- Historical build up of depositions from agricultural, atmospheric, municipal and industrial sources in rivers, lakes, estuaries and oceans can reach levels that are detrimental to benthic life

Types of Organisms

Freshwater Organisms

- Hyalella azteca- common to Pacific North west, Ed Bousfield identified several local areas. Original population collected from UBC Research forest 1986 (gvA). EPA/Burlington cultures added 1994.
- PESC is national source for cultures
- animals can be acclimated to 20 ppt salinity
-

Organisms

- Chironomus tentans/riparius (Diptera)
- Tentans used at PESC, commonly found.
- Easy to culture,
- 2nd Instar stage used for test.
- Ecology relevant

Microtox Solid Phase Test

- bacterial test
- solid phase
-

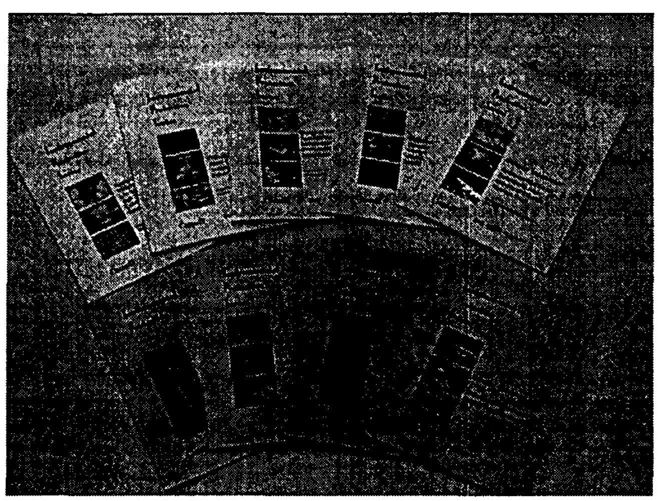
Organisms-Marine

- Various Amphipod species mainly Eohaustorius species
- E. washingtonianus- 25-27 ppt salinity common to BC. Grain size sensitive
- E. estuarius- 0-25ppt. Not as common; Long Beach area. Fine sediment preference
- Rhepoxynius abronius
- - common in USA
- no local populations known.

Advantages and Disadvantages for use of Sediment Tests

Advantages

- measure bioavailable fraction of contaminant(s)
- provide a direct measure of benthic effects, assuming no field adaptation or amelioration of effects
- limited special equipment is required
- methods are rapid and inexpensive
- legal and scientific precedence exist for use.



Advantages

- Measures unique information relative to chemical analysis or benthic community analyses
- tests with spiked chemicals provide data on cause-effect relationships
- sediment-toxicity tests can be applied to all chemicals of concern

Advantages

- Tests applied to field samples reflect cumulative effects of contaminants and contaminant interactions
- Toxicity tests are amenable to field validation
- Environment Canada Methods:

1/RM/33-Hyalella azteca

1/RM/32-Chironomus tentans

1/RM/26 -Marine and Estuarine Amphipods.

Disadvantages

- Sediment collection, handling, and storage may alter bioavailability
- Spiked sediments may not be representative of field contaminated sediment
- Natural geochemical characteristics of sediment may affect the response of test organism
- Indigenous animals may be presents in field-collected sediments

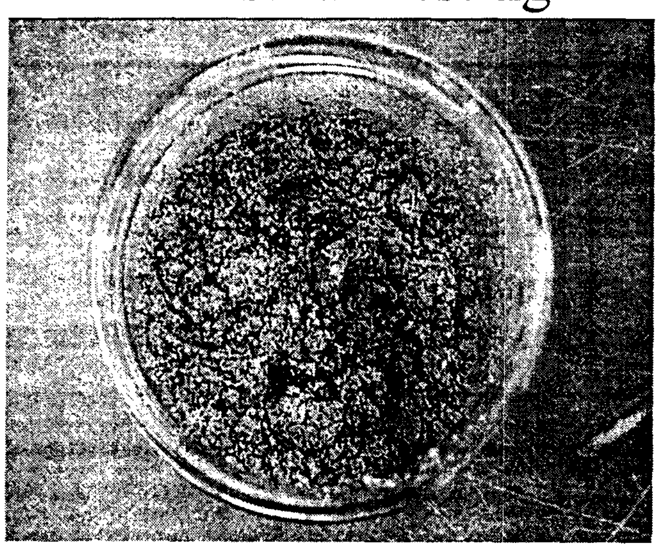
Disadvantages

- Route of exposure may be uncertain and data generated in sediment toxicity tests may be difficult to interpret if factors controlling the bioavailability of contaminants in sediments is unknown
- Tests applied to field samples may not discriminate effects of individual chemicals
- Only a few chronic methods for measuring sublethal effects have been developed or extensively evaluated

Examples of Use

- Ocean Disposal Regulation requires material slated for ocean disposal must be tested(dredge spoils)
- Environmental assessment of aquaculture on benthic habitat
- Impact assessment of sediments at depositional zones from industrial activities
- sediment quality criteria objectives
- sediment triad approach (Chapman 85)

Terrestrial Testing



Terrestrial Testing

- Main focus is looking at contaminated soil (petroleum Hydrocarbons) . Canada wide Standard Agreement -CCME Jan 1998.
- Usual suite of tests includes: plant (cereal and garden) growth and root elongation, and worm test.
- TPH-National Guidelines largely fueling directions in which Canadian science will take and what methods are adopted
-

Terrestrial Testing

- Environment Canada (PESC) and CCME looking into standardizing methods
- acute earthworm toxicity test using Eisenia foetida (mortality endpoint) U. of Guelph
- a seed germination, early seedling growth test. (seedling emergence, growth endpoint)
- Canola, Alfalfa, northern wheat grass lettuce and radish seeds main focus

Soil Testing

- PESC currently has capabilities for 7-day earthworm testing; E. foetida
- Eisena will be Rainbow trout for soil
- easy to culture
- respond well reference toxicants
- documented methods (OECD 19984, ISO, 1991, ASTM, 1995, E 1676-95)

Soil Testing

- Plant testing divided into to phases:

  1. Solid (direct soil contact)

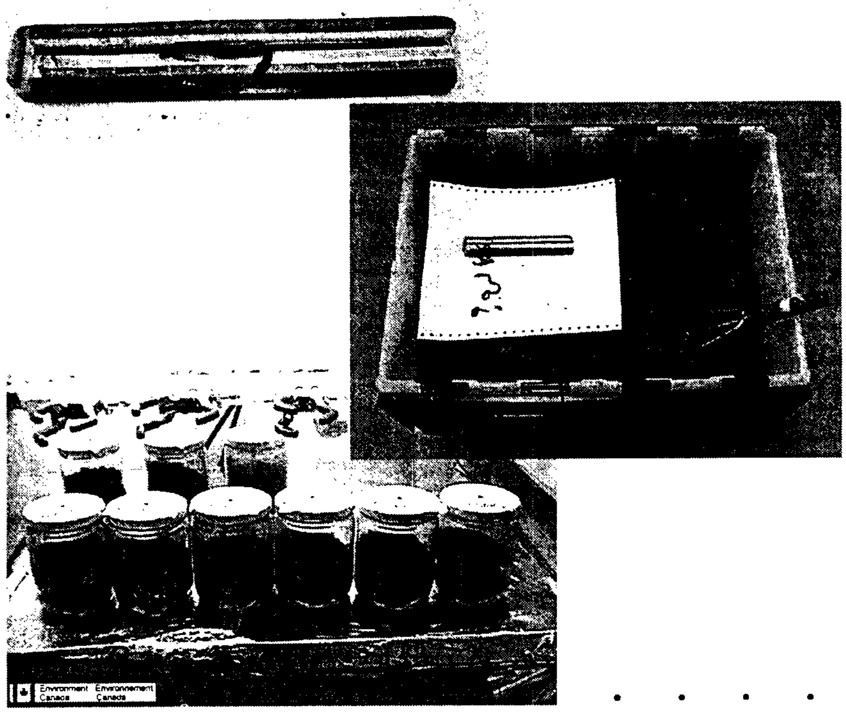
  Solid Phase follows ASTM guide E1598-94

  Standard Practice for Conducting Early Seedling growth.

- 2. Liquid Phase (water soluble fraction) lettuce seed/radish

  EPA/600/3-88

  B. Dutka-ENV. Canada



Environment Canada Environnement Canada

Environment Canada Environnement Canada

Exposure of California Quail to organophosphorus insecticides in apple orchards in the Okanagan Valley, British Columbia. Wilson, LK, P. Martin, J. Elliott, P. Mineau, K. Cheng

California quail (*Callipepla californica*) (n=25) were radio-tagged in an apple orchard during early spring, 1992-93. The orchard was situated in the south Okanagan Valley near Penticton, British Columbia, Canada. Birds were located throughout the summer to determine use of orchards and to detect changes in use patterns resulting from spraying of organophosphorus (OP) insecticides azinphos-methyl and diazinon. Plasma (n = 65) samples were collected from 53 individuals prior to spraying, immediately (< 24 hours), and 10 days after each of three insecticide spray events, and plasma cholinesterase (p-ChE) was measured. Quail use of orchards varied over the summer, with the highest use occurring in May, declining to very low use by July. Quail roosted in sparsely forested uplands at night, traveled into orchard areas to feed early each morning, and returned to roosts at dusk. During the day, quail were regularly observed in orchards, but preferred the orchard periphery or wooded upland habitat. Spraying of orchards occurred in the early morning, and while 14-20% of quail detections were in the orchards within 3 h of spraying, they quickly declined to <4%. However, by the next day, quail use of the orchard had rebounded. Mean p-ChE declined significantly ($p<0.05$, n=12) to 60% of pre-spray mean activity (controls) immediately following the first spray event, but by ten days had recovered to 86% of mean control activity. Subsequent spray events caused no significant declines in p-ChE activity. Mean values continued to increase throughout the season; by ten days following the third spray, mean activity was slightly greater than control values.

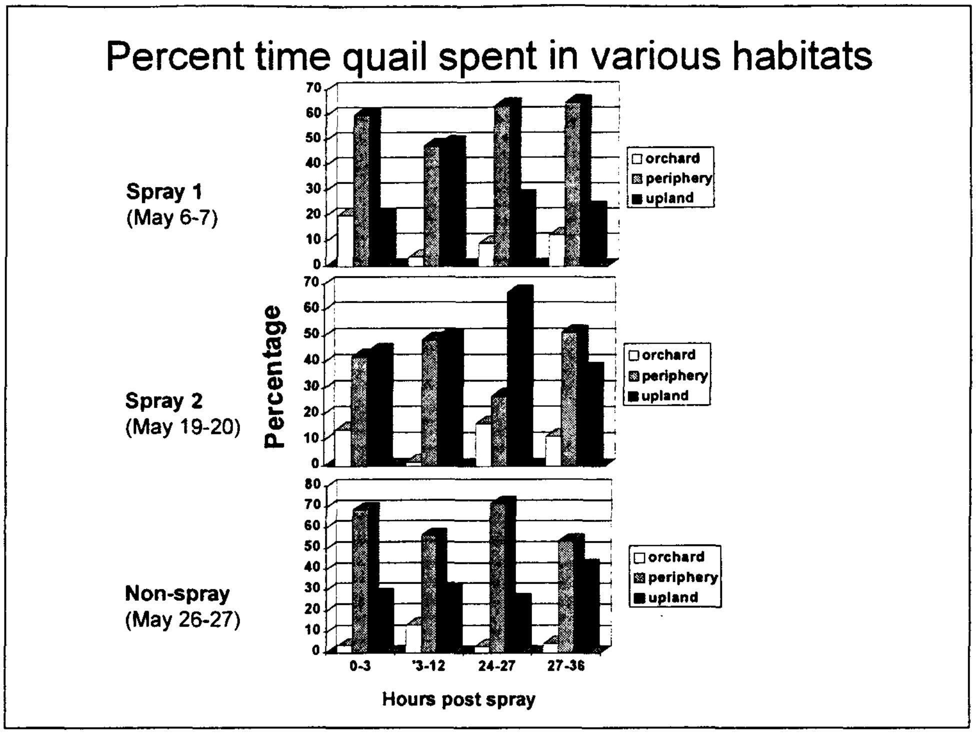
Reference:
Wilson, LK, P. Martin. J. Elliott, P. Mineau, K. Cheng. Exposure of California Quail to organophosphorus insecticides in apple orchards in the Okanagan Valley, British Columbia. Ecotoxicology. Submitted.

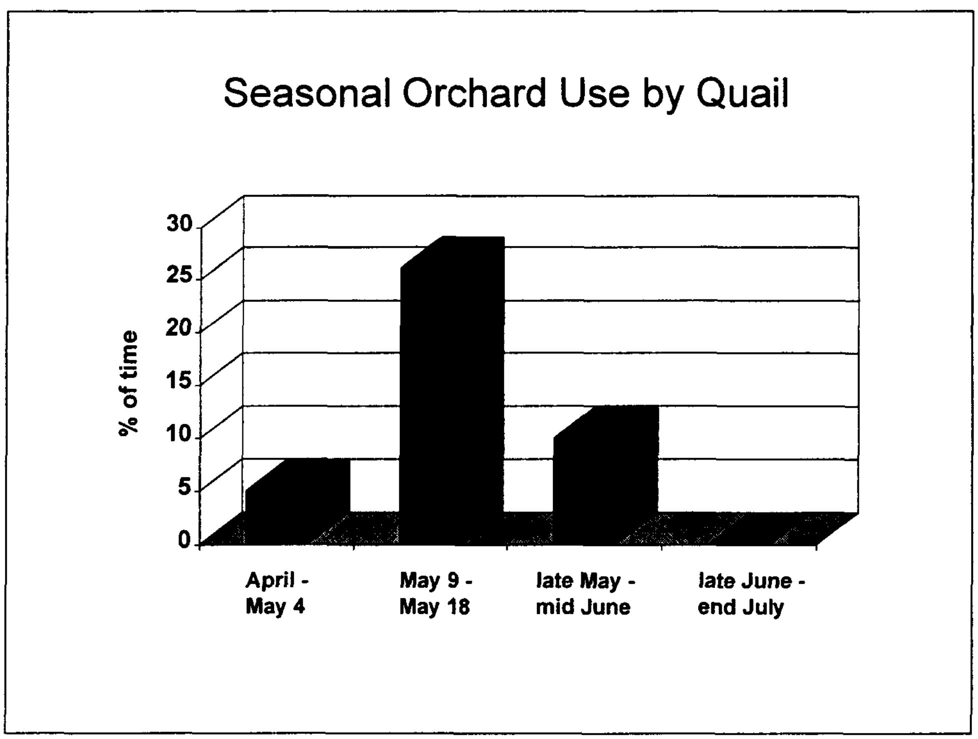
Exposure of California Quail to organophosphorus insecticides in apple orchards in the Okanagan Valley, British Columbia

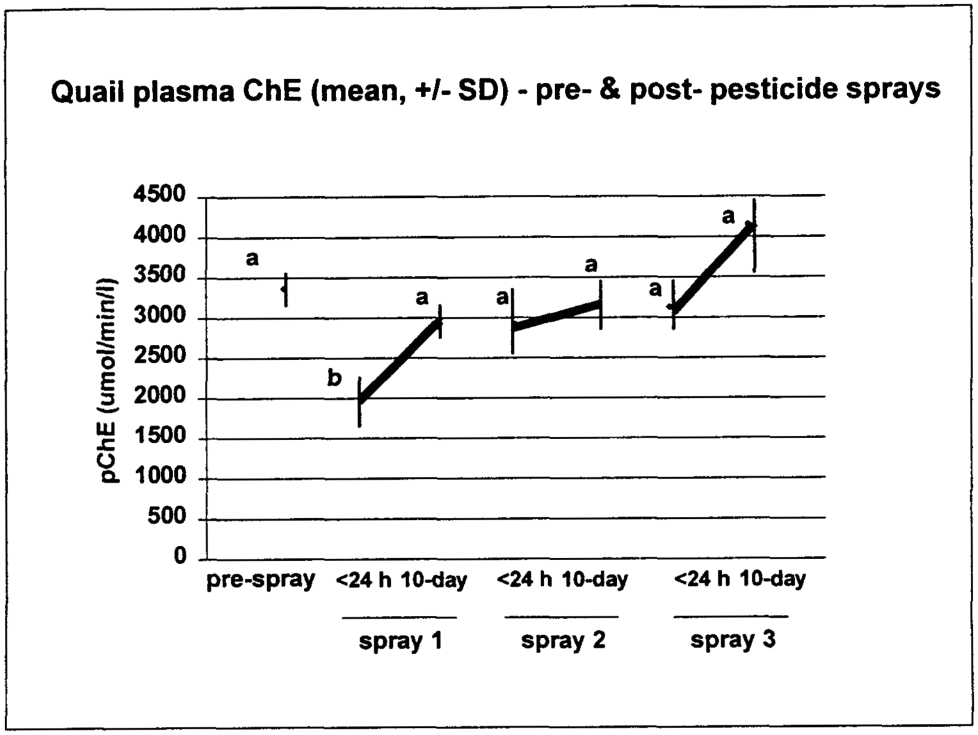
Laurie Wilson, John Elliott - CWS, Delta
Pierre Mineau - CWS, Ottawa
Kim Cheng - UBC

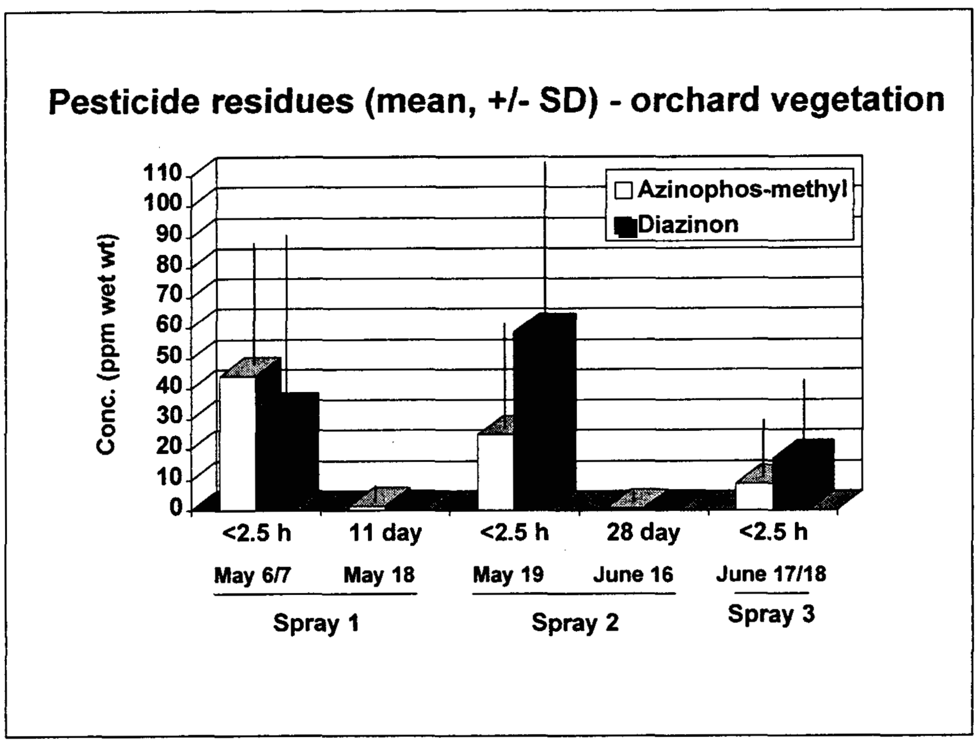
Methods

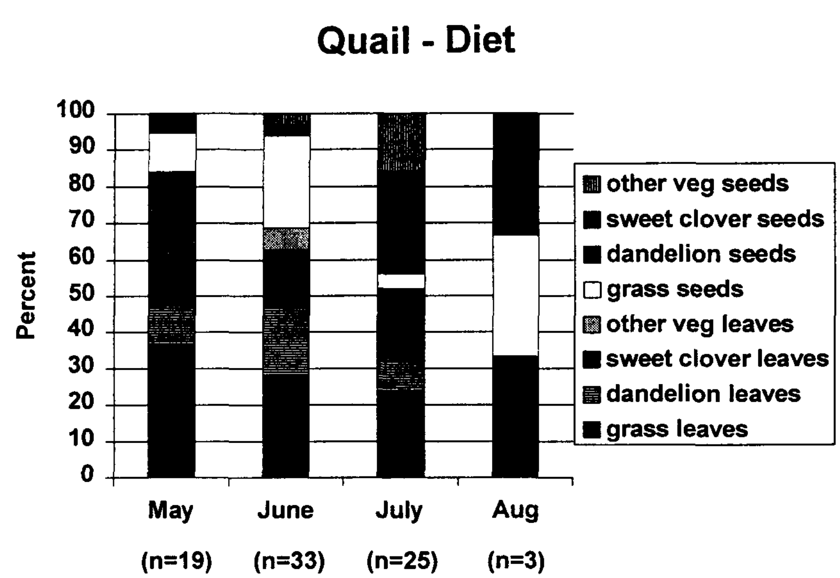
- Quail movements
  - 25 quail equipped with radio transmitters (2.9g) & located regularly (more intensively during spray periods)
- Pesticide exposure
  - plasma cholinesterase measured prior to spray, <24h post-spray & 10-day post spray (3 spray events)
- Pesticide residues
  – orchard vegetation collected for residue analysis
- Dietary observations
  - opportunistically


Percent time quail spent in various habitats
Spray 1
(May 6-7)
Spray 2
(May 19-20)
Non-spray
(May 26-27)
Percentage
orchard
periphery
upland
0-3
3-12
24-27
27-36
Hours post spray


Seasonal Orchard Use by Quail
% of time
April -
May 4
May 9 -
May 18
late May -
mid June
late June -
end July


Quail plasma ChE (mean, +/- SD) - pre- & post- pesticide sprays
pChE (umol/min/l)
4500
4000
3500
3000
2500
2000
1500
1000
500
0
a
b
a
a
a
a
a
pre-spray
<24 h 10-day
<24 h 10-day
<24 h 10-day
spray 1
spray 2
spray 3


Pesticide residues (mean, +/- SD) - orchard vegetation
Conc. (ppm wet wt)
110
100
90
80
70
60
50
40
30
20
10
0
Azinophos-methyl
Diazinon
<2.5 h
11 day
<2.5 h
28 day
<2.5 h
May 6/7
May 18
May 19
June 16
June 17/18
Spray 1
Spray 2
Spray 3



Summary

- orchard use
  - no significant difference pre/post pesticide sprays
  - seasonal changes strongly evident (intensively used early spring, less used by late summer)
- plasma ChE
  - significantly lower (40%) immediately after 1st spray but recovered by 10-days post spray
  - no reduction after 2nd & 3rd sprays
- grass pesticide residues
  - highly variable coverage; residues breakdown quickly
- dietary observations
  - initially grasses, switching to seeds

Nitrate Levels in Clayburn Creek in Relation to Rainfall - An Indicator of Potential Windows for Pesticide Monitoring?

George Derksen and Beverley Locken

Background

During the Fraser River Action Plan, farm surveys were conducted in 1994 and 1997, in the Clayburn Creek watershed located in North Matsqui (City of Abbotsford). To augment this work, the Ministry of Environment, Lands and Parks conducted water quality surveys. Weekly water quality monitoring occurred during two periods (October-November and February-March) which were of primary interest from a manure/nutrient management perspective. The goal in the Lower Fraser Valley is to work towards eliminating the practice of applying manure to bare ground (usually on silage corn fields after harvesting) in the late-fall and/or on forage grass between November and February.

The manure contribution of N/P in the watershed was about 60% dairy and 20% each for poultry and swine. The median dairy manure application rate (kg N/ha/yr) was 207 kg in 1994 and 191 kg in 1997. Both manure-N/P and fertilizer-N/P use were estimated in 1997 on dairy farms. Over the dairy landbase it was estimated approximately 41% of the farms were applying nitrogen above 350 kg N/ha (limit for forage grass N uptake). Fertilizer was the main N source. Ninety-seven percent of dairy farms were applying phosphorus above the application rate of 100 kg P_2O_5/ha. Manure was the main P source.

In soil, nitrogen is highly mobile and quickly leached whereas phosphorus is generally considered to be less mobile (unless soils are P saturated) and retained in the soil and would be lost largely through erosion processes. Various pesticides depending on their soil particle absorption and water solubility may more closely follow the nitrate pathway or phosphorus pathway. Therefore, it might be of interest to see how nutrient levels vary in a stream relative to rainfall events. Unfortunately, in the Lower Mainland, little is known about the time-of-travel and retention time of runoff in the lowland, flood-gated streams like Clayburn Creek.

Results

Results for cumulative rainfall at Abbotsford Airport showed higher rainfall in fall 1995 (~600mm, Figure 1) *vs* 1994 (~400mm) and higher rainfall in winter 1995 (~300 mm, Figure 2) vs 1996 (~200 mm).

Nitrate levels a three water quality sites within the watershed were summarized. Station 1 (S1) was an upstream "control" draining an urbanized area, Station 2 (S2) was an upstream control draining an undeveloped forested area and Station 4 (S4) was located in the lower section of the watershed.

In both fall 1994 (Figure 3) and 1995(Figure 4) nitrate levels at Site 4 dramatically increased in apparent response to the earlier seasonally large rain events. Later in the fall, the nitrate response was less obvious. The larger fall peaks in nitrate at S4 were not as apparent in the winter period (Figures 5 and 6).

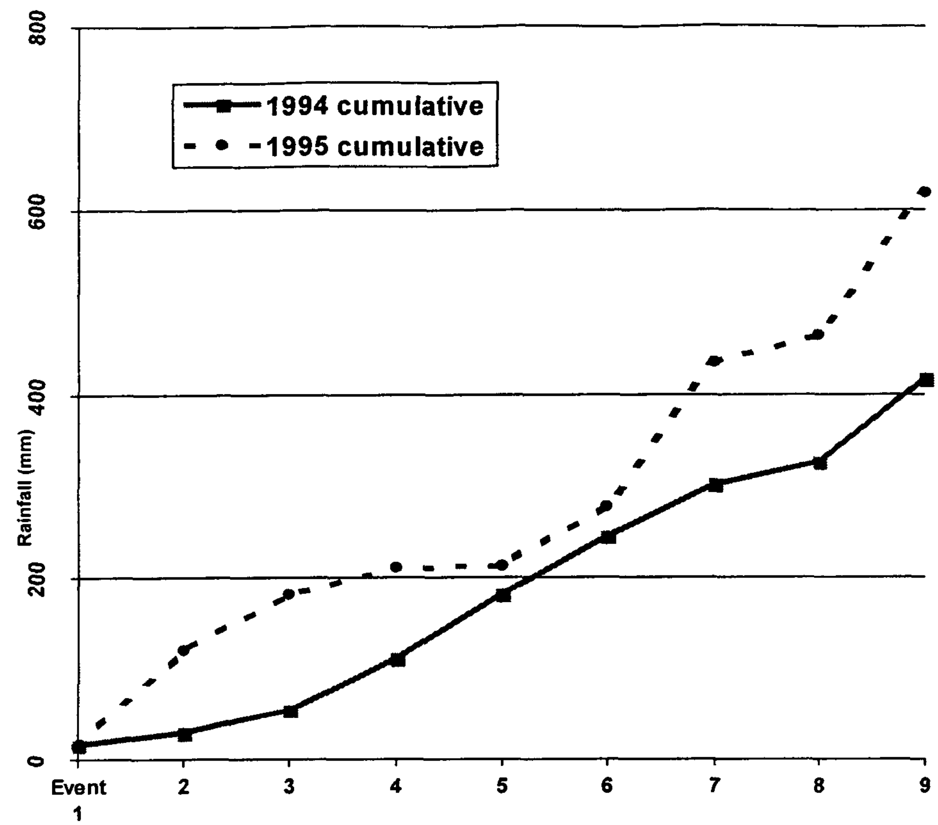


Figure 1: October and November Cumulative Rainfall Over Sample Period

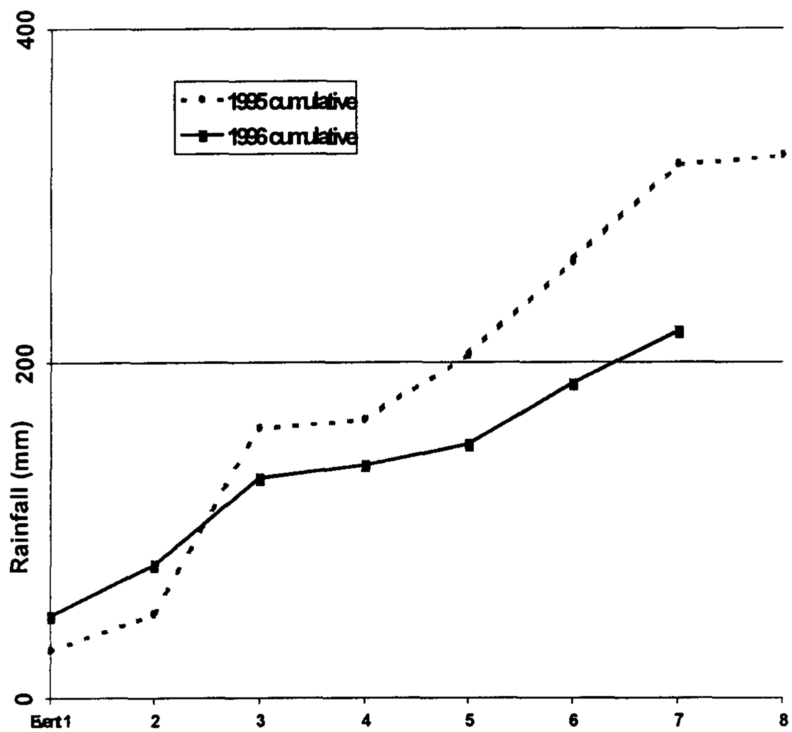


Figure 2: February and March Cumulative Rainfall Over Sample Period

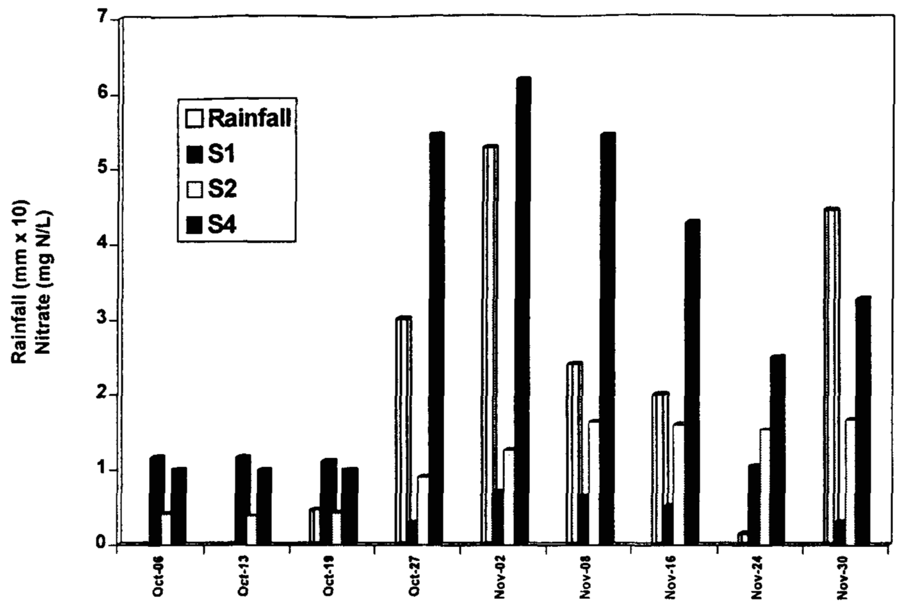


Figure 3: Clayburn Creek - 1994 Fall Nitrate vs Preceding Two Days Total Rainfall

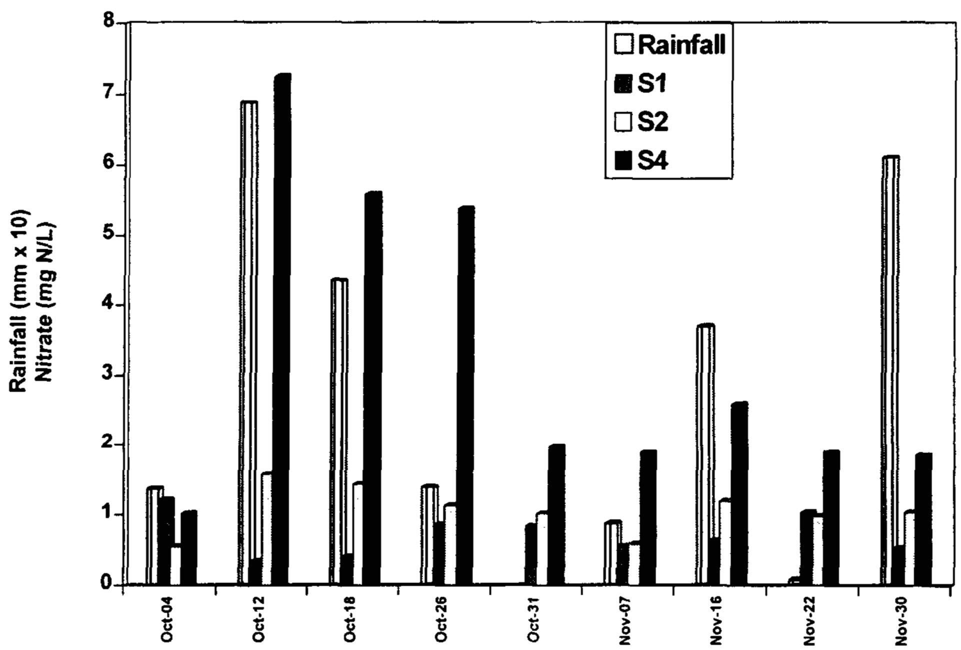


Figure 4: Clayburn Creek - 1995 Fall Nitrate vs Preceding Two Days Total Rainfall

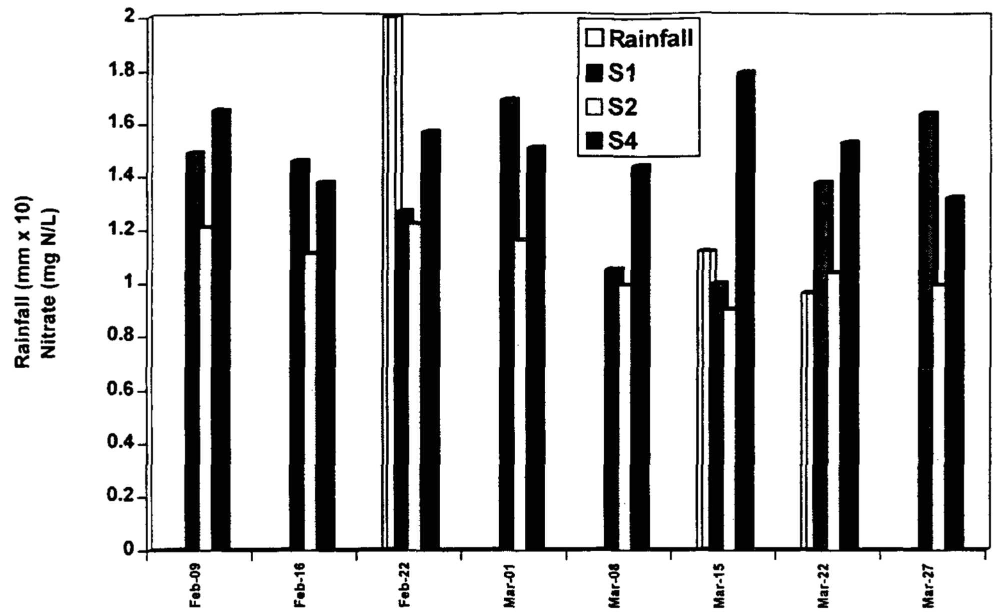


Figure 5: Clayburn Creek - 1995 Winter Nitrate vs Preceding Two Days Total Rainfall

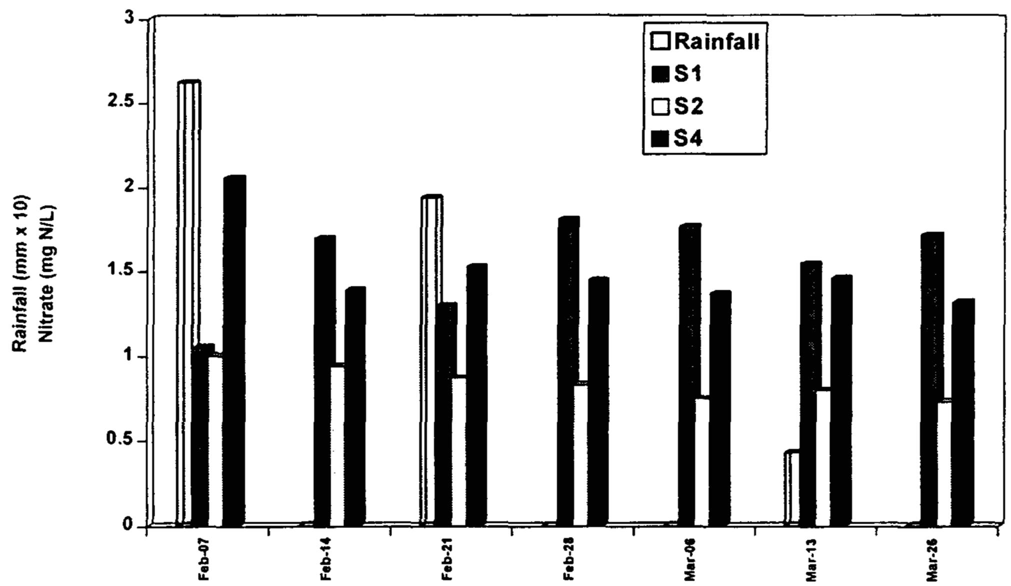


Figure 6: Clayburn Creek - 1996 Winter Nitrate vs Preceding Two Days Total Rainfall

Pesticides Assessment and the Use of TOMES Plus CD ROM

John Pasternak

A presentation of the TOMES Plus system will be given with a focus on applications relevant to pesticides assessment. The TOMES Plus system is composed of a variety of chemical and environmental databases allowing quick retrieval of chemical data relevant to physical properties, environmental fate, exposure potential, monitoring and analytical methods, human and animal toxicity, handling guidelines, and occupational health and safety. The database is perfect for use with pesticide evaluation, environmental emergencies, and research applications requiring immediate access to chemical specific information. For chemical risk assessment applications, it's a good database to start your research. Currently, the CD ROM is licensed for use at one workstation. This workstation is located at the Environmental Protection Library on the 4th floor, 224 West Esplanade, but consideration would be given to a multiple-user license and adding workstations at Airport Square, CWS and PESC if there is sufficient interest. The total cost for the renewal of a single workstation license is $2,079.00 US (or approximately $3,243.24 CNDN, assuming 1.56 exchange). The renewal is due December 5th. Financial contribution for the subscription will be sought from those interested in using the CD ROM in the future.

Pesticides Assessment & TOMES

Toxicology, Occupational Med. & Environmental Series

Useful source of chemical data we may not have access to much longer.

What is it?

- broad collection of databases (governmental, private/proprietary) that have been assembled with a software interface to allow very quick and easy retrieval of a large amount of chemical data.
- In total 120,000 chemicals with 1.2 million synonyms
- the data usually published and always peer reviewed
- chemical identification, manufacturing and formulations
- chemical and physical properties
- environmental fate analysis and monitoring
- toxicology
- emergency and spill response information (both Canadian and U.S.)
- occupational health (MSDS)

TOMES Databases

- **CHRIS (Chemical Hazard Response Information System)**
- **HSDB (Hazardous Substances Data Bank),.**
- **IRIS (Integrated Risk Information System).**
- **New Jersey Hazardous Substance Fact Sheets**
- **1996 North American Emergency Response Guidebook**
- **NIOSH Pocket Guide OHM/TADS (Oil and Hazardous Materials/Technical Assistance Data System)**
- **REPROTOX® System**
- **RTECS® (Registry of Toxic Effects of Chemical Substances)**
- **SHEPARD'S**
- **TERIS (The Teratogen Information System).**

Data Relevant to Pesticides Assessment

- Who are the manufacturers?
- What are the *formulations*, *purities* and rates of application?
- Chemical identification (formulas, CAS No., synonyms).
- Physical and Chemical Properties (state, colour, odour, melting/freezing/boiling point, viscosity, density, vapour pressure, solubilities, pK, pH, Kow, etc.)
- Environmental Monitoring (water, soil, sediment, air, biotic concentrations, volatilization potential, soil adsorption/mobility potential, persistence in different media, analytical methods)
- Toxicology (Aquatic vertibrate, invertebrates and plants, waterfowl; terrestrial plants and animals; and humans. Acute, *chronic, reproductive, carcinogenicity, genotoxicity and* mutagenicity).

Application to Pesticides Assessment

- *Clarification of formulation, purity and chemical identification*
- General level evaluation of environmental fate - review of physicochemical properties and processes of the parent compound and major transformation products. E.g., review of
  - vapour pressure and volatilization;
  - hydrolysis, photolysis;
  - solubility in water;
  - soil mobility and bioaccumulation potential.
- General level evaluation of toxicity. E.g., review of:
  - acute and chronic aquatic toxicology
  - acute and chronic toxicology of birds and animals.
- Use for pesticides and other chemicals for which data are required immediately
- Use to focus an assessment. E.g., What exposure pathway should I be most interested in when I conduct my comprehensive research? What receptors are potentially at risk?

Cost

			350.00
			080.00
			220.00

Action

- Demo version has been installed by Micromedex until December 4, 1998.
- For those interested, can get temporary access
- I am seeking interest and support for a 2 Location, 5 User license

Regional Pesticide Programs

Presented by Bryan Kelso, CCD, EPB

1. Picloram issue -

Currently, no data exists regarding the environmental impact on the use of Picloram in British Columbia. The persistence of Picloram in the environment may pose potential adverse effect to non-target organisms. In order to address this concern, two reports, "DOE Literature Review & Recommendation on Picloram" and "DOE Recommendation on Picloram Residues Monitoring in British Columbia" were prepared by Jen-ni Stroh and Mike Wan. Both reports are currently under review by the British Columbia Pesticide Control Committee.

2. Pest Management Plans (PMP) -

PMPs are being developed in order to replace the old Pesticide Use Permit Application system. PMPs are currently being developed for northern B.C. and Vancouver Island for the Forestry sectors. It is a 3-5 year pest management plan as opposed to the 1 year permit system. DOE had provided BCMOE a guideline which encompasses DOE requirements for the PMP.

3. Inspection -

BCMOE has cut back on the number of pesticide Inspections because of budget cuts. The inspections of forestry regarding pesticide applications in B.C. were funded through the BC Forestry Renewal Fund. With the help of the Fund, inspections were carried out by contractors hired by BCMOE. DOE Inspections did not carry out any inspections of pesticide applications for the years of 1997 and 1998.

4. Gypsy moth issue -

In April, 1998, the BC Environmental Appeal Board overturned the decision made by the Deputy Administrator, Pesticide Control Act, regarding the aerial application of Foray 48B on Vancouver Island. However, Oregon State has indicated they might implement quarantine measures on Vancouver Island's B.C. forest and lumber products. Should the decision be made to spray with Foray 48B in the Spring, an Order in Council of the B.C. Provincial cabinet would be required.