Organochlorinated Contaminants in Yukon Wood Frogs (*Rana sylvatica*)

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ABSTRACT

Contamination of Yukon wood frogs (*Rana sylvatica*) with DDT and metabolites, PCBs, chlorinated pesticides, and chlorinated benzenes was determined. Spatial trends in amphibian contamination was examined. DDE contamination was greatest in wood frogs from Hillcrest Marsh and Paddy's Pond. DDE contamination was also high in wood frogs from Watson Lake Airport, Watson Lake, and Wye Lake. DDE contamination was greatest in wood frogs from the area of Whitehorse. DDE was not detected in wood frogs 250 km distant from contaminated sites. Site contamination was due to historic DDT application for mosquito control, in contrast to southern Ontario where DDE contamination was due mainly to past DDT application during agricultural practices.

Golden Pond wood frogs were highly contaminated with PCBs. The source of PCBs was from road oiling for dust control with PCB contaminated oil. PCB concentrations in Golden Pond wood frogs exceed guidelines established for the protection of higher trophic level wildlife. PCB contamination at Golden Pond was greater than observed in some areas of southern Ontario.

Differences in DDE accumulation between terrestrial and aquatic frogs was observed. It was proposed that lack of effective chemical elimination mechanisms to water in terrestrial frogs was responsible for observed differences. Wood frog tadpoles and adults accumulated different amount of DDE. These differences were attributed to the terrestrial habit of adult wood frogs. Similar differences were not seen with Arochlor 1260. It was proposed that the relatively high hydrophobicity of Arochlor 1260 rendered chemical uptake from water in larval wood frogs a minor exposure route, and thus both adult and

larval wood frogs accumulate high K_{ow} compounds from similar sources. It was concluded that monitoring chemical contamination in the Yukon using wood frogs is effective when the physicochemical properties of target chemicals and the frog life stage are considered.

INTRODUCTION

DDT contamination has been identified and quantified in Yukon wood frogs (*Rana sylvatica*) (Whitley et al., 1996). Available information indicate that DDT contamination was due to historic use of DDT for mosquito control in areas human habitation. Records indicate that DDT use ceased in the Yukon in 1969, and DDT use was banned or severely restricted in North America since 1972 (Voldner and Li, 1995). The accumulation of DDT and metabolites in the environment, biomagnification in terrestrial and aquatic food-webs, and deleterious effects on non-target organisms are negative consequences of long-term persistence of DDT.

DDT was released to the commercial market in 1945, was first used in agriculture in 1946, and reached peak production in 1963, when 81,154 tonnes were produced. It is estimated that 2,600,000 tonnes of DDT were used world-wide between 1950 and 1993 (Voldner and Li, 1995). DDT is still used as a broad-spectrum insecticide in developing countries (Matthiessen, 1985; Ramesh et al., 1991). Physicochemical properties of DDT and its metabolites result in uptake of these compounds by organisms. Low water solubilities and high lipid solubilities of DDT and metabolites lead to retention in lipid tissues of terrestrial and aquatic biota. The high retention of DDT and metabolites can result in toxic effects that are remote in time and space from the point of exposure (Russell et al, 1995a; WHO, 1989). These chemicals are accumulated from the surrounding medium and from diet. Terrestrial organisms accumulate DDT and metabolites primarily from dietary items while water is generally the most important source of DDTs in aquatic biota. Higher trophic level organisms tend to accumulate more DDTs than lower trophic in grebes (Forsyth et al., 1994), peregrine falcons (Hartley et al., 1995), and bald eagles (Anthony et al., 1993; Wiemeyer et al., 1993). DDE was implicated in reproductive failure in a population of prairie falcons (Jarman et al., 1996). Guillette et al. (1996) associated DDT contamination in a Florida lake with reduced penis size in American alligators. Short term dietary exposure to large amounts of DDT resulted in neurological damage in laboratory mammals while similar long term exposure resulted in liver dysfunction and liver cancer (ATSDR, 1994). Deleterious reproductive effects have occurred at low dietary dosages of DDT in laboratory animals.

Adverse effects of PCBs, DDT and metabolites, and related compounds may be associated with their structural similarity to estrogen, and thus, interaction with estrogen receptors (Bitman and Cecil, 1970), resulting in modification of development and reproduction. PCBs have been implicated in reproductive failure in mink (Aulerich et al., 1985). It is often assumed that tissue concentrations of toxicants below detection limits are safe (Korach, 1993), however, endocrine disrupting agents can have effects on biota at tissue concentrations below analytical detection limits (Carey and Bryant, 1995). DDT and metabolites are known to be embryotoxic and fetotoxic in rodents (Fabro et al., 1984). The estrogenic activity of DDT and metabolites at environmental levels are individually low, but additive and synergistic effects when coupled with PCBs and other environmental estrogens may enhance the endocrine disrupting effect of these contaminants (Foster, 1995). Effects of endocrine disrupting chemicals on anurans are not well understood.

Environmental contamination with anthropogenic chemicals has been implicated in the decline and disappearance of amphibians from many localities around the world

(Barinaga, 1990; Blaustein and Wake, 1990; Phillips, 1990; Wyman; 1990). Characteristics of amphibian life histories make them ideal indicators of ecosystem health and environmental degradation (Vitt et al., 1990). Effects of environmental contaminants on amphibians include developmental anomalies (Cooke, 1979; Osborn et al., 1981; Snawder et al., 1989), behavioral changes (Cooke, 1970; 1971; Haniffa and Augustin, 1989; Semlitsch et al., 1995), and death (Mulla, 1962; Sanders, 1970). Chlorinated organic chemicals are of particular concern due to their toxicity to amphibians (Power et al., 1989), persistence in amphibian populations (Russell et al., 1995a), and magnification in amphibian food webs (Korschgen, 1970). The use of organochlorinated chemicals has been severely curtailed for over 25 years, however, the legacy of these chemicals is seen in amphibian populations (Russell et al., 1995a). The complex life cycles and permeable skins of amphibians make them particularly susceptible to accumulation and toxic effects of water borne chemicals (Duellman and Trueb, 1986). The importance of amphibians in ecosystems is evident where amphibians may constitute a major portion of biomass in specific communities (Burton and Likens, 1975).

This project determines the distribution of DDT and metabolites, chlorinated pesticides, chlorinated benzenes, and polychlorinated biphenyls in wood frogs (*Rana sylvatica*) from the Yukon. The feasibility of using wood frogs as monitors of environmental contamination with hydrophobic organic chemicals in northern Canada is examined. We compare contamination in Yukon frogs with chemical contamination in frogs from other areas in Canada.

MATERIALS AND METHODS

Field Sampling

Wood frogs (*Rana sylvatica*) were collected at 14 sites in the Yukon territory by DIAND staff. Length and weight of frogs were recorded. One spotted frog (*Rana pretiosa*) was collected. One sediment sample from the Watson Lake Airport was collected.

Preparation of Sediment

Sediment samples were extracted by Soxhlet extractors positioned above electric heaters. A 20 g (wet weight) aliquot of sediment was weighted into a 200 mL glass beaker. The sediment sample was combined with 100 g anhydrous sodium sulphate (5 X sample weight) using a solvent rinsed spatula, then transferred to a glass thimble pre-layered with 10 g anhydrous sodium sulphate. The beaker was rinsed with 10 g anhydrous sodium sulphate, then added to the thimble, followed by another 10 g anhydrous sodium sulphate. The charged glass thimble was mounted in the Soxhlet extractor. A 500 mL round bottom flask filled with acetone:hexane solution (150 mL:150 mL) and boiling chips (previously cleaned with solvents) was attached to the Soxhlet extractor and the system allowed to reflux for 16 hours at the boiling temperature of the solvent mixture. After completion of the Soxhlet extraction, the system was cooled to room temperature and the round bottom flask now containing sediment extract was removed from the Soxhlet apparatus and rotary evaporated to 50 mL volume. The concentrated extract was transferred to a 500 mL separatory funnel containing 200 mL Nanopure grade water and extracted successively with respectively 50, 25, 25 mL hexane (Omnisolv grade). Following each extraction, the mixture was allowed sufficient time for phase separation. The 3 portions of hexane were collected in the same 250 mL round bottom flask, rotary evaporated to a 50 mL volume, then transferred to a chromatographic column (35 cm x 2 cm with a 200 mL reservoir) previously filled with a glass wool stopper and 80 g anhydrous sodium sulphate. The extract was collected at the bottom of the column in a 500 mL flask. The column was flushed with 250 mL hexane (Omnisolv grade) to remove all components from the column and collected in the 500 mL flask with the sediment extract.

The extract was rotary evaporated to 2 mL, then transferred into a florisil column previously prepared from 6 g of activated florisil (60-200 mesh) with a 2 cm of anhydrous sodium sulphate layer added at the top. The sample was eluted with 50 mL of hexane, the first fraction was collected in a 250 mL round bottom flask at a drip rate of 3 mL/min. The column was eluted with 50 mL of 15% DCM/hexane (V/V) and Fraction 2 was collected in a 250 mL round bottom flask. The column was finally eluted with 50 mL of 50% DCM/hexane (V/V) and Fraction 3 was collected in a 250 mL round bottom flask. The 3 fractions were concentrated separately to approximately 2 mL, transferred, then made up in a suitable volumetric flask to 10 mL. Activated copper-powder (0.2 - 0.5 g) was added into each volumetric flask and the solution was vortexed for 1-2 minutes. The extract on copper was stored in a refrigerator overnight before gas chromatographic analysis.

In addition to extraction procedures a 5 g aliquot of each sediment sample was weighed in a preweighed aluminum weighing boat and placed in a drying oven for 24 hours at 106°C. The weigh boat was reweighed and the difference in weight represented the mass of water in the sediment or soil sample. A 1.0 g aliquot of dry sediment sample was weighed in a 15 mL glass beaker and placed in a muffle furnace at 450°C for 24 hours for combustion. The total organic content of the sediment or soil sample was determined by the difference in weight before and after combustion.

Preparation of Biological Tissues

Biological tissues were prepared by the method of Lazar et al. (1992). A 2-5 g aliquot of biological tissue was homogenized with anhydrous sodium sulphate using a glass mortar and pestle. The free flowing powder obtained was poured into a 35 cm x 2 cm glass column (with Teflon stopcock and 300 mL reservoir) which had been plugged previously with glass wool, filled with 30 mL dichloromethane/hexane (50% V/V) and 2 cm of anhydrous sodium sulphate. Another 10 g sodium sulphate were mixed into the mortar (to remove sample residue) and added to the top of the column. The mortar and pestle were rinsed three times with a total volume of 30 mL of 50% DCM/hexane and these rinses are transferred to the column. After one hour, the stopcock was opened and the sample was eluted with 250 mL of 50% DCM/hexane (total amount of solvent used is 310 mL). The eluate was collected in a 500 mL round bottom flask with a steady drip of 5-10 mL/min., then rotary evaporated (Büchi-Rotovaporator) to approximately 5 mL and transferred to a 50 mL centrifuge tube (with ground glass stopper), made up to 25 mL with hexane, mixed, then allowed to stand until the sodium sulphate was settled.

Lipid determination was made by pipetting 2 mL of the above extract into preweighed 10 mL glass beakers. The solvent was evaporated to dryness, then placed in a drying oven at 105°C for 1 hour. The beaker was removed from the oven, placed in a desiccator for 1 hour, then reweighed. The difference in weight was the mass of lipid in the sample. Percent lipid is calculated as follows:

$$\% \ lipid = \frac{W_L}{W_T} \times \frac{V_T}{V_e} \times 100$$

where: W_L = Weight of lipid

W_T = Total weight of sample

V_T = Total volume of extract (25 mL)

V_e = Volume of extract used for lipid determination (2 mL)

The remaining 23 mL of sample extract (after lipid determination) was rotary evaporated to 1.5 - 2 mL. Two mL of DCM were added and the resultant solution was then transferred to the top of a gel permeation chromatography (G.P.C.) - column using a Pasteur pipette. The G.P.C. column consisted of a 50 cm x 2.2 cm Pyrex chromatographic column, with a Teflon stopcock, prepacked with a 2 cm glass wool plug and a slurry of 50 g BioBeads, S-X3 (BioRad) in 50% DCM/hexane (V/V) and fitted with a 250 mL pressure-equalizing separatory funnel. The sample was loaded onto the column and the eluate was collected in a graduated container. The initial sample container was rinsed 3 x 4 mL of DCM/hexane (1:1) from a premeasured 300 mL volume. Following the final rinse, the separatory funnel was attached to the top of the column, the column filled with remaining solvent, and elution was performed at a steady drip of 5 mL/min. The first 40 mL of eluate was discarded, the next 110 mL eluate, (containing lipids) was also discarded (although this fraction could be used for lipid content determination), and the last 150 mL were collected in a 500 mL round bottom flask. This final fraction is kept for cleanup and separation prior to electron capture gas chromatography (GC/ECD) analysis of chlorinated pesticides and PCBs.

The final 150 mL eluate from G.P.C. was rotary evaporated to 1.5 - 2 mL (after 5 mL of isooctane was added) and transferred to a florisil column. The florisil column was composed of a 25 cm x 1 cm glass column (with a Teflon stopcock and 250 mL reservoir), plugged with 2 cm glass wool, filled with hexane and then, with the stopcock slightly open, 6 g of activated florisil was poured into the column (Florisil 60-100 mesh from BDH activated overnight at 130°C). Two cm of sodium sulphate was added to the top of the column. When hexane reached the top of the column, the stopcock was closed, a 250 mL round bottom flask placed under the column, and the evaporated sample extract was transferred to the top of the column using a Pasteur pipette. As the sample moved through the column, the sample container was rinsed with 3 x 2 mL aliquots of hexane (from a premeasured volume 50 mL of hexane) and rinses were transferred to the column. The remaining hexane was poured into the reservoir of the column and the elution of Fraction 1 was performed at a steady rate of 3 mL/min. When hexane reached the top of the column, the stopcock was closed, the flask with Fraction 1 was replaced with another 250 mL flask, the column was eluted with 50 mL of 15% DCM/hexane (V/V) and Fraction 2 was collected. This procedure was repeated for Fraction 3 using 150 mL of 50% DCM/hexane (V/V). Each of the 3 fractions were rotary evaporated (after adding 5 mL isooctane) separately to 2 mL, then transferred and made up to a suitable volume with isooctane. Low weight samples (<2 g) were evaporated then made up to 200 µL for GC/ECD.

Fractionation Pattern

The pattern of fractionation following florisil cleanup was as follows:

Fraction 1: Organochlorinated hydrocarbons, pesticides and PCBs:

1,2,4,5 tetrachlorobenzene (1245TCB)

1,2,3,4 tetrachlorobenzene (1234TCB)

pentachlorobenzene (QCB)

hexachlorobenzene (HCB)

octachlorostyrene (OCS)

trans-nonachlor

pp'-DDE

photomirex

mirex

PCBs (including mono-ortho substituted congeners)

Fraction 2: Chlorinated Pesticides

α-HCH

ß-HCH

γ-HCH (lindane)

oxychlordane

trans-chlordane

cis-chlordane

pp'-DDD

cis-nonachlor

pp'-DDT

Fraction 3:

heptachlor expoxide

dieldrin

Instrument Conditions

The 3 fractions from the florisil column cleanup step were run separately on a Hewlett Packard model 5890 gas chromatograph, equipped as follows:

^{63}Ni-electron capture detector

HP-3396 Integrator

HP-7673A Autosampler

Column: 30 m x 0.25 mm. I.D. x 0.25 µm DB-5 film thickness (J&W Scientific)

Injection Temperature: 250°C

Detector Temperature: 300°C

Carrier Gas: ultrapure helium at 30 cm/sec - determined at 100°C (1 mL/min)

Make-up Gas: Ar/CH_4 (95%/5%) at 50 mL/min

Oven Temperature Program:

Initial Temp:	100°C
Initial Time:	1 min
Rate:	10°C/min to 150°C, then 3°C/ min to 275°C
Final Hold Time:	5 min
Equilibration Time:	3 min

Two µL sample was injected using a splitless injection mode. Parameters analyzed and detection limits are described in Appendix II.

Calculation of Results

The quantification of each compound was done by comparing the sample-peak area against the standard-peak area from 3 Canadian Wildlife Service calibrated standard solutions as:

Std #1: 10 organochlorinated compounds + Arochlors 1242:1254:1260 (1:1:1) in isooctane

Std #2: 18 organochlorinated compounds in isooctane

Std #3: heptachlor epoxide and dieldrin in isooctane.

$$C_{param} = \frac{A_{sam}}{A_{std}} \times StdC_{param} \times \frac{V}{W}$$

Where:

	C_{param}	= concentration of specific parameter in sample extract
	A_{sam}	= peak area of the same parameter in the sample extract
	A_{std}	= peak area of the same parameter in the standard solution
	$Std\ C_{param}$	= concentration of parameter in standard solution (pg/µL)
	V	= final volume of sample extract (mL)
	W	= wet weight of sample extracted (g)

Laboratory procedures, instrument conditions and data handling were consistent with procedures outlined by the Canadian Council of Ministers of the Environment (1993).

Statistical Analysis

Means and standard errors were calculated where appropriate. A Friedman non-parametric procedure for analysis of repeated measures (Wilkinson, 1990) was used to make interlab comparisons of DDE results.

RESULTS

Contaminant concentrations in wood frogs and sediment, blanks, CWS egg pool reference materials, and surrogate recoveries as determined by the Great Lakes Institute for Environmental Research (GLIER) are shown in Appendix I. PCBs 101, 110, 151, 149, 146, 153, 138, 182/187, 183, 180, and 201 were detected at low concentrations in Watson Airport swamp sediments. Concentration of the PCB mixture Arochlor 1260 was estimated at 3.90 µg/kg dry wt. in Watson Lake airport swamp sediment. Pesticides detected in Watson Lake airport swamp sediments were DDT (2.08 µg/kg), DDD (18.40 µg/kg), and DDE (2.69 µg/kg).

Contaminant concentrations in wood frogs as determined by Envirotest Laboratories are shown in Appendix II. Table 1 diagrams results of a Friedman's repeated measures analysis of DDE concentrations in wood frogs analyzed by Envirotest Laboratories and GLIER from 6 sites in the Yukon. Frogs from the sites listed were analyzed by both laboratories. Test results from the laboratories were similar but not identical. Differences were mainly due to differences in DDE accumulation by individual frogs, however instrument conditions, column types (DB-5 at GLIER vs. SPB-20 at Envirotest), and extraction methods (solid-solid at GLIER vs. liquid-solid at Envirotest) contributed to differences in results obtained by the 2 laboratories. Friedman test results indicated no significant differences between analyses performed by the 2 laboratories ($p=1.00$).

Summary statistics for combined data sets are shown in Table 2. DDE was detected at high levels in wood frogs from Paddy's Pond, Watson Lake airport wetland, Watson

Table 1. Friedman's repeated measures analysis of DDE concentrations (µg/kg wet wt.) in wood frogs analyzed by Envirotest Laboratories and GLIER from 6 sites in the Yukon.

SITE	Envirotest	GLIER
Paddy's Pond	23.00	106.72
McClintock River	1.10	0.93
Pothole	0.90	0.00
Watson Lake airport	28.00	39.01
Wye Lake	37.00	8.29
Range Road Dump	5.90	7.55

Friedman Two-way Analysis of Variance Results

VARIABLE	RANK SUM
Envirotest	9
GLIER	9

Friedman Test Statistic = 0.00, $p = 1.00$

Table 2. continued.

Yukon Frogs 1997:	Summary Statistics			
	CONCENTRATIONS: ug/kg wet wt.			
SITE	pp'-DDT	Heptachlor Epoxide	Dieldrin	Arochlor 1260
MEANS				
Paddy's Pond - Whitehorse	34.04	0.01	0.05	0.90
Hidden Lake 2 - Whitehorse	ND	ND	ND	ND
M'Clintock River	0.10	0.02	0.02	ND
Pothole - Johnson Crossing	ND	ND	ND	ND
Watson Lake Airport wetland	31.11	0.40	0.25	7.37
Watson Lake shore	3.00	ND	ND	ND
Wye Lake	0.69	ND	ND	0.09
Golden Pond	ND	ND	ND	420.00
Hillcrest wetland - Whitehorse	31.31	0.03	0.06	4.78
Whitehorse effluent lagoon	ND	ND	ND	ND
Yukon River - pothole below Marsh Lake	ND	ND	ND	ND
Snag Rd. - 9 km from airport	ND	ND	ND	ND
Yukon River at Thistle Creek	ND	ND	ND	ND
Range Road dump	2.08	0.10	0.36	23.76
Skagway Rd. - R. pretiosa	ND	ND	ND	ND
STANDARD ERRORS				
Paddy's Pond - Whitehorse	20.55	0.01	0.02	0.33
Hidden Lake 2 - Whitehorse				
M'Clintock River	0.10	0.02	0.02	
Pothole - Johnson Crossing				
Watson Lake Airport wetland				
Watson Lake shore				
Wye Lake	0.40			0.05
Golden Pond				
Hillcrest wetland - Whitehorse	7.98	0.02	0.04	0.61
Whitehorse effluent lagoon				
Yukon River - pothole below Marsh Lake				
Snag Rd. - 9 km from airport				
Yukon River at Thistle Creek				
Range Road dump	0.44	0.10	0.15	5.94
Skagway Rd. - R. pretiosa				
ND Indicates Not Detected				

Lake shore, Wye Lake and Hillcrest wetland. Wood frogs from these areas accumulated 3X to 350X greater DDE than other sample sites. DDE concentrations were slightly elevated in Range Road dump wood frogs (7.14 μg/kg). The spatial distribution of DDE in Yukon frogs is diagramed in Figure 1. DDD was detected in wood frogs from the sites discussed above and at no other sites. DDT was detected at elevated levels in Paddy's Pond, Watson Lake airport wetland, and Hillcrest wetland wood frogs.

PCB (Arochlor 1260) was detected at high levels in Golden Pond wood frogs (420 μg/kg) and Range Road dump frogs (23.76 μg/kg). Arochlor 1260 was also detected at lower levels in Watson Lake airport wetland frogs (7.37 μg/kg) and Hillcrest wetland frogs (4.78 μg/kg). The distribution of Arochlor 1260 in Yukon frogs is shown in Figure 2. Other pesticides (mirex, α-, β-, γ-HCH, oxy-, cis-, trans-chlordane, heptachlor epoxide, and dieldrin) were either not detected or found at low levels in Yukon wood frogs.

The Yukon River at Thistle Creek and Snag Road sites were approximately 250 km northwest of the nearest contaminated site, Whitehorse, and thus serve as sources of background contamination in wood frogs. Chemical analysis of wood frogs from these reference sites resulted in no chemical detections.

Figure 1. Spatial distribution of DDE in Yukon wood frogs. The Skagway Road frog was *Rana pretiosa* (spotted frog).

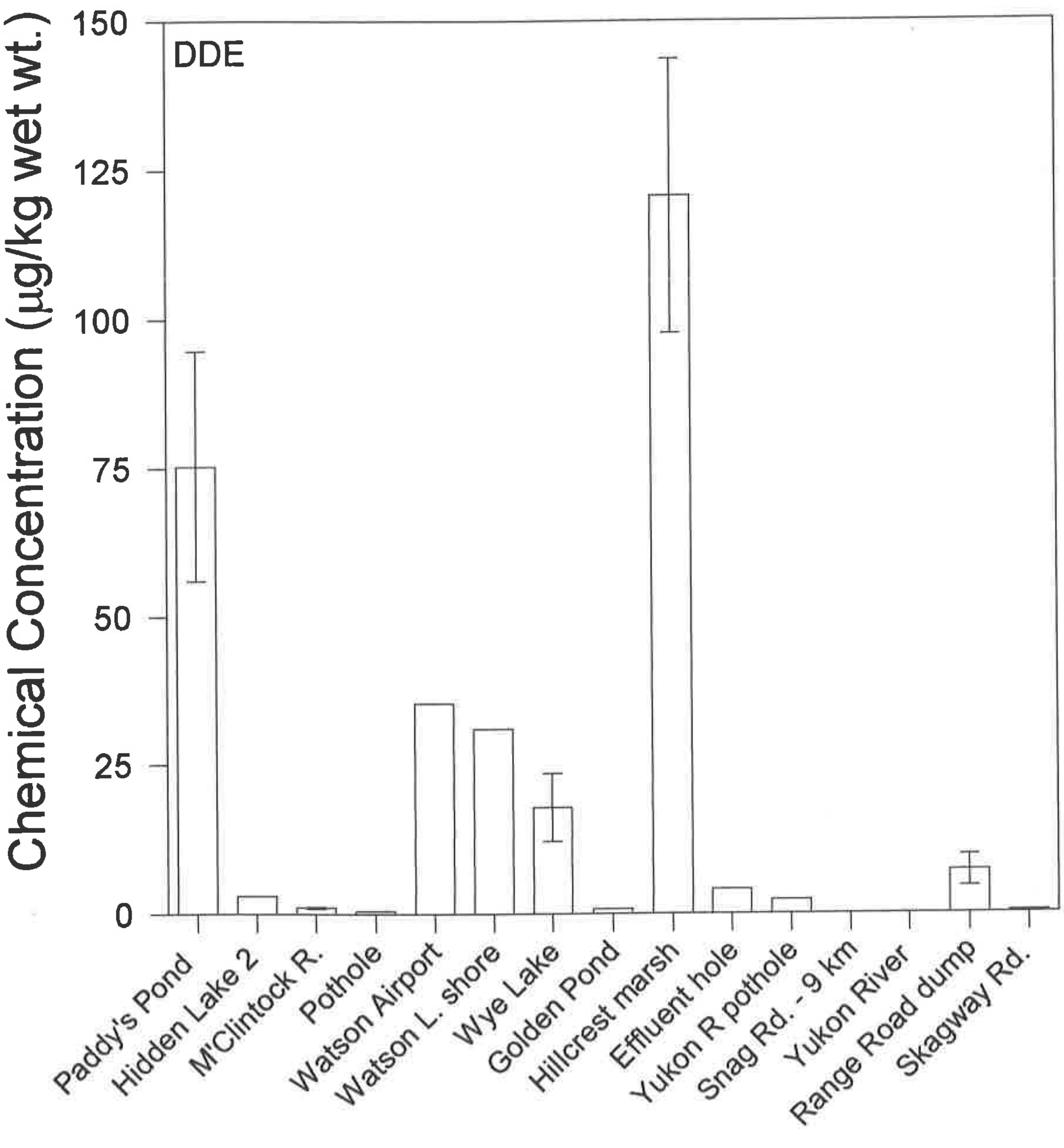
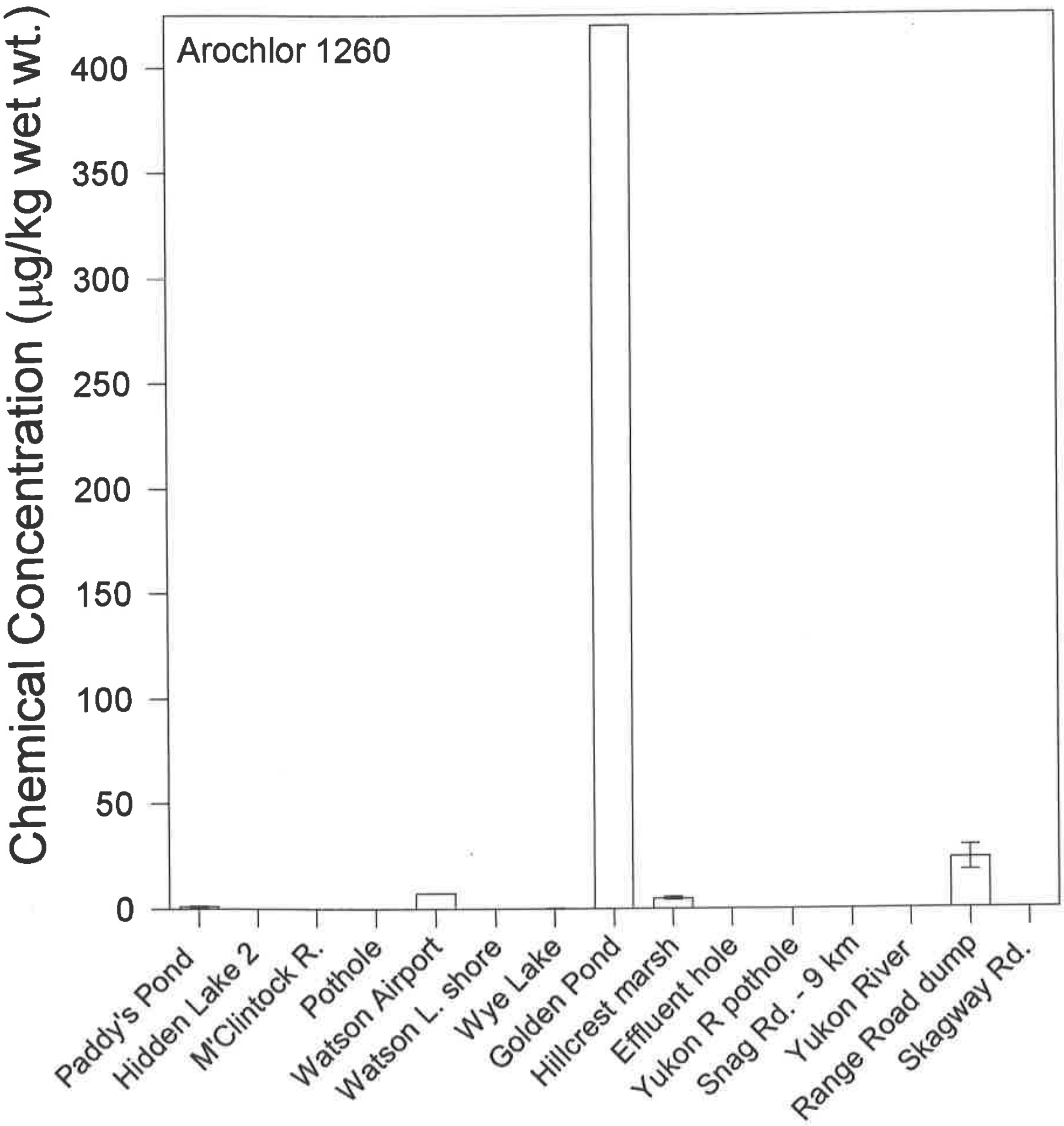


Figure 2. Spatial distribution of Arochlor 1260 in Yukon wood frogs. The Skagway Road frog was *Rana pretiosa* (spotted frog).



DISCUSSION

Paddy's Pond, Watson Lake Airport wetland, Wye Lake were sprayed with DDT for mosquito control between 1950 and 1969 (Belton, 1989; Whitley et al., 1996). Aerial spraying of DDT combined with ground fogging and manual application of Tossits® were carried out at least once per year in these areas. The Watson Lake Airport wetland may be a disposal site for unused DDT (Whitley et al., 1996). Both Hillcrest wetland and Paddy's Pond are in the Hillcrest neighborhood, so it can be concluded that the Hillcrest wetland was subject to similar DDT application patterns.

DDE concentrations in wood frogs from Paddy's Pond, Watson Lake Airport, Wye Lake, and Hillcrest wetland were 75.32 µg/kg, 35.34 µg/kg, 17.86 µg/kg, and 120.64 µg/kg respectively. Wood frogs from Watson Lake contained 31 µg/kg DDE. Hidden Lake, M'Clintock River, Golden Pond, Whitehorse effluent lagoon, Yukon River below Marsh Lake, and Range Road dump sites are in the Whitehorse locale. Wood frogs from all these sites contained lower DDE concentrations than at Paddy's Pond and the Hillcrest wetland, however, they were also more contaminated than wood frogs from the reference sites. DDE contamination at the Range Road dumpsite was probably due to disposal of DDT at the site (Whitley et al., 1996). The Johnson Crossing site was located between the 2 contaminated sites at Whitehorse and Watson Lake. DDE concentrations in wood frogs from Johnson Crossing were low, but still higher than at reference sites. The pattern of DDE contamination in Yukon wood frogs indicates that the method of DDT application resulted in some degree of off-site contamination. Environmental contamination remote in time and space from the site of application is commonly observed with this pesticide

(WHO, 1989). DDE concentrations in wood frogs decreased to low levels approximately 75 km from the site of application (0.45 µg/kg at Johnson Crossing) and decreased below detection limits approximately 250 km from the contaminated site. Based on DDE concentrations in wood frogs, DDE contamination in the Yukon is to limited to a few contaminated sites. Similar patterns and degrees of DDE contamination have been observed in southern Ontario green frogs (*Rana clamitans*), where Summerstown green frogs accumulated 0.58 µg/kg DDE and Ancaster green frogs accumulated 45 µg/kg DDE (Russell et al., 1997b). Agricultural application of DDT was implicated in high levels of DDE in Ancaster green frogs. Summerstown and Rondeau Provincial Park wood frogs (southern Ontario) accumulated 0.29 µg/kg and 9.8 µg/kg DDE respectively (R.Russell, unpublished data). The slightly elevated DDE concentrations in Rondeau Park wood frogs may be due to proximity to a long-established recreation area. Unlike the Yukon, there were no areas in southern Ontario where DDE was undetected in amphibian tissues.

The relative isolation of Yukon has not resulted in low levels of DDE contamination in its amphibian fauna. DDE concentrations in Point Pelee green frogs averaged 35 µg/kg DDE (Russell et al., 1995b), American toads (*Bufo americanus*) averaged 148 µg/kg DDE and leopard frogs (*Rana pipiens*) averaged 4 µg/kg (R.Russell, unpublished data). Local environmental contamination with DDE at Point Pelee National Park is considered high, and is strongly associated with DDE accumulation by local amphibians (Russell and Haffner, 1997a). It was concluded that extreme DDE contamination at Point Pelee was due to agricultural application in apple orchards. Moubry et al., (1968) and Elliot et al., (1994) have made comparable observations regarding DDE contamination in orchards. Similar

DDE concentrations were observed in Watson Lake and Whitehorse area wood frogs.

Point Pelee spring peepers (*Pseudacris crucifer*) accumulated greater than 1000 µg/kg DDE (Russell et al., 1995a). These DDE concentrations were much greater than anything observed in southern Ontario or in the Yukon. Point Pelee spring peepers have qualitatively similar diets to other Point Pelee amphibians and are found in similar areas. Spring peepers are terrestrial frogs which hibernate on land, spend relatively little time immersed in water compared to aquatic frogs (green frog, bullfrog), and contain glucose as a cryo-protectant solution in their tissues. Glucose levels remain elevated post-hibernation (Feder and Burggren, 1992). This may result in increased fugacity capacity (ability to retain contaminants) (Mackay, 1979) and thus, greater body burdens of specific chemical contaminants. The terrestrial behaviour of spring peepers eliminates an important source of chemical depuration from the animal. Amphibians have highly permeable skin and are able to pass large amounts of water in and out of the body via the skin. Amphibian skin is a highly developed chemical elimination route in aquatic amphibians but is much less effective in terrestrial amphibians. The elevated fugacity capacity and decreased chemical elimination potential in spring peepers may account for the dramatic increase DDE accumulation in these frogs. Wood frogs have similar terrestrial habits and contain similar amounts of glucose cryo-protectants as spring peepers. For these reasons, data gathered for Yukon wood frogs may not be directly comparable to observed chemical concentrations in southern Ontario aquatic frogs.

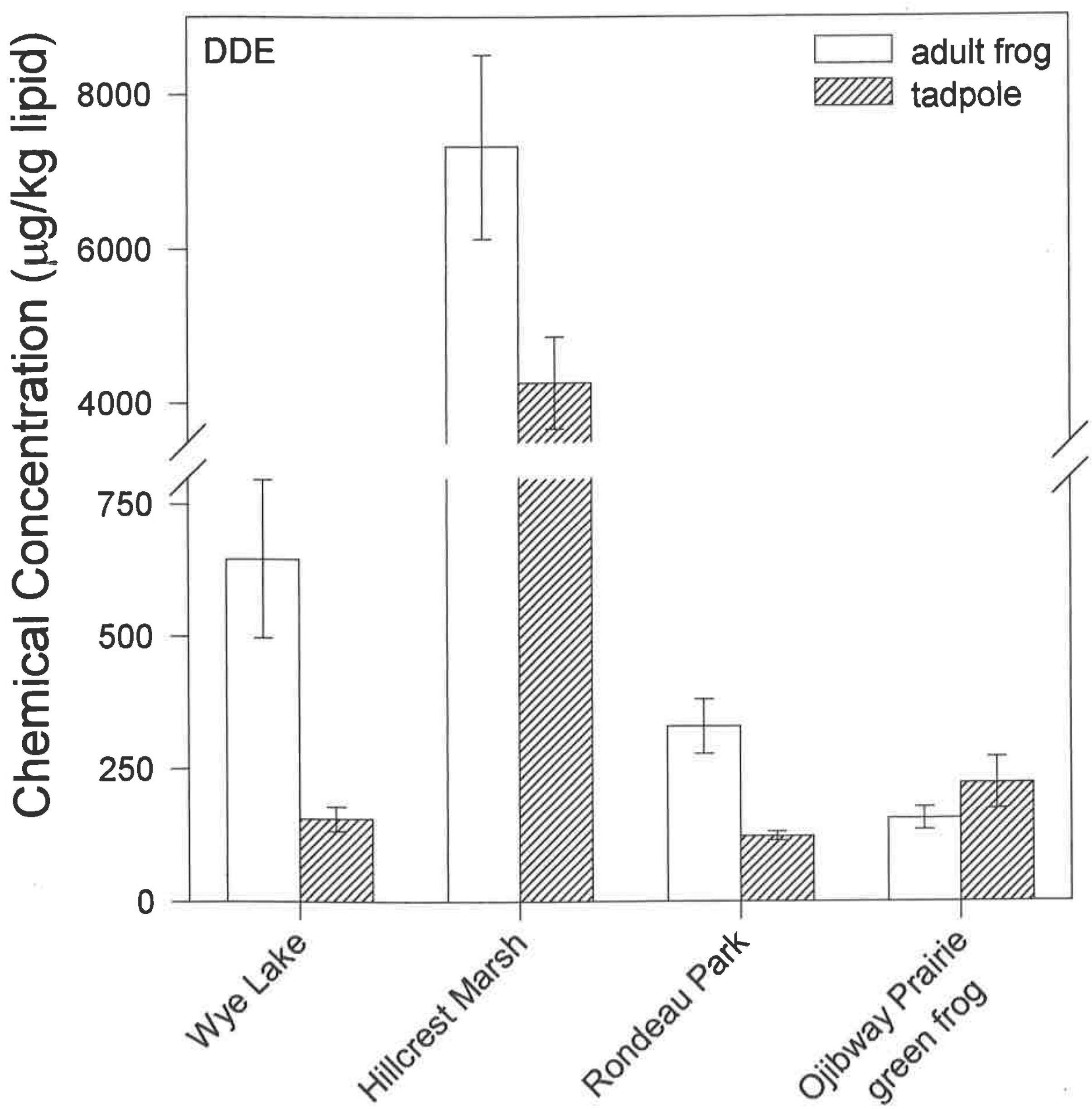
DDD concentrations in wood frogs were low at all Yukon locations, but at greatest at sites where DDT was historically applied. DDT concentrations were greatest in Paddy's

Pond frogs (34.04 µg/kg), Watson Lake Airport frogs (31.11 µg/kg), and Hillcrest wetland (31.31 µg/kg). DDT was applied directly to these areas and it is expected that there is considerable DDT remaining at these sites 27 years following cessation of DDT use (Russell et al., 1995a; Dimond and Owen, 1996). The lack of DDT in Wye Lake wood frogs (0.69 µg/kg) is surprising based on the amount of DDE in frogs. DDT degradation in the environment is variable, based on many physical, chemical, and biological factors (Beyer and Gish, 1980; Gish and Hughes, 1982; Forsyth et al., 1983; Szeto and Price, 1991).

Arochlor 1260 concentrations in Golden Pond wood frogs averaged 420 µg/kg. High PCB concentrations in these frogs was due to runoff from adjacent roads which were oiled with PCB-contaminated oil for dust control (Whitley et al., 1996). Wood frogs from the Range Road dump had elevated Arochlor 1260 levels (41 µg/kg). This was most likely due to disposal of PCB containing products. Arochlor 1260 levels were slightly elevated at Hillcrest wetland (3.58 µg/kg) and Watson Lake Airport wetland (7.37 µg/kg). This was probably due to road oiling with PCB-contaminated oil. Background PCB contamination from the reference sites was below detection limits. Summerstown and Rondeau Provincial Park wood frogs (southern Ontario) accumulated 1.67 µg/kg and 11 µg/kg Arochlor 1260 respectively (R.Russell, unpublished data). Hillman Marsh in southern Ontario was considered moderately contaminated with PCBs (Russell et al., 1997a). Green frogs, leopard frogs, and American toads accumulated 20 µg/kg, 17 µg/kg, and 19 µg/kg Arochlor 1260 respectively at Hillman Marsh (R.Russell, unpublished data). Levels of Arochlor 1260 in Hillman Marsh amphibians were less than Range Road dump and Golden Pond amphibians. The Governments of United States and Canada (1989) consider a maximum of 100 μg/kg total PCB in forage species for the protection of higher trophic level wildlife. PCB contamination at Golden Pond exceeds this guideline and should be of concern.

Amphibians exhibit complex life cycles and associated dramatic changes in behaviour and physiology (Duellman and Trueb, 1986). Changes in chemical accumulation between life stages in amphibians may occur. Figure 3 illustrates differences in DDE accumulation between adult frogs and tadpoles. Wye Lake, Hillcrest Marsh, and Rondeau Park adult wood frogs accumulated greater amounts of DDE than wood frog tadpoles. Ojibway Prairie (southern Ontario) adult green frogs accumulated similar amounts of DDE as green frog tadpoles. It is proposed that observed differences in DDE accumulation between adult and larval amphibians is a function of the difference in habitat use between adults and tadpoles. Adult wood frogs are primarily terrestrial, and spend the major portion of their lives in the terrestrial environment. Wood frog larvae are totally aquatic. Adult green frogs are primarily aquatic, while green frog tadpoles are totally aquatic. There are dietary differences between adult and larval amphibians related to basic physiology and morphology and habitat use. Their are also differences in chemical dynamics between terrestrial and aquatic frogs as discussed above, which can be extended to terrestrial adults compared to aquatic larvae. Larvae of terrestrial frogs have a greater potential to eliminate chemicals to the environment than their terrestrial adult counterparts. This may explain differences in DDE accumulation between adult and larval wood frogs where these differences do not exist with aquatic green frogs. A consequence of this is adult wood frogs may be better monitors of terrestrial DDE contamination, while wood frog tadpoles may measure bioavailable concentrations of DDE in the aquatic environment.

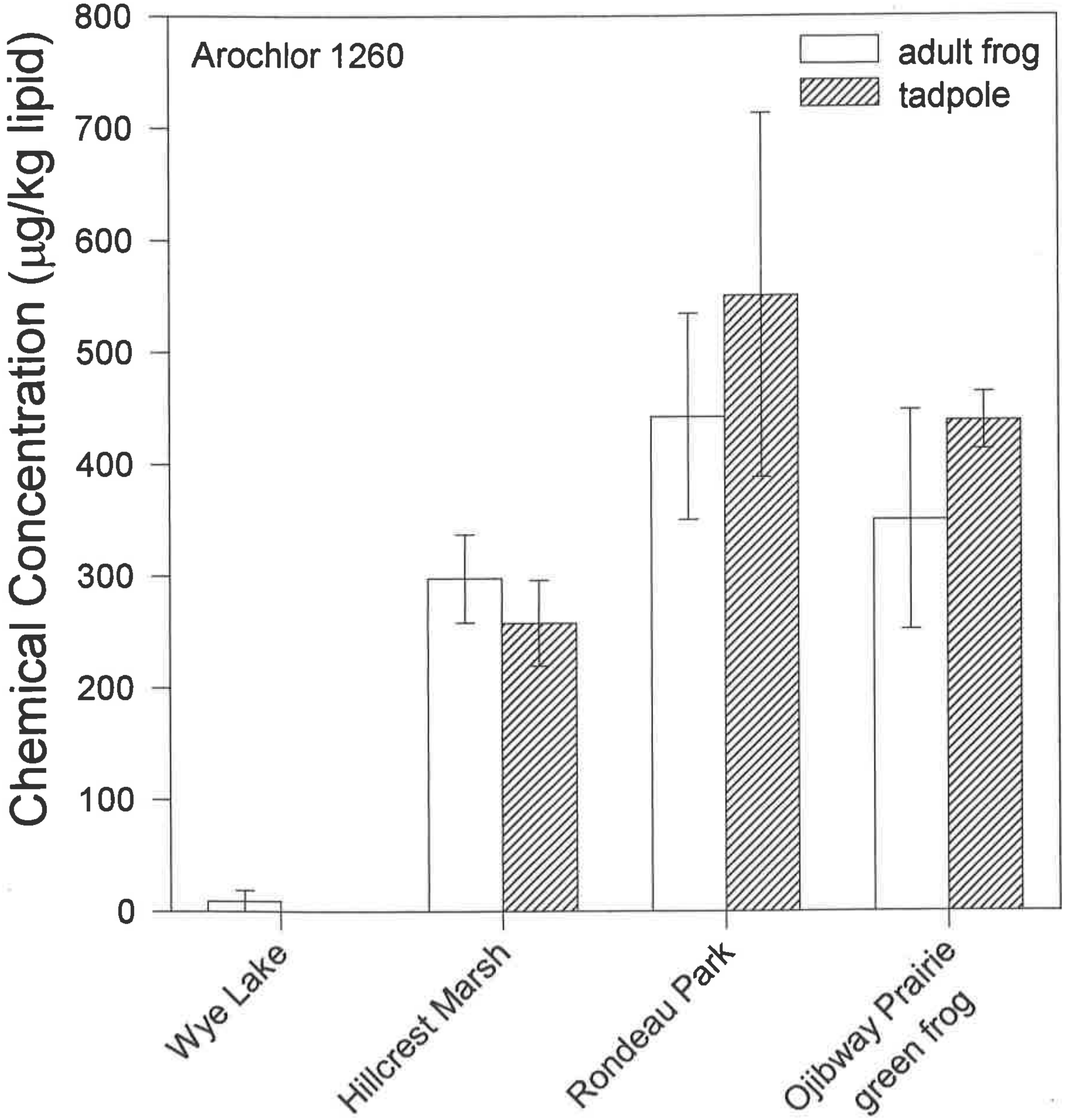
Table 3. DDE in adult and larval frogs from the Yukon and southern Ontario. Concentrations are lipid adjusted to account for differences interspecific and inter-life stage differences in lipid content.



Differences in Arochlor 1260 accumulation between adult and larval frogs are shown in Figure 4. Overlapping error bars at all sites for all species indicate that there are no differences in PCB accumulation between adult frogs and tadpoles, regardless of the terrestrial habit of adults. The PCB components of Arochlor 1260 are more hydrophobic than DDE. Log K_{ow} for Arochlor 1260 range from 6.3 to 7.5 (Mackay et al., 1992) while log K_{ow} for DDE is 5.69. This indicates that bioavailability of Arochlor 1260 is considerably lower than DDE in the aquatic environment since high K_{ow} compounds are more likely to bind to particulate and dissolved organic matter in the water column. The relatively high hydrophobicity of Arochlor 1260 results in dramatically decreased elimination of this chemical across membranes to water when compared to DDE. Major uptake routes for Arochlor 1260 in adult and larval amphibians is dietary and elimination is by fecal egestion. Since DDE has greater solubility in water, major uptake and elimination routes for larval wood frogs is via the gill and across body surfaces. In contrast, DDE dynamics in adult wood frogs resemble Arochlor 1260 due to the terrestrial habit of wood frogs at this life stage. Wood frog tadpoles may reflect bioavailability of lower K_{ow} chemicals (log K_{ow} <6) in water while adult wood frogs reflect chemical contamination in their diet. Both adult and larval wood frogs measure chemical accumulation by diet for high K_{ow} chemicals.

Wood frogs may be good biomonitors of long-range contamination in the Arctic, however, this study measured only local contamination by direct application. DDT and metabolites, and PCB contamination as measured by wood frogs was not widespread in the Yukon. DDE contamination dropped to low levels in wood frogs within 75 km from the site of application and was not detected within 250 km of the application site. The utility

Table 4. Arochlor 1260 in adult and larval frogs from the Yukon and southern Ontario. Concentrations are lipid adjusted to account for differences interspecific and inter-life stage differences in lipid content.



of using wood frogs to monitor environmental contamination with hydrophobic chemicals is seen at Watson Lake Airport wetland, where many chemicals were not detected in sediment, but were detected in Watson Lake Airport wood frogs (QCB, HCB, oxy-chlordane, α-HCH, heptachlor epoxide, and dieldrin). Monitoring organic chemicals using wood frogs can be very effective when the physicochemical properties of target contaminants and the life stage of the wood frog are considered.

CONCLUSIONS

DDE contamination was greatest in wood frogs from Hillcrest Marsh and Paddy's Pond. DDE contamination was also high in wood frogs from Watson Lake Airport, Watson Lake, and Wye Lake. DDE contamination was greatest in wood frogs from Whitehorse. DDE was not detected in wood frogs 250 km distant from contaminated sites. Site contamination was due to historic DDT application for mosquito control, in contrast to southern Ontario where DDE contamination was due mainly to past agricultural practices.

Golden Pond wood frogs were highly contaminated with PCBs. The source of PCBs was from road oiling activities previously performed in the area. PCB concentrations in Golden Pond wood frogs exceed guidelines established for the protection of wildlife. PCB contamination at Golden Pond was greater than observed in some areas of southern Ontario.

Differences in life stage determine DDE accumulation in wood frogs. Wood frog tadpoles monitor bioavailable DDE concentrations in water while DDE concentrations in adult wood frogs may reflect dietary accumulation. Highly hydrophobic chemicals (high log K_{ow}) are reduced in bioavailability due to sorption to aqueous organic carbon. Both adult and tadpole wood frogs accumulate similar amounts of high K_{ow} chemicals (Arochlor 1260). Monitoring chemical contamination in the Yukon using wood frogs is effective when the physicochemical properties of target chemicals and the frog life stage are considered.

RECOMMENDATIONS

1. Sample sediments, wood frog tadpoles, and wood frog adults from each site to link environmental contamination to chemical accumulation by wood frogs.
2. Determine spatial extent of environmental contamination by sampling wood frogs at varying distances from contaminated sites.
3. For interlab comparisons, detection limits should be as low as possible, however, detection limits are affected by sample preparation methods, instrument conditions, and sample size. Pool samples when individuals are small and collect multiple samples or pools to allow calculation of variance.
4. A congener specific PCB analysis may be useful when attempting to locate sources of contamination by presenting a PCB congener "fingerprint". Determination of DDT and metabolites in biota and sediments over time would allow calculation of half-times for DDT degradation in the Yukon.
5. Surplus biological samples can be archived for future organic analysis provided they are stored in clean, non-absorbing, air tight containers (glass or metal) and maintained at -40°C or less.
6. Estimates of the spatial extent of environmental contamination can be enhanced by knowledge of home range sizes of biomonitors. Care must be exercised when distinguishing home range size from long range movements to and from breeding ponds and hibernacula.
7. Data from wood frog biomonitoring projects can be developed into a management model Yukon wetlands.

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APPENDIX I

Contaminant concentrations in wood frogs and sediment determined by the GLIER. Contaminant concentrations in sediment are expressed in µg/kg dry weight and contaminant concentrations in amphibians are expressed in µg/kg wet weight.

Yukon Frogs 1997: Processed by GLIER										
				CONCENTRATIONS:	micrograms/kilogram					
Sediment - dry wt. concentrations										
SITE	**LIFE STAGE**	**I.D.**	**Dry Wt. (g)**	**% TOTAL ORGANIC**		**1,2,4,5 -TCB**	**1,2,3,4 -TCB**	**QCB**	**HCB**	**OCS**
Watson Airport Swamp		Sediment - SWAMP/SURROG.*	13.08	4.65		ND	ND	ND	ND	ND
Amphibians - wet wt. concentrations										
SITE	**LIFE STAGE**	**I.D.**	**Wet Wt. (g)**	**% Lipids**	**% Moisture**	**1,2,4,5 -TCB**	**1,2,3,4 -TCB**	**QCB**	**HCB**	**OCS**
M'Clintock River	adult	Y-F-Site 3-5	1.14	0.40		ND	ND	ND	ND	ND
M'Clintock River	adult	Y-F-Site 3-6	2.17	1.06		ND	ND	ND	0.15	ND
M'Clintock River	adult	Y-F-Site 3-7	1.52	0.76		ND	ND	ND	0.13	ND
		Blank(mar/12/97),Fr.1,2,3,/2mL								
		8929-Ref.Egg pool-Dil.9:1(A)	0.92	11.00	75.50	ND	ND	ND	4.65	3.98
Paddy's Pond - Whitehorse	adult	Y-F-Site 1-1	4.32	0.48		ND	ND	ND	0.15	ND
Paddy's Pond - Whitehorse	adult	Y-F-Site 1-3	4.63	0.75	73.16	ND	ND	ND	0.12	ND
Paddy's Pond - Whitehorse	adult	Y-F-Site 1-4	4.64	0.97	74.26	ND	ND	ND	0.16	ND
Paddy's Pond - Whitehorse	adult	Y-F-Site 1-9	2.99	1.19		ND	ND	ND	0.18	ND
Paddy's Pond - Whitehorse	adult	Y-F-Site 1-10	4.65	1.24	71.63	ND	ND	ND	0.19	ND
		Blank(mar/18/97),Fr.1,2,3,/2mL								
Pothole - Johnson Crossing	adult	Y-F-Site 4-2	2.15	1.23		ND	ND	ND	0.11	ND
Watson Lake Airport wetland	adult	Y-F-Site 5-1 A	4.61	2.60	77.08	ND	ND	ND	0.23	ND
Watson Lake Airport wetland	adult	Y-F-Site 5-1 B	4.61	3.14	77.08	ND	ND	0.06	0.27	ND
Wye Lake	adult	Y-F-Site 7-1	4.61	1.00		ND	ND	ND	ND	ND
Wye Lake	adult	Y-F-Site 7-3	1.44	2.08		ND	ND	ND	ND	ND
Wye Lake	tadpole	Y-F-Site 7-8	0.52	0.67		ND	ND	ND	ND	ND
		Blank(mar/20/97),Fr.1,2,3,/2mL								
		8929-Ref.Egg pool-Dil.9:1(A)	0.92	11.38	75.30	ND	ND	ND	4.09	2.44
Wye Lake	tadpole	Y-F-Site 7-9	0.09	2.50		ND	ND	ND	ND	ND
Wye Lake	tadpole	Y-F-Site 7-10	0.30	1.52		ND	ND	ND	ND	ND
Wye Lake	tadpole	Y-F-Site 7-11	0.16	2.08		ND	ND	ND	ND	ND
Wye Lake	tadpole	Y-F-Site 7-12	0.16	3.13		ND	ND	ND	ND	ND
Hillcrest wetland - Whitehorse	adult	Y-F-Site 9-2	4.61	1.95	77.72	ND	ND	0.07	0.14	ND
		Blank(mar/24/97),Fr.1,2,3,/2mL								
Hillcrest wetland - Whitehorse	adult	Y-F-Site 9-3	4.60	1.83	76.59	ND	ND	ND	0.16	ND
Hillcrest wetland - Whitehorse	adult	Y-F-Site 9-4	4.66	1.48	77.12	ND	ND	ND	0.15	ND
Hillcrest wetland - Whitehorse	adult	Y-F-Site 9-5	4.63	1.29	78.42	ND	ND	ND	0.11	ND
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-6	0.28	3.33		0.35	ND	0.47	0.08	ND
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-7	0.25	3.70		0.50	ND	0.52	ND	ND
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-8	0.35	1.32		0.32	ND	0.17	0.06	ND
		Blank(mar/26/97),Fr.1,2,3,/2mL								
		8929-Ref.Egg pool-Dil.9:1(A),Fr1	0.92	10.88	75.53	ND	ND	ND	3.93	2.59
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-9	0.25	2.03		0.81	0.11	0.78	0.22	ND
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-10	0.37	2.50		0.68	ND	0.41	0.16	ND
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-11	0.18	1.25		2.33	0.40	ND	0.14	ND
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-12	0.23	3.00		0.82	0.31	0.91	0.34	ND
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-13	0.21	1.63		2.20	0.21	ND	0.56	ND
Range Road dump	adult	Y-F-Site 14-1	0.98	1.87		0.35	0.05	ND	0.24	ND
Range Road dump	adult	Y-F-Site 14-2	1.79	1.35		0.36	ND	0.43	0.57	ND
Range Road dump	adult	Y-F-Site 14-3	0.63	0.73		0.99	0.09	0.27	0.25	ND
ND denotes non-detect										

Chemical concentrations in wood frogs and sediment determined by the GLIER continued.

Yukon Frogs 1997: Processed by GLIER

SITE	LIFE STAGE	I.D.	trans-Nonachlor	pp'-DDE	photo-Mirex	Mirex	a-HCH	b-HCH	g-HCH	oxy-Chlordane
Sediment - dry wt. concentrations										
Watson Airport Swamp		Sediment - SWAMP/SURROG.*	ND	2.69	ND	ND	ND	ND	ND	ND
Amphibians - wet wt. concentrations										
SITE	**LIFE STAGE**	**I.D.**	**trans-Nonachlor**	**pp'-DDE**	**photo-Mirex**	**Mirex**	**a-HCH**	**b-HCH**	**g-HCH**	**oxy-Chlordane**
M'Clintock River	adult	Y-F-Site 3-5	ND	0.60	ND	ND	ND	ND	ND	ND
M'Clintock River	adult	Y-F-Site 3-6	ND	0.94	ND	ND	ND	ND	ND	0.14
M'Clintock River	adult	Y-F-Site 3-7	ND	1.24	ND	ND	ND	ND	ND	ND
		Blank(mar/12/97),Fr.1,2,3,/2mL								
		8929-Ref.Egg pool-Dil.9:1(A)	6.42	406.49	ND	69.44	ND	ND	ND	11.83
Paddy's Pond - Whitehorse	adult	Y-F-Site 1-1	ND	100.18	ND	ND	0.45	ND	0.17	0.09
Paddy's Pond - Whitehorse	adult	Y-F-Site 1-3	ND	155.13	ND	ND	0.41	0.15	0.10	0.11
Paddy's Pond - Whitehorse	adult	Y-F-Site 1-4	ND	148.20	ND	ND	0.57	0.12	0.13	0.14
Paddy's Pond - Whitehorse	adult	Y-F-Site 1-9	ND	62.73	ND	ND	0.15	ND	ND	0.06
Paddy's Pond - Whitehorse	adult	Y-F-Site 1-10	ND	67.35	ND	0.07	0.19	ND	ND	0.14
		Blank(mar/18/97),Fr.1,2,3,/2mL								
Pothole - Johnson Crossing	adult	Y-F-Site 4-2	ND	ND	ND	ND	0.23	ND	ND	0.07
Watson Lake Airport wetland	adult	Y-F-Site 5-1 A	0.06	35.09	ND	ND	0.53	ND	ND	0.32
Watson Lake Airport wetland	adult	Y-F-Site 5-1 B	0.07	42.93	ND	ND	0.62	ND	ND	0.38
Wye Lake	adult	Y-F-Site 7-1	ND	4.14	ND	ND	0.15	ND	ND	ND
Wye Lake	adult	Y-F-Site 7-3	ND	12.43	ND	ND	ND	ND	ND	ND
Wye Lake	tadpole	Y-F-Site 7-8	ND	1.05	ND	ND	ND	ND	ND	ND
		Blank(mar/20/97),Fr.1,2,3,/2mL								
		8929-Ref.Egg pool-Dil.9:1(A)	6.30	358.98	ND	61.01	ND	ND	ND	10.86
Wye Lake	tadpole	Y-F-Site 7-9	ND	4.40	ND	ND	ND	ND	ND	ND
Wye Lake	tadpole	Y-F-Site 7-10	ND	3.80	ND	ND	ND	ND	ND	ND
Wye Lake	tadpole	Y-F-Site 7-11	ND	2.93	ND	ND	ND	ND	ND	ND
Wye Lake	tadpole	Y-F-Site 7-12	ND	4.13	ND	ND	ND	ND	ND	ND
Hillcrest wetland - Whitehorse	adult	Y-F-Site 9-2	ND	105.56	ND	ND	0.34	ND	ND	0.09
		Blank(mar/24/97),Fr.1,2,3,/2mL								
Hillcrest wetland - Whitehorse	adult	Y-F-Site 9-3	ND	174.14	ND	ND	0.22	ND	ND	0.11
Hillcrest wetland - Whitehorse	adult	Y-F-Site 9-4	0.06	136.72	ND	ND	0.29	ND	ND	0.19
Hillcrest wetland - Whitehorse	adult	Y-F-Site 9-5	ND	66.14	ND	ND	0.18	ND	ND	0.11
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-6	0.11	84.94	ND	ND	ND	ND	ND	ND
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-7	0.13	117.45	ND	ND	ND	ND	ND	ND
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-8	0.06	83.96	ND	ND	ND	ND	ND	ND
		Blank(mar/26/97),Fr.1,2,3,/2mL								
		8929-Ref.Egg pool-Dil.9:1(A),Fr1	6.56	391.46	ND	62.55	ND	ND	ND	12.33
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-9	0.06	75.76	ND	ND	0.12	ND	ND	ND
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-10	0.14	104.51	ND	ND	0.38	ND	ND	ND
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-11	0.15	75.99	ND	ND	0.34	ND	ND	ND
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-12	0.10	62.76	ND	ND	0.37	ND	ND	ND
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-13	0.19	98.05	ND	ND	0.16	ND	ND	ND
Range Road dump	adult	Y-F-Site 14-1	0.31	14.72	ND	ND	0.14	ND	ND	4.12
Range Road dump	adult	Y-F-Site 14-2	0.12	5.57	ND	0.30	0.14	ND	ND	1.25
Range Road dump	adult	Y-F-Site 14-3	0.21	2.36	ND	0.16	0.13	ND	ND	1.79

ND denotes non-detect

Chemical concentrations in wood frogs and sediment determined by the GLIER continued.

Yukon Frogs 1997: Processed by GLIER

SITE	LIFE STAGE	I.D.	trans-Chlordane	cis-Chlordane	pp'-DDD	cis-Nonachlor	pp'-DDT	Heptachlor Epoxide	Dieldrin	PCB #31/28
Sediment - dry wt. concentrations										
Watson Airport Swamp		Sediment - SWAMP/SURROG.*	ND	ND	18.40	ND	2.08	ND	ND	ND
Amphibians - wet wt. concentrations										
M'Clintock River	adult	Y-F-Site 3-5	ND	ND	ND	ND	ND	ND	ND	ND
M'Clintock River	adult	Y-F-Site 3-6	ND	ND	ND	ND	0.48	0.09	0.12	ND
M'Clintock River	adult	Y-F-Site 3-7	ND	ND	ND	ND	ND	ND	ND	ND
		Blank(mar/12/97),Fr.1,2,3,/2mL								
		8929-Ref.Egg pool-Dil.9:1(A)	ND	1.64	ND	6.03	32.89	4.67	10.61	5.65
Paddy's Pond - Whitehorse	adult	Y-F-Site 1-1	ND	ND	1.19	ND	0.99	ND	0.09	ND
Paddy's Pond - Whitehorse	adult	Y-F-Site 1-3	ND	ND	12.82	ND	76.58	ND	0.08	ND
Paddy's Pond - Whitehorse	adult	Y-F-Site 1-4	ND	ND	18.24	0.09	161.88	0.07	0.13	ND
Paddy's Pond - Whitehorse	adult	Y-F-Site 1-9	ND	ND	0.91	ND	3.12	ND	ND	ND
Paddy's Pond - Whitehorse	adult	Y-F-Site 1-10	ND	ND	6.95	ND	28.72	ND	0.09	ND
		Blank(mar/18/97),Fr.1,2,3,/2mL								
Pothole - Johnson Crossing	adult	Y-F-Site 4-2	ND	ND	ND	ND	ND	ND	ND	ND
Watson Lake Airport wetland	adult	Y-F-Site 5-1 A	ND	ND	5.79	ND	32.75	0.57	0.38	ND
Watson Lake Airport wetland	adult	Y-F-Site 5-1 B	ND	ND	7.05	ND	42.58	0.63	0.38	ND
Wye Lake	adult	Y-F-Site 7-1	ND	ND	ND	ND	ND	ND	ND	ND
Wye Lake	adult	Y-F-Site 7-3	ND	ND	1.80	ND	2.06	ND	ND	ND
Wye Lake	tadpole	Y-F-Site 7-8	ND	ND	ND	ND	ND	ND	ND	ND
		Blank(mar/20/97),Fr.1,2,3,/2mL								
		8929-Ref.Egg pool-Dil.9:1(A)	ND	1.08	ND	5.18	24.14	4.72	10.61	5.14
Wye Lake	tadpole	Y-F-Site 7-9	ND	ND	ND	ND	ND	ND	ND	ND
Wye Lake	tadpole	Y-F-Site 7-10	ND	ND	ND	ND	ND	ND	ND	ND
Wye Lake	tadpole	Y-F-Site 7-11	ND	ND	ND	ND	ND	ND	ND	ND
Wye Lake	tadpole	Y-F-Site 7-12	ND	ND	ND	ND	ND	ND	ND	ND
Hillcrest wetland - Whitehorse	adult	Y-F-Site 9-2	ND	ND	2.93	ND	13.46	0.06	0.15	ND
		Blank(mar/24/97),Fr.1,2,3,/2mL								
Hillcrest wetland - Whitehorse	adult	Y-F-Site 9-3	ND	ND	5.39	0.17	30.47	ND	0.07	ND
Hillcrest wetland - Whitehorse	adult	Y-F-Site 9-4	ND	ND	5.99	0.15	29.03	ND	ND	ND
Hillcrest wetland - Whitehorse	adult	Y-F-Site 9-5	ND	ND	11.66	ND	52.28	0.05	ND	ND
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-6	ND	ND	36.04	3.80	33.98	ND	ND	ND
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-7	ND	ND	24.81	1.99	23.04	ND	ND	ND
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-8	ND	ND	24.63	1.60	16.77	ND	ND	ND
		Blank(mar/26/97),Fr.1,2,3,/2mL								
		8929-Ref.Egg pool-Dil.9:1(A),Fr1	ND	1.41	ND	5.72	25.66	4.41	9.45	3.33
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-9	ND	ND	29.23	ND	2.92	ND	ND	ND
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-10	ND	ND	25.55	ND	3.06	ND	ND	ND
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-11	ND	ND	ND	ND	ND	ND	ND	ND
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-12	ND	ND	14.96	ND	ND	ND	ND	ND
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-13	ND	ND	9.42	ND	ND	ND	ND	ND
Range Road dump	adult	Y-F-Site 14-1	ND	ND	0.72	ND	1.06	ND	0.48	0.48
Range Road dump	adult	Y-F-Site 14-2	ND	ND	0.54	ND	3.21	ND	0.24	1.16
Range Road dump	adult	Y-F-Site 14-3	ND	ND	ND	0.08	2.04	ND	ND	1.40

ND denotes non-detect

Chemical concentrations in wood frogs and sediment determined by the GLIER continued.

Yukon Frogs 1997: Processed by GLIER										
Sediment - dry wt. concentrations										
	LIFE									**PCB**
SITE	**STAGE**	**I.D.**	**PCB #52**	**PCB #49**	**PCB #44**	**PCB #42**	**PCB #64**	**PCB #74**	**PCB #70**	**#66/95**
Watson Airport Swamp		Sediment - SWAMP/SURROG.*	ND	ND	ND	ND	ND	ND	ND	ND
Amphibians - wet wt. concentrations										
	LIFE									**PCB**
SITE	**STAGE**	**I.D.**	**PCB #52**	**PCB #49**	**PCB #44**	**PCB #42**	**PCB #64**	**PCB #74**	**PCB #70**	**#66/95**
M'Clintock River	adult	Y-F-Site 3-5	ND	ND	ND	ND	ND	ND	ND	ND
M'Clintock River	adult	Y-F-Site 3-6	ND	ND	ND	ND	ND	ND	ND	ND
M'Clintock River	adult	Y-F-Site 3-7	ND	ND	ND	ND	ND	ND	ND	ND
		Blank(mar/12/97),Fr.1,2,3,/2mL								
		8929-Ref.Egg pool-Dil.9:1(A)	15.75	ND	2.84	ND	0.88	14.00	ND	27.67
Paddy's Pond - Whitehorse	adult	Y-F-Site 1-1	ND	ND	ND	ND	ND	ND	ND	ND
Paddy's Pond - Whitehorse	adult	Y-F-Site 1-3	ND	ND	ND	ND	ND	ND	ND	ND
Paddy's Pond - Whitehorse	adult	Y-F-Site 1-4	ND	ND	ND	ND	ND	ND	ND	ND
Paddy's Pond - Whitehorse	adult	Y-F-Site 1-9	ND	ND	ND	ND	ND	ND	ND	ND
Paddy's Pond - Whitehorse	adult	Y-F-Site 1-10	ND	ND	ND	ND	ND	ND	ND	ND
		Blank(mar/18/97),Fr.1,2,3,/2mL								
Pothole - Johnson Crossing	adult	Y-F-Site 4-2	ND	ND	ND	ND	ND	ND	ND	ND
Watson Lake Airport wetland	adult	Y-F-Site 5-1 A	ND	ND	ND	ND	ND	ND	ND	ND
Watson Lake Airport wetland	adult	Y-F-Site 5-1 B	ND	ND	ND	ND	ND	ND	ND	ND
Wye Lake	adult	Y-F-Site 7-1	ND	ND	ND	ND	ND	ND	ND	ND
Wye Lake	adult	Y-F-Site 7-3	ND	ND	ND	ND	ND	ND	ND	ND
Wye Lake	tadpole	Y-F-Site 7-8	ND	ND	ND	ND	ND	ND	ND	ND
		Blank(mar/20/97),Fr.1,2,3,/2mL								
		8929-Ref.Egg pool-Dil.9:1(A)	14.11	ND	2.58	ND	0.79	12.82	ND	27.29
Wye Lake	tadpole	Y-F-Site 7-9	ND	ND	ND	ND	ND	ND	ND	ND
Wye Lake	tadpole	Y-F-Site 7-10	ND	ND	ND	ND	ND	ND	ND	ND
Wye Lake	tadpole	Y-F-Site 7-11	ND	ND	ND	ND	ND	ND	ND	ND
Wye Lake	tadpole	Y-F-Site 7-12	ND	ND	ND	ND	ND	ND	ND	ND
Hillcrest wetland - Whitehorse	adult	Y-F-Site 9-2	ND	ND	ND	ND	ND	ND	ND	ND
		Blank(mar/24/97),Fr.1,2,3,/2mL								
Hillcrest wetland - Whitehorse	adult	Y-F-Site 9-3	ND	ND	ND	ND	ND	ND	ND	ND
Hillcrest wetland - Whitehorse	adult	Y-F-Site 9-4	ND	ND	ND	ND	ND	ND	ND	ND
Hillcrest wetland - Whitehorse	adult	Y-F-Site 9-5	ND	ND	ND	ND	ND	ND	ND	ND
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-6	ND	ND	ND	ND	ND	ND	0.15	ND
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-7	ND	ND	ND	ND	ND	ND	ND	ND
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-8	ND	ND	ND	ND	ND	ND	ND	ND
		Blank(mar/26/97),Fr.1,2,3,/2mL								
		8929-Ref.Egg pool-Dil.9:1(A),Fr1	14.84	ND	2.77	ND	0.86	11.48	ND	25.37
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-9	ND	ND	ND	ND	ND	ND	ND	ND
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-10	ND	ND	ND	ND	ND	ND	0.13	0.24
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-11	ND	ND	0.51	ND	ND	ND	0.31	0.37
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-12	ND	ND	0.36	ND	ND	ND	ND	ND
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-13	ND	ND	0.49	ND	ND	ND	0.18	0.22
Range Road dump	adult	Y-F-Site 14-1	ND	ND	0.07	ND	ND	0.26	ND	0.15
Range Road dump	adult	Y-F-Site 14-2	0.07	ND	0.08	ND	ND	0.16	ND	ND
Range Road dump	adult	Y-F-Site 14-3	0.18	ND	0.22	ND	ND	1.29	ND	0.15
ND denotes non-detect										

Chemical concentrations in wood frogs and sediment determined by the GLIER continued.

Yukon Frogs 1997: Processed by GLIER										
Sediment - dry wt. concentrations										
	LIFE									
SITE	**STAGE**	**I.D.**	**PCB #60**	**PCB #101**	**PCB #99**	**PCB #97**	**PCB #87**	**PCB #110**	**PCB #151**	**PCB #149**
Watson Airport Swamp		Sediment - SWAMP/SURROG.*	ND	0.15	ND	ND	ND	0.19	0.12	0.55
Amphibians - wet wt. concentrations										
	LIFE									
SITE	**STAGE**	**I.D.**	**PCB #60**	**PCB #101**	**PCB #99**	**PCB #97**	**PCB #87**	**PCB #110**	**PCB #151**	**PCB #149**
M'Clintock River	adult	Y-F-Site 3-5	ND	ND	ND	ND	ND	ND	ND	ND
M'Clintock River	adult	Y-F-Site 3-6	ND	ND	ND	ND	ND	ND	ND	ND
M'Clintock River	adult	Y-F-Site 3-7	ND	ND	ND	ND	ND	ND	ND	ND
		Blank(mar/12/97),Fr.1,2,3,/2mL								
		8929-Ref.Egg pool-Dil.9:1(A)	10.92	30.88	59.62	4.43	5.18	19.56	3.45	29.25
Paddy's Pond - Whitehorse	adult	Y-F-Site 1-1	ND	ND	ND	ND	ND	ND	ND	ND
Paddy's Pond - Whitehorse	adult	Y-F-Site 1-3	ND	ND	ND	ND	ND	ND	ND	ND
Paddy's Pond - Whitehorse	adult	Y-F-Site 1-4	ND	ND	ND	ND	ND	ND	ND	ND
Paddy's Pond - Whitehorse	adult	Y-F-Site 1-9	ND	ND	ND	ND	ND	ND	ND	ND
Paddy's Pond - Whitehorse	adult	Y-F-Site 1-10	ND	ND	ND	ND	ND	ND	ND	ND
		Blank(mar/18/97),Fr.1,2,3,/2mL								
Pothole - Johnson Crossing	adult	Y-F-Site 4-2	ND	ND	ND	ND	ND	ND	ND	ND
Watson Lake Airport wetland	adult	Y-F-Site 5-1 A	ND	0.06	0.39	ND	ND	ND	ND	ND
Watson Lake Airport wetland	adult	Y-F-Site 5-1 B	ND	0.09	0.47	ND	ND	ND	ND	ND
Wye Lake	adult	Y-F-Site 7-1	ND	ND	ND	ND	ND	ND	ND	ND
Wye Lake	adult	Y-F-Site 7-3	ND	ND	ND	ND	ND	ND	ND	ND
Wye Lake	tadpole	Y-F-Site 7-8	ND	ND	ND	ND	ND	ND	ND	ND
		Blank(mar/20/97),Fr.1,2,3,/2mL								
		8929-Ref.Egg pool-Dil.9:1(A)	11.14	27.01	52.55	3.96	4.77	17.10	3.26	25.77
Wye Lake	tadpole	Y-F-Site 7-9	ND	ND	ND	ND	ND	ND	ND	ND
Wye Lake	tadpole	Y-F-Site 7-10	ND	ND	ND	ND	ND	ND	ND	ND
Wye Lake	tadpole	Y-F-Site 7-11	ND	ND	ND	ND	ND	ND	ND	ND
Wye Lake	tadpole	Y-F-Site 7-12	ND	ND	ND	ND	ND	ND	ND	ND
Hillcrest wetland - Whitehorse	adult	Y-F-Site 9-2	ND	ND	0.07	ND	ND	ND	ND	ND
		Blank(mar/24/97),Fr.1,2,3,/2mL								
Hillcrest wetland - Whitehorse	adult	Y-F-Site 9-3	ND	ND	ND	ND	ND	ND	ND	ND
Hillcrest wetland - Whitehorse	adult	Y-F-Site 9-4	ND	ND	0.12	ND	ND	ND	ND	ND
Hillcrest wetland - Whitehorse	adult	Y-F-Site 9-5	0.07	ND	0.10	ND	ND	ND	ND	ND
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-6	1.17	0.23	ND	ND	ND	ND	ND	ND
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-7	1.24	0.30	ND	ND	ND	ND	ND	ND
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-8	ND	0.17	ND	ND	ND	ND	ND	0.29
		Blank(mar/26/97),Fr.1,2,3,/2mL								
		8929-Ref.Egg pool-Dil.9:1(A),Fr1	7.81	28.13	54.81	3.97	4.75	17.15	3.30	26.54
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-9	ND	0.20	ND	ND	ND	ND	ND	0.45
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-10	ND	0.26	ND	ND	ND	ND	ND	0.53
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-11	0.27	0.16	ND	ND	ND	ND	ND	ND
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-12	ND	0.25	ND	ND	ND	ND	ND	0.19
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-13	0.94	0.33	ND	ND	ND	ND	ND	0.66
Range Road dump	adult	Y-F-Site 14-1	0.10	ND	0.25	ND	ND	ND	0.05	0.05
Range Road dump	adult	Y-F-Site 14-2	ND	ND	0.18	ND	ND	ND	ND	0.08
Range Road dump	adult	Y-F-Site 14-3	0.09	ND	0.13	ND	ND	0.05	ND	0.14
ND denotes non-detect										

Chemical concentrations in wood frogs and sediment determined by the GLIER continued.

Yukon Frogs 1997: Processed by GLIER										
Sediment - dry wt. concentrations										
SITE	**LIFE STAGE**	**I.D.**	**PCB #118**	**PCB #146**	**PCB #153**	**PCB #105**	**PCB #141**	**PCB #138**	**PCB #158**	**PCB #129**
Watson Airport Swamp		Sediment - SWAMP/SURROG.*	ND	0.13	0.49	ND	ND	0.46	ND	ND
Amphibians - wet wt. concentrations										
SITE	**LIFE STAGE**	**I.D.**	**PCB #118**	**PCB #146**	**PCB #153**	**PCB #105**	**PCB #141**	**PCB #138**	**PCB #158**	**PCB #129**
M'Clintock River	adult	Y-F-Site 3-5	ND	ND	ND	ND	ND	ND	ND	ND
M'Clintock River	adult	Y-F-Site 3-6	ND	ND	ND	ND	ND	ND	ND	ND
M'Clintock River	adult	Y-F-Site 3-7	ND	ND	ND	ND	ND	ND	ND	ND
		Blank(mar/12/97),Fr.1,2,3,/2mL								
		8929-Ref.Egg pool-Dil.9:1(A)	84.36	30.75	199.84	16.73	7.52	195.17	8.03	10.92
Paddy's Pond - Whitehorse	adult	Y-F-Site 1-1	ND	ND	0.12	ND	ND	ND	ND	ND
Paddy's Pond - Whitehorse	adult	Y-F-Site 1-3	ND	ND	0.13	ND	ND	ND	ND	ND
Paddy's Pond - Whitehorse	adult	Y-F-Site 1-4	ND	0.34	0.35	ND	ND	ND	ND	ND
Paddy's Pond - Whitehorse	adult	Y-F-Site 1-9	ND	ND	ND	ND	ND	ND	ND	ND
Paddy's Pond - Whitehorse	adult	Y-F-Site 1-10	ND	ND	0.23	ND	ND	ND	ND	ND
		Blank(mar/18/97),Fr.1,2,3,/2mL								
Pothole - Johnson Crossing	adult	Y-F-Site 4-2	ND	ND	ND	ND	ND	ND	ND	ND
Watson Lake Airport wetland	adult	Y-F-Site 5-1 A	0.87	0.13	2.34	0.08	ND	1.15	ND	0.05
Watson Lake Airport wetland	adult	Y-F-Site 5-1 B	0.90	0.19	2.78	0.10	ND	1.51	ND	0.07
Wye Lake	adult	Y-F-Site 7-1	ND	ND	ND	ND	ND	ND	ND	ND
Wye Lake	adult	Y-F-Site 7-3	ND	ND	ND	ND	ND	ND	ND	ND
Wye Lake	tadpole	Y-F-Site 7-8	ND	ND	ND	ND	ND	ND	ND	ND
		Blank(mar/20/97),Fr.1,2,3,/2mL								
		8929-Ref.Egg pool-Dil.9:1(A)	72.70	27.46	177.89	16.31	6.79	171.45	7.91	10.71
Wye Lake	tadpole	Y-F-Site 7-9	ND	ND	ND	ND	ND	ND	ND	ND
Wye Lake	tadpole	Y-F-Site 7-10	ND	ND	ND	ND	ND	ND	ND	ND
Wye Lake	tadpole	Y-F-Site 7-11	ND	ND	ND	ND	ND	ND	ND	ND
Wye Lake	tadpole	Y-F-Site 7-12	ND	ND	ND	ND	ND	ND	ND	ND
Hillcrest wetland - Whitehorse	adult	Y-F-Site 9-2	0.16	0.13	0.42	ND	ND	0.31	ND	ND
		Blank(mar/24/97),Fr.1,2,3,/2mL								
Hillcrest wetland - Whitehorse	adult	Y-F-Site 9-3	ND	0.23	0.62	ND	ND	0.44	ND	ND
Hillcrest wetland - Whitehorse	adult	Y-F-Site 9-4	ND	0.17	0.54	ND	ND	0.41	ND	ND
Hillcrest wetland - Whitehorse	adult	Y-F-Site 9-5	ND	ND	0.35	ND	ND	ND	ND	ND
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-6	ND	0.12	0.53	ND	ND	0.82	ND	ND
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-7	ND	0.11	0.59	ND	ND	0.80	ND	ND
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-8	ND	0.11	0.50	ND	ND	0.54	ND	ND
		Blank(mar/26/97),Fr.1,2,3,/2mL								
		8929-Ref.Egg pool-Dil.9:1(A),Fr1	77.35	29.06	182.57	16.75	6.84	175.49	6.32	9.36
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-9	ND	0.15	0.45	ND	ND	0.65	ND	0.11
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-10	ND	0.16	0.82	ND	0.16	0.79	ND	ND
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-11	ND	ND	0.39	ND	ND	0.67	ND	ND
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-12	ND	ND	0.32	ND	ND	0.62	ND	ND
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-13	ND	0.09	0.77	0.20	0.19	0.96	ND	ND
Range Road dump	adult	Y-F-Site 14-1	0.44	0.11	2.49	0.07	ND	1.63	0.05	0.08
Range Road dump	adult	Y-F-Site 14-2	0.46	0.07	2.07	ND	ND	1.11	ND	ND
Range Road dump	adult	Y-F-Site 14-3	1.72	ND	1.20	0.14	ND	0.97	ND	ND
ND denotes non-detect										

Chemical concentrations in wood frogs and sediment determined by the GLIER continued.

Yukon Frogs 1997: Processed by GLIER

SITE	LIFE STAGE	I.D.	PCB #182/187	PCB #183	PCB #185	PCB #174	PCB #171	PCB #200	PCB #172	PCB #180
Sediment - dry wt. concentrations										
Watson Airport Swamp		Sediment - SWAMP/SURROG.*	0.46	0.10	ND	ND	ND	ND	ND	0.44
Amphibians - wet wt. concentrations										
SITE	**LIFE STAGE**	**I.D.**	**PCB #182/187**	**PCB #183**	**PCB #185**	**PCB #174**	**PCB #171**	**PCB #200**	**PCB #172**	**PCB #180**
M'Clintock River	adult	Y-F-Site 3-5	ND	ND	ND	ND	ND	ND	ND	ND
M'Clintock River	adult	Y-F-Site 3-6	ND	ND	ND	ND	ND	ND	ND	ND
M'Clintock River	adult	Y-F-Site 3-7	ND	ND	ND	ND	ND	ND	ND	ND
		Blank(mar/12/97),Fr.1,2,3,/2mL								
		8929-Ref.Egg pool-Dil.9:1(A)	89.96	41.83	1.98	8.27	23.73	6.17	8.61	151.90
Paddy's Pond - Whitehorse	adult	Y-F-Site 1-1	ND	ND	ND	ND	ND	ND	ND	0.14
Paddy's Pond - Whitehorse	adult	Y-F-Site 1-3	ND	ND	ND	ND	ND	ND	ND	0.15
Paddy's Pond - Whitehorse	adult	Y-F-Site 1-4	ND	ND	ND	ND	ND	ND	ND	0.31
Paddy's Pond - Whitehorse	adult	Y-F-Site 1-9	ND	ND	ND	ND	ND	ND	ND	0.08
Paddy's Pond - Whitehorse	adult	Y-F-Site 1-10	ND	ND	ND	ND	ND	ND	ND	0.06
		Blank(mar/18/97),Fr.1,2,3,/2mL								
Pothole - Johnson Crossing	adult	Y-F-Site 4-2	ND	ND	ND	ND	ND	ND	ND	ND
Watson Lake Airport wetland	adult	Y-F-Site 5-1 A	0.33	0.17	ND	ND	ND	ND	ND	1.12
Watson Lake Airport wetland	adult	Y-F-Site 5-1 B	0.42	0.20	ND	ND	ND	ND	ND	1.40
Wye Lake	adult	Y-F-Site 7-1	ND	ND	ND	ND	ND	ND	ND	ND
Wye Lake	adult	Y-F-Site 7-3	ND	ND	ND	ND	ND	ND	ND	ND
Wye Lake	tadpole	Y-F-Site 7-8	ND	ND	ND	ND	ND	ND	ND	ND
		Blank(mar/20/97),Fr.1,2,3,/2mL								
		8929-Ref.Egg pool-Dil.9:1(A)	77.52	35.59	1.63	7.31	19.84	5.08	7.46	133.84
Wye Lake	tadpole	Y-F-Site 7-9	ND	ND	ND	ND	ND	ND	ND	ND
Wye Lake	tadpole	Y-F-Site 7-10	ND	ND	ND	ND	ND	ND	ND	ND
Wye Lake	tadpole	Y-F-Site 7-11	ND	ND	ND	ND	ND	ND	ND	ND
Wye Lake	tadpole	Y-F-Site 7-12	ND	ND	ND	ND	ND	ND	ND	ND
Hillcrest wetland - Whitehorse	adult	Y-F-Site 9-2	0.17	0.07	ND	ND	ND	ND	ND	0.41
		Blank(mar/24/97),Fr.1,2,3,/2mL								
Hillcrest wetland - Whitehorse	adult	Y-F-Site 9-3	0.10	0.15	ND	ND	ND	ND	ND	0.71
Hillcrest wetland - Whitehorse	adult	Y-F-Site 9-4	0.08	0.12	ND	ND	ND	ND	ND	0.60
Hillcrest wetland - Whitehorse	adult	Y-F-Site 9-5	ND	0.05	ND	ND	ND	ND	ND	0.46
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-6	0.71	0.18	ND	0.14	ND	ND	ND	0.71
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-7	0.79	0.19	ND	2.15	ND	ND	ND	0.72
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-8	0.42	ND	ND	0.08	ND	ND	ND	0.40
		Blank(mar/26/97),Fr.1,2,3,/2mL								
		8929-Ref.Egg pool-Dil.9:1(A),Fr1	81.69	37.00	1.70	8.15	20.46	4.92	6.95	135.14
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-9	0.48	ND	ND	0.24	ND	ND	ND	0.47
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-10	0.60	0.19	ND	0.21	0.11	ND	ND	0.66
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-11	1.17	0.19	ND	ND	ND	ND	ND	0.63
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-12	0.92	ND	ND	0.12	ND	ND	ND	0.53
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-13	1.01	0.18	ND	0.24	ND	ND	ND	0.75
Range Road dump	adult	Y-F-Site 14-1	0.55	0.51	ND	0.35	0.15	ND	ND	2.52
Range Road dump	adult	Y-F-Site 14-2	0.38	0.39	ND	ND	0.17	ND	ND	1.69
Range Road dump	adult	Y-F-Site 14-3	0.12	0.37	ND	0.06	0.21	ND	ND	1.95
ND denotes non-detect										

Chemical concentrations in wood frogs and sediment determined by the GLIER continued.

Yukon Frogs 1997: Processed by GLIER										
Sediment - dry wt. concentrations										
SITE	**LIFE STAGE**	**I.D.**	**PCB #170/190**	**PCB #201**	**PCB #203**	**PCB #195**	**PCB #194**	**PCB #206**	**Total PCB**	**Arochlor 1254:1260**
Watson Airport Swamp		Sediment - SWAMP/SURROG.*	ND	0.10	ND	ND	ND	ND	3.19	6.21
Amphibians - wet wt. concentrations										
SITE	**LIFE STAGE**	**I.D.**	**PCB #170/190**	**PCB #201**	**PCB #203**	**PCB #195**	**PCB #194**	**PCB #206**	**Total PCB**	**Arochlor 1254:1260**
M'Clintock River	adult	Y-F-Site 3-5	ND	ND	ND	ND	ND	ND	ND	ND
M'Clintock River	adult	Y-F-Site 3-6	ND	ND	ND	ND	ND	ND	ND	ND
M'Clintock River	adult	Y-F-Site 3-7	ND	ND	ND	ND	ND	ND	ND	ND
		Blank(mar/12/97),Fr.1,2,3,/2mL								
		8929-Ref.Egg pool-Dil.9:1(A)	61.51	31.39	23.16	8.88	18.91	6.14	1265.85	2637.42
Paddy's Pond - Whitehorse	adult	Y-F-Site 1-1	ND	ND	ND	ND	ND	ND	0.26	ND
Paddy's Pond - Whitehorse	adult	Y-F-Site 1-3	ND	ND	ND	ND	ND	ND	0.28	ND
Paddy's Pond - Whitehorse	adult	Y-F-Site 1-4	0.10	ND	ND	ND	0.05	ND	1.14	ND
Paddy's Pond - Whitehorse	adult	Y-F-Site 1-9	ND	ND	ND	ND	ND	ND	0.08	ND
Paddy's Pond - Whitehorse	adult	Y-F-Site 1-10	ND	ND	ND	ND	0.05	ND	0.34	ND
		Blank(mar/18/97),Fr.1,2,3,/2mL								
Pothole - Johnson Crossing	adult	Y-F-Site 4-2	ND	ND	ND	ND	ND	ND	ND	ND
Watson Lake Airport wetland	adult	Y-F-Site 5-1 A	0.41	0.09	0.10	ND	0.11	ND	7.42	15.59
Watson Lake Airport wetland	adult	Y-F-Site 5-1 B	0.58	0.11	0.10	ND	0.14	ND	9.13	20.36
Wye Lake	adult	Y-F-Site 7-1	ND	ND	ND	ND	ND	ND	0.07	ND
Wye Lake	adult	Y-F-Site 7-3	ND	ND	ND	ND	ND	ND	ND	ND
Wye Lake	tadpole	Y-F-Site 7-8	ND	ND	ND	ND	ND	ND	ND	ND
		Blank(mar/20/97),Fr.1,2,3,/2mL								
		8929-Ref.Egg pool-Dil.9:1(A)	51.36	26.97	19.81	7.21	16.18	4.37	1113.69	2316.91
Wye Lake	tadpole	Y-F-Site 7-9	ND	ND	ND	ND	ND	ND	ND	ND
Wye Lake	tadpole	Y-F-Site 7-10	ND	ND	ND	ND	ND	ND	ND	ND
Wye Lake	tadpole	Y-F-Site 7-11	ND	ND	ND	ND	ND	ND	ND	ND
Wye Lake	tadpole	Y-F-Site 7-12	ND	ND	ND	ND	ND	ND	ND	ND
Hillcrest wetland - Whitehorse	adult	Y-F-Site 9-2	0.16	0.07	0.06	ND	0.10	ND	2.14	4.19
		Blank(mar/24/97),Fr.1,2,3,/2mL								
Hillcrest wetland - Whitehorse	adult	Y-F-Site 9-3	0.36	0.05	0.15	0.05	0.21	ND	3.06	5.90
Hillcrest wetland - Whitehorse	adult	Y-F-Site 9-4	0.34	ND	0.13	0.05	0.14	ND	2.71	5.51
Hillcrest wetland - Whitehorse	adult	Y-F-Site 9-5	0.14	ND	0.07	ND	0.13	ND	1.37	ND
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-6	0.26	0.16	0.10	ND	0.46	ND	5.75	11.06
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-7	0.26	0.12	0.08	ND	0.49	ND	7.83	10.76
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-8	0.18	0.10	0.05	ND	0.22	ND	3.06	7.28
		Blank(mar/26/97),Fr.1,2,3,/2mL								
		8929-Ref.Egg pool-Dil.9:1(A),Fr1	54.57	30.37	20.91	7.58	15.48	5.14	1137.50	2371.53
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-9	0.21	0.10	0.07	0.14	0.15	ND	3.87	8.84
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-10	0.32	0.16	0.10	ND	0.16	ND	5.61	10.74
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-11	0.21	ND	0.08	ND	0.61	ND	5.56	9.02
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-12	0.24	ND	0.11	ND	0.43	ND	4.08	8.35
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-13	0.29	0.17	0.13	ND	0.36	ND	8.15	13.02
Range Road dump	adult	Y-F-Site 14-1	1.23	0.12	0.31	0.18	0.45	0.05	12.80	22.04
Range Road dump	adult	Y-F-Site 14-2	0.97	0.06	0.23	0.20	0.42	0.06	10.25	15.00
Range Road dump	adult	Y-F-Site 14-3	0.98	ND	0.41	0.17	0.47	0.06	12.62	13.11
ND denotes non-detect										

Chemical concentrations in wood frogs and sediment determined by the GLIER continued.

Yukon Frogs 1997: Processed by GLIER						
				SURROGATE RECOVERY(%)		
Sediment - dry wt. concentrations						
SITE	**LIFE STAGE**	**I.D.**	**Arochlor 1260**	**1,3,5-tri-bromobenz**	**Tetra-Cl-m-xylene**	**PCB#209**
Watson Airport Swamp		Sediment - SWAMP/SURROG.*	3.90	96.27	94.88	100.90
Amphibians - wet wt. concentrations						
SITE	**LIFE STAGE**	**I.D.**	**Arochlor 1260**	**1,3,5-tri-bromobenz**	**Tetra-Cl-m-xylene**	**PCB#209**
M'Clintock River	adult	Y-F-Site 3-5	ND	79.51	89.92	89.22
M'Clintock River	adult	Y-F-Site 3-6	ND	106.60	117.50	118.55
M'Clintock River	adult	Y-F-Site 3-7	ND	104.07	106.56	113.84
		Blank(mar/12/97),Fr.1,2,3,/2mL		105.93	108.16	102.16
		8929-Ref.Egg pool-Dil.9:1(A)	1332.47	98.11	99.44	120.50
Paddy's Pond - Whitehorse	adult	Y-F-Site 1-1	1.20	98.85	102.50	118.55
Paddy's Pond - Whitehorse	adult	Y-F-Site 1-3	1.29	95.51	97.29	94.17
Paddy's Pond - Whitehorse	adult	Y-F-Site 1-4	2.73	96.66	99.29	115.96
Paddy's Pond - Whitehorse	adult	Y-F-Site 1-9	0.74	99.07	96.41	119.73
Paddy's Pond - Whitehorse	adult	Y-F-Site 1-10	1.21	76.13	82.43	86.88
		Blank(mar/18/97),Fr.1,2,3,/2mL		86.91	105.61	141.72
Pothole - Johnson Crossing	adult	Y-F-Site 4-2	ND	97.49	99.18	133.97
Watson Lake Airport wetland	adult	Y-F-Site 5-1 A	9.83	95.51	97.83	123.24
Watson Lake Airport wetland	adult	Y-F-Site 5-1 B	12.29	88.89	98.29	135.37
Wye Lake	adult	Y-F-Site 7-1	0.28	74.93	85.35	107.48
Wye Lake	adult	Y-F-Site 7-3	ND	78.15	82.21	85.83
Wye Lake	tadpole	Y-F-Site 7-8	ND	103.57	123.21	171.94
		Blank(mar/20/97),Fr.1,2,3,/2mL		99.65	104.59	110.67
		8929-Ref.Egg pool-Dil.9:1(A)	1174.06	105.03	98.87	134.00
Wye Lake	tadpole	Y-F-Site 7-9	ND	109.52	111.14	116.90
Wye Lake	tadpole	Y-F-Site 7-10	ND	100.61	96.27	81.11
Wye Lake	tadpole	Y-F-Site 7-11	ND	97.82	95.04	84.19
Wye Lake	tadpole	Y-F-Site 7-12	ND	105.67	103.69	87.55
Hillcrest wetland - Whitehorse	adult	Y-F-Site 9-2	3.58	108.68	103.31	106.21
		Blank(mar/24/97),Fr.1,2,3,/2mL		96.25	96.03	90.82
Hillcrest wetland - Whitehorse	adult	Y-F-Site 9-3	6.23	99.03	96.25	97.99
Hillcrest wetland - Whitehorse	adult	Y-F-Site 9-4	5.30	94.62	94.17	105.61
Hillcrest wetland - Whitehorse	adult	Y-F-Site 9-5	4.00	83.52	83.64	94.85
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-6	6.24			
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-7	6.31			
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-8	3.53			
		Blank(mar/26/97),Fr.1,2,3,/2mL		112.24	112.70	111.20
		8929-Ref.Egg pool-Dil.9:1(A),Fr1	1185.44	111.19	110.03	130.32
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-9	4.14			
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-10	5.82			
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-11	5.55			
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-12	4.65			
Hillcrest wetland - Whitehorse	tadpole	Y-F-Site 9-13	6.59			
Range Road dump	adult	Y-F-Site 14-1	22.09			
Range Road dump	adult	Y-F-Site 14-2	14.82			
Range Road dump	adult	Y-F-Site 14-3	17.12			
ND denotes non-detect						

APPENDIX II

Contaminant concentrations in wood frogs determined by the Envirotest Laboratories.

Contaminant concentrations in amphibians are expressed in µg/kg wet weight.

Yukon Frogs 1997: Processed by			Envirotest								
			CONCENTRATIONS: ug/kg wet wt.								
SITE	LIFE STAGE	ID	% LIPID	pp'-DDE	Mirex	HCB/ a-HCH	b-HCH	g-HCH	oxy-Chlordane	trans-Chlordane	cis-Chlordane
Paddy's Pond - Whitehorse	adult	1-2	0.9	31	ND	ND	ND	ND	ND	ND	ND
Paddy's Pond - Whitehorse	adult	1-5	0.8	25	ND	ND	ND	ND	ND	ND	ND
Paddy's Pond - Whitehorse	adult	1-6 to 1-8	1.3	13	ND	0.4	ND	0.6	ND	ND	ND
Hidden Lake 2 - Whitehorse	adult	2-1	0.7	2	ND	ND	ND	ND	ND	ND	ND
Hidden Lake 2 - Whitehorse	adult	2-2	0.6	4	ND	ND	ND	ND	ND	ND	ND
M'Clintock River	adult	3-1	3	0.8	ND	ND	ND	ND	ND	ND	ND
M'Clintock River	adult	3-2	1.5	1.4	ND	ND	ND	0.9	ND	ND	ND
Pothole - Johnson Crossing	adult	4-1	4.1	0.9	ND	ND	ND	ND	ND	ND	ND
Watson Lake Airport wetland	adult	5-2	5.2	28	ND	ND	ND	ND	ND	ND	ND
Watson Lake shore	adult	6-1	5.1	31	ND	ND	ND	ND	ND	ND	ND
Wye Lake	adult	7-2	4	37	ND	ND	ND	ND	ND	ND	ND
Wye Lake	tadpole	7-4 to 7-7	2.8	2.2	ND	ND	ND	ND	ND	ND	ND
Golden Pond	adult	8-1 to 8-3	2.5	0.7	ND	ND	ND	ND	ND	ND	ND
Whitehorse effluent lagoon	adult	10-1	2.8	4	ND	ND	ND	ND	ND	ND	ND
Yukon River - pothole below I	adult	11-1	2.5	2.3	ND	ND	ND	12	ND	ND	ND
Snag Rd. - 9 km from airport	adult	12-1	2.1	ND	ND	ND	ND	ND	ND	ND	ND
Snag Rd. - pond 1 km from a	adult	12-2	2.2	ND	ND	ND	ND	ND	ND	ND	ND
Yukon River at Thistle Creek	adult	13-1	2	ND	ND	ND	ND	ND	ND	ND	ND
Range Road dump	adult	14-4	2.3	5.9	ND	0.7	ND	0.5	1	ND	ND
Skagway Rd. - R. pretiosa	adult	15-1		0.3	ND	ND	ND	ND	ND	ND	ND
ND Indicates Non-Detect											

Contaminant concentrations in wood frogs determined by the Envirotest Laboratories continued.

Yukon Frogs 1997: Processed by		Envirotest					
SITE	LIFE STAGE	ID	pp'-DDD	pp'-DDT	Heptachlor Epoxide	Dieldrin	Arochlor 1260
Paddy's Pond - Whitehorse	adult	1-2	ND	ND	ND	ND	ND
Paddy's Pond - Whitehorse	adult	1-5	ND	ND	ND	ND	ND
Paddy's Pond - Whitehorse	adult	1-6 to 1-8	0.7	1	ND	ND	ND
Hidden Lake 2 - Whitehorse	adult	2-1	ND	ND	ND	ND	ND
Hidden Lake 2 - Whitehorse	adult	2-2	ND	ND	ND	ND	ND
M'Clintock River	adult	3-1	ND	ND	ND	ND	ND
M'Clintock River	adult	3-2	ND	ND	ND	ND	ND
Pothole - Johnson Crossing	adult	4-1	ND	ND	ND	ND	ND
Watson Lake Airport wetland	adult	5-2	4.5	18	ND	ND	ND
Watson Lake shore	adult	6-1	1.6	3	ND	ND	ND
Wye Lake	adult	7-2	1.4	ND	ND	ND	ND
Wye Lake	tadpole	7-4 to 7-7	ND	ND	ND	ND	ND
Golden Pond	adult	8-1 to 8-3	ND	ND	ND	ND	420
Whitehorse effluent lagoon	adult	10-1	ND	ND	ND	ND	ND
Yukon River - pothole below I	adult	11-1	ND	ND	ND	ND	ND
Snag Rd. - 9 km from airport	adult	12-1	ND	ND	ND	ND	ND
Snag Rd. - pond 1 km from a	adult	12-2	ND	ND	ND	ND	ND
Yukon River at Thistle Creek	adult	13-1	ND	ND	ND	ND	ND
Range Road dump	adult	14-4	0.9	2	0.4	0.7	41
Skagway Rd. - R. pretiosa	adult	15-1	ND	ND	ND	ND	ND
ND indicates Non-Detect							