Community-Based Participatory Research on Saint Lawrence Island

How Yupik Residents are Helping to Identify Persistent Pollutants in Their Communities

Frank von Hippel, Northern Arizona University

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Persistent Organic Pollutants

Perfluorinated compounds (PFCs)

Polybrominated diphenyl ethers (PBDEs)

Chlorinated pesticides

Polychlorinated biphenyls (PCBs)
Health Patterns of Concern

• Cancers
• Thyroid disease
• Diabetes
• Heart disease
• Birth defects, low birthweight babies, premature births, stillbirths, miscarriages
• Other reproductive health problems
“Protecting the Health of Future Generations: Assessing and Preventing Exposures to Endocrine-Disrupting Chemicals in Two Alaska Native Arctic Communities on St. Lawrence Island”
Community outreach & CBPR: Pam Miller & ACAT, SLI Working Group
Ecotoxicology: Frank von Hippel
Endocrinology: Loren Buck
Human health research: David Carpenter
Gene expression: John Postlethwait
PCBs in blood serum of St. Lawrence Island people
Mean [PCB] (ppb, wet weight)

- Background concentration in U.S. residents, low
- Background concentration in U.S. residents, high
Mean [PCB] (ppb, wet weight)

- Background concentration in U.S. residents, low
- Background concentration in U.S. residents, high
- Savoonga residents without camps at NEC

Data from Carpenter & Miller (2011)
Mean [PCB] (ppb, wet weight)

- Background concentration in U.S. residents, low
- Background concentration in U.S. residents, high
- Savoonga residents without camps at NEC
- Savoonga residents with camps at NEC

Data from Carpenter & Miller (2011)
White Alice Communication Site, operational 1957-1972
Above ground structures & debris removed in 2003
$123 million spent on site remediation
1) At the conclusion of site remediation, is remaining PCB contamination due primarily to the formerly used defense site or to atmospheric deposition?
2) Is the remaining PCB contamination biologically relevant for resident freshwater fishes?
3) Do contaminant levels have implications for the health of the Yupik people on St. Lawrence Island?
DNA for sex genotyping

gonads, liver & kidney
split samples RNA and histology

DNA for sex genotyping

thyroid RNA & histology

brain RNA + contaminant chemistry

+ contaminant chemistry
B) Alaska blackfish

○ Downstream; n=29
□ Upstream; n=10

Mean [PCB] (ng/g ± 1 SE)

Number of chlorines

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Levels of PCBs in the fish are still high, even though clean-up is considered complete... and contaminant chemistry reveals a mostly local source (FUDS), but are these [PCB] biologically meaningful?
Is the endocrine system of the fish disrupted?
B) Alaska blackfish

- PCB52
- PCB61_70_74_76
- PCB83_99
- PCB90_101_113
- PCB93_95_98_100_102
- PCB110_115
- PCB153_168

Mean [estrogenic PCBs] (ng/g ± 1 SE)

Site Number

Downstream

Upstream

n=5  n=4  n=2  n=5  n=5  n=3  n=5

n=5  n=5
Sites downstream of FUDS

"Reference" sites

[T4] (ng/g ± 1 SE)

SQ2 n=20
SQ4 n=20
SQ5 n=28
SQ6 n=28
SQ7 n=20
SQ11 n=28
SQ13 n=28
TP n=28
TL n=85

Suqi downstream
Suqi upstream

"Reference" sites
Is gene expression of the fish disrupted?
5-mC DNA ELISA Kit

$p < .03$
Gene expression results...

Stickleback collected at more contaminated reaches of the Suqitughneq River expressed numerous genes differentially compared to fish collected at less contaminated reaches, including genes relevant to DNA replication, response to DNA damage, and cell signaling.

Decreased expression of DNA repair genes could increase the accumulation of mutations and intensify the potential for carcinogenesis.

Reduced cell signaling might exacerbate the risk of carcinogenesis by decreasing normal pathways of cell cycle arrest and apoptosis for genetically damaged cells.

Conservation of the vertebrate endocrine system and genome...
What’s next for St. Lawrence Island?

RO1 renewal:
- Mechanistic studies with stickleback to identify upstream biomarkers of human disease
- Focus on childhood development in Gambell & Savoonga

Potential solutions...
Practical implications for arctic communities

Environmental remediation standards
Prevalence of contaminated sites throughout the Arctic
CBPR is informing policy at the local, state, national, and international levels