COLLABORATIVE ON HEALTH AND THE ENVIRONMENT - ALASKA

STATE OF THE SCIENCE: CHILDREN'S ENVIRONMENTAL HEALTH IN ALASKA AND THE CIRCUMPOLAR NORTH

JANUARY 31, 2018

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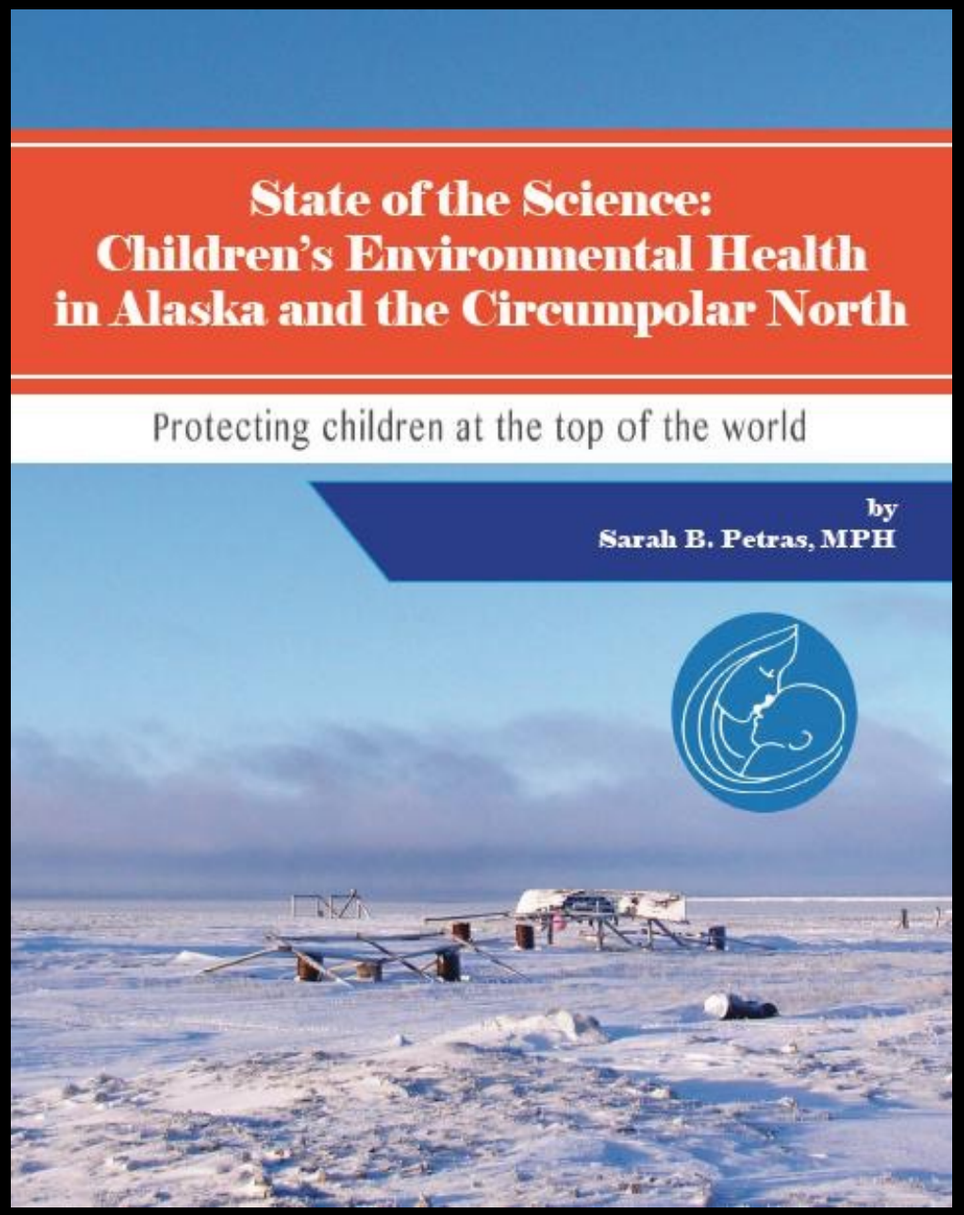
STATE OF THE SCIENCE REPORT & CHILDREN'S ENVIRONMENTAL HEALTH SUMMIT



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ENVIRONMENTAL EXPOSURES IN THE CIRCUMPOLAR NORTH

- Persistent organic pollutants (POPs) migrate from lower latitudes and settle in the Arctic
- People in the Circumpolar North face disproportionate exposures to toxic chemicals, and children are at highest risk
- Arctic Indigenous Peoples who rely on a traditional fat-based diet are particularly vulnerable to exposure
- Arctic Indigenous Peoples have been found to have levels of POPs concentrations in blood and breast milk that are among the highest of any population on Earth

LIMITED RESEARCH IN ALASKA AND THE CIRCUMPOLAR NORTH

- The body of evidence on links between environmental exposures and children's health is growing, but is likely just the tip of the iceberg
- Concentrations of chemicals in the North are disproportionately higher, and many diseases known to be correlated to these exposures also occur in greater numbers
- More research is needed on:
  - Chemical mixtures
  - Impacts to Arctic Indigenous Peoples
  - Multigenerational effects

ENVIRONMENTAL LINKS TO CHILDREN'S HEALTH DISPARITIES

- Exposure before and after birth to chemicals of concern may interfere with normal development and functioning of systems in the body and lead to lifelong health conditions

- Environmental exposures have been linked to adverse health outcomes in children:
  - Endocrine disruption
  - Birth defects
  - Cancer
  - Neurodevelopmental disorders
  - Respiratory disorders

ENDOCRINE DISRUPTION

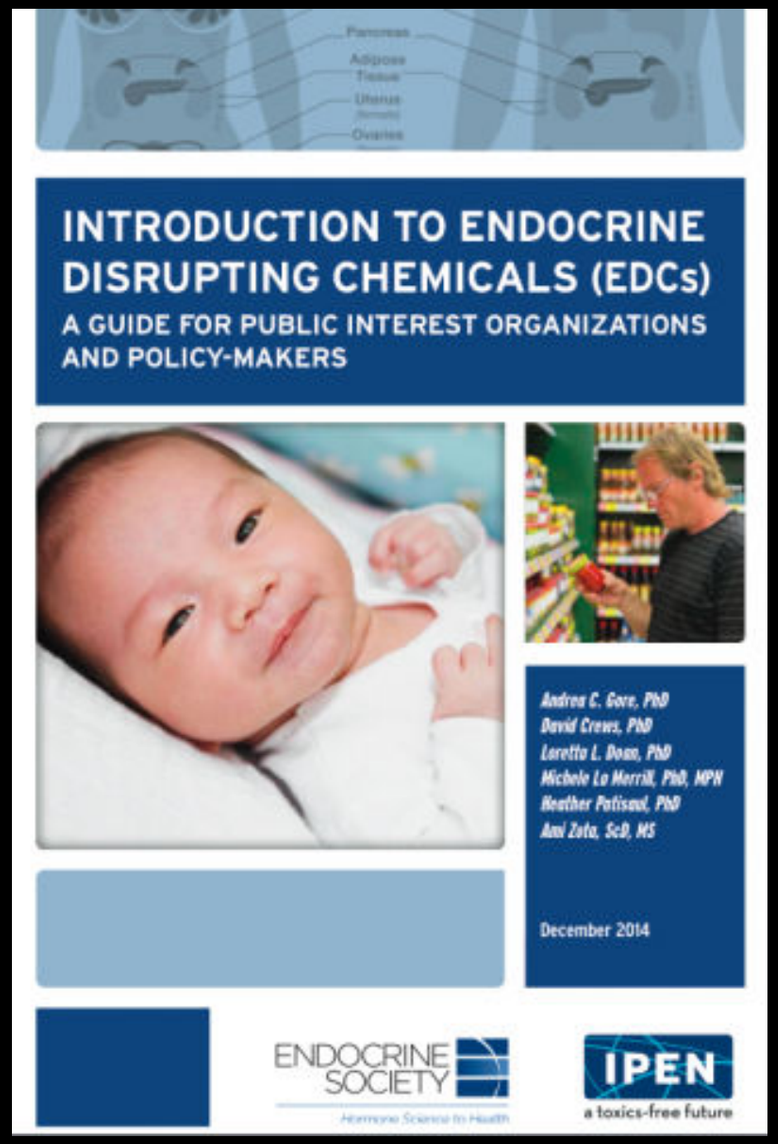
- Endocrine disrupting chemicals (EDCs) trigger different effects in the body depending on the timing and amount of exposure
- EDCs are particularly damaging during critical windows of development, when even subtle disruptions in the normal functioning of hormones may cause significant damage to a developing embryo, fetus or child

ENDOCRINE DISRUPTION

- EDCs can affect virtually all organ systems and are associated with a staggering array of health problems:

"The incidence of endocrine-associated pediatric disorders, including male reproductive problems (cryptorchidism, hypospadias, testicular cancer), early female puberty, leukemia, brain cancer, and neurobehavioral disorders, have all risen rapidly over the past 20 years. … Data from human, animal, and cell-based studies have generated considerable evidence linking EDC exposure to these and other human health disorders."

- Endocrine Society and International Persistent Organic Pollutants Elimination Network (IPEN), 2014



ENDOCRINE DISRUPTION > SLI

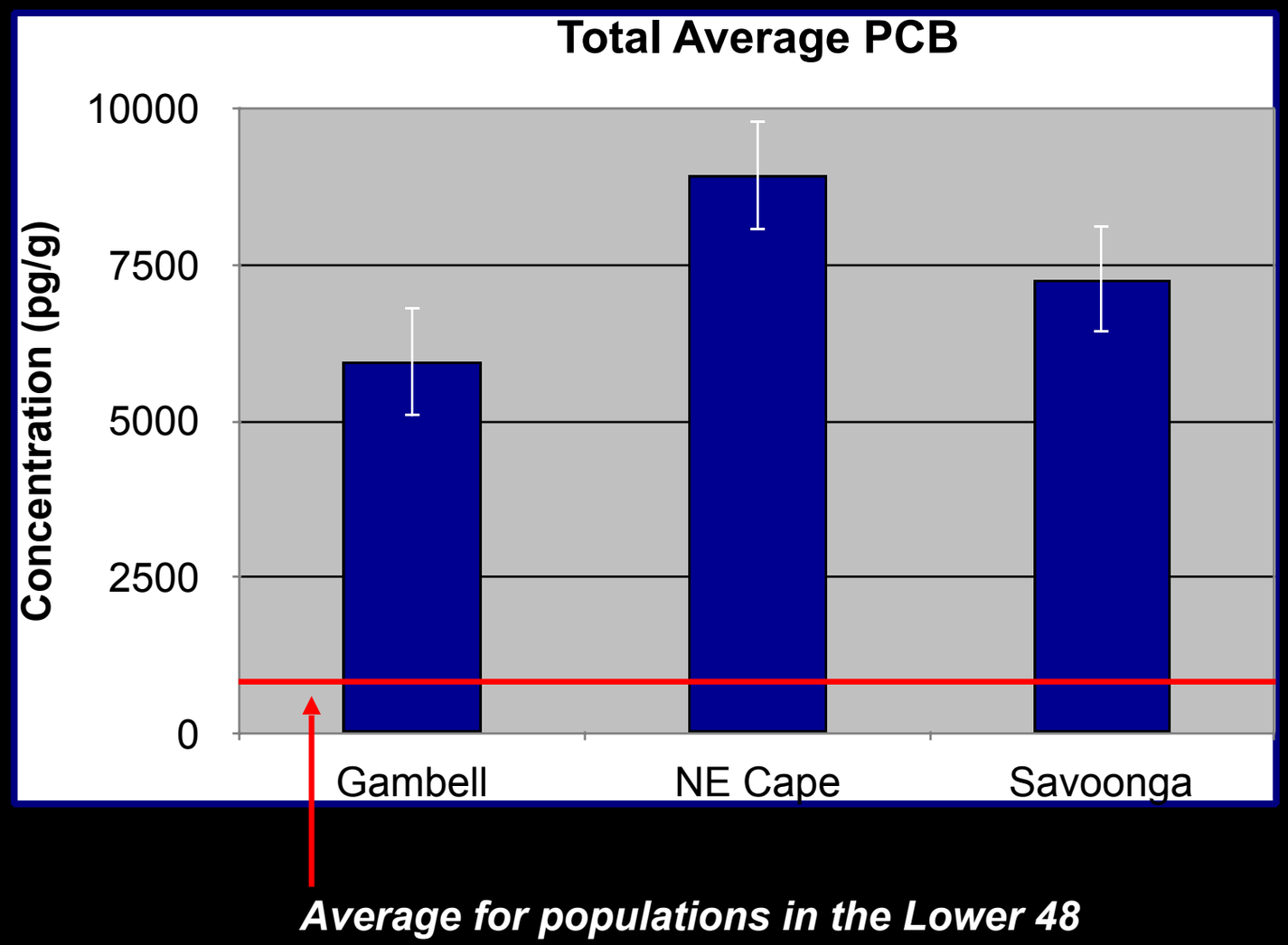
- POPs that are also EDCs are of particular concern in the Arctic, e.g., PCBs & PBDEs
- ACAT's work with the communities of St. Lawrence Island (SLI), Alaska has demonstrated:
  - SLI residents are exposed to numerous POPs, including PCBs and PBDEs from local and global sources (Byrne et al., 2015; Byrne et al., 2017)
  - PBDEs are associated with thyroid disruption in humans (Byrne et al., under review)
  - Exposure to contaminants from formerly used defense (FUD) sites and long-range sources could lead to the adverse health outcomes reported by the people of SLI, including cancers, thyroid diseases and disorders of reproductive development (von Hippel et al., 2017)

ENDOCRINE DISRUPTION > PCBS

- Polychlorinated biphenyls (PCBs) are used to manufacture plastics and as lubricating fluids in transformers and other products
- Banned since 1979, PCBs nevertheless continue to build up in the environment and people of the Arctic
- Health effects:
  - Hypothyroidism (Schell et al., 2008)
  - Impaired fetal growth (Carpenter, 2006)
  - Reduced testosterone levels and sperm mobility
  - Endometriosis
  - Earlier menarche

ENDOCRINE DISRUPTION > PCBS

- ACAT research with communities of St. Lawrence Island (Carpenter et al., 2005) found:
  - Higher blood serum levels of PCBs in residents who lived, worked or conducted subsistence activities near contaminated FUD sites
  - Serum levels 6-9 times higher than average in Lower-48 populations
  - Evidence of PCBs accumulating in the Arctic via global transport
  - Military contamination also a significant source



ENDOCRINE DISRUPTION > PBDES

- Polybrominated diphenyl ether (PBDE) flame retardants are used in children's products, furniture, electronics, plastics, and textiles
- Associated with harm to function of thyroid and reproductive hormones. One study found indicators of hypothyroidism in U.S. children with elevated levels of PBDEs (Jacobson, 2016).
- Research consistently shows that children have higher exposures to PBDEs:
  - PBDEs have been found in high levels in breast milk and can also cross the placenta
  - Young children are more highly exposed than adults, with some studies finding levels approximately 3-9x higher in children than adults

ENDOCRINE DISRUPTION > PBDES

- Research in Arctic environments and people demonstrates:
  - Higher PBDEs concentrations found in Inuit children than adults, and higher PBDE levels than those reported for many children around the world (O'Brien et al., 2012)
  - Levels of PBDEs found in the blood of Yupik people of the Yukon-Kuskokwim Delta region of Alaska are the highest known human PBDE concentrations in the Circumpolar North (AMAP, 2014)
  - ACAT research found PBDEs are ubiquitous in dust collected from SLI households, with concentrations of several PBDEs in dust associated with serum concentrations (Byrne et al., 2017)
  - ACAT also found associations between PBDEs in serum and thyroid hormone levels in SLI communities (Byrne et al., 2017)

ENDOCRINE DISRUPTION

- Non-POPs EDCs: phthalates & bisphenol A (BPA)
- While BPA and phthalates are not POPs, they are so widely used in consumer products that people are continuously exposed through contaminated dust in homes, workplaces and cars
- Children in the Circumpolar North are disproportionately exposed to these indoor contaminants:
  - Indoors for longer periods of time during the year
  - Homes that are kept closed retain more contaminated dust than those with more ventilation

BIRTH DEFECTS

- Industrial chemicals, pollutants and pesticides cross the placenta as readily as residues from cigarettes and alcohol, posing serious threats to the health of developing fetuses

- The prevalence of birth defects in Alaska is twice as high as the national average (McLaughlin & Gessner, 2008)

- Alaska Native infants have more than twice the risk of birth defects compared to white infants in Alaska

BIRTH DEFECTS

- Two landmark studies (Gilbreath & Kass, 2006a & 2006b) in Alaska found:
  - Women from communities with hazardous open dump sites were more likely to deliver preterm or low birth weight babies
  - Women from communities with the most hazardous open dump sites delivered babies who weighed less, were too small for their gestational age, were born too early, or had higher rates of some birth defects.
- Chemicals of concern in the Arctic linked to birth defects:
  - Solvents
  - Heavy metals
  - Pesticides
  - Phthalates
  - PCBs

NEURODEVELOPMENTAL DISORDERS

- Project TENDR (Targeting Environmental Neuro-Development Risks)
- TENDR Consensus Statement on the strength of the scientific evidence linking exposures to toxic chemicals in air, food, water, and everyday products with children's risks for neurodevelopmental disorders and impairment

NEURODEVELOPMENTAL DISORDERS

- Project TENDR identifies the following chemicals of concern that increase the risk of neurodevelopmental disorders and contribute to learning, behavioral and/or intellectual impairment in children:
  - Organophosphate pesticides
  - PBDE flame retardants
  - Combustion-related air pollutants
  - Lead
  - Mercury
  - PCBs

NEURODEVELOPMENTAL DISORDERS

- Organophosphate pesticides:
  - Developmental disorders, delays, hyperactivity and autism spectrum disorders (ASD)
- PBDE flame retardants:
  - Interfere with development and aging of the brain, and are linked to lower IQ, hyperactive behaviors, lower performance on mental and physical development tests, impaired attention, and poorer fine motor coordination
- Mercury:
  - A potent neurotoxin that can cause serious, long-term, adverse health effects in children and developing fetuses
  - Learning disabilities, altered motor function and memory, visual and hearing impairment, tremors and muscle spasms, impairment of the developing central nervous system
- PCBs:
  - Lower developmental test scores, short-term memory defects, lower IQ levels

PROJECT TENDR CALL TO ACTION

"The TENDR Consensus Statement is a **call to action** to reduce exposures to toxic chemicals that can contribute to the prevalence of neurodevelopment disabilities in America's children. … This **preventable threat** results from a **failure of our industrial and consumer markets and regulatory systems** to protect the developing brain from toxic chemicals. To lower children's risks for developing neurodevelopment disorders, **policies and actions are urgently needed to eliminate or significantly reduce exposures** to these chemicals. Further, if we are to protect children, we must **overhaul how government agencies and business assess risks to human health from chemical exposures, how chemicals in commerce are regulated, and how scientific evidence informs decision making by government and the private sector**."

- Bennett et al., 2016

REFERENCES *(complete list in report)*

- AMAP 2014. Trends in Stockholm Convention Persistent Organic Pollutants (POPs) in Arctic Air, Human media and Biota. AMAP Technical Report to the Stockholm Convention. AMAP Technical Report. No. 7 (2014), Arctic Monitoring and Assessment Programme (AMAP), Oslo, Norway http://www.amap.no/documents/search/ ISBN – 978-82-7971-084-4

- Bennett D, Bellinger DC, Birnbaum LS, Bradman A, Chen A, Cory-Slechta DA, et al. 2016. Project TENDR: Targeting Environmental Neuro-Developmental Risks. The TENDR Consensus Statement. Environ Health Perspect 124:A118-A122. http://dx.doi.org/10.1289/EHP358.

- Byrne, SC, P Miller, S Seguinot-Medina, V. Waghiyi, CL Buck, FA von Hippel, DO Carpenter. (under review). Associations between serum polybrominated diphenyl ethers and thyroid hormones in a remote Alaska Native population. Under review at Environmental Research.

- Byrne, SC. S Seguinot-Medina, V Waghiyi, PK Miller, CL Buck, F von Hippel, DO Carpenter. 2017. Exposures to polybrominated diphenyl ethers and perfluoroalkyl substances in a remote population of Alaska Natives. Environ Pollut. 231(Pt 1):387-395. doi: 10.1016/j.envpol.2017.08.020.

- Byrne, S. P Miller, V Waghiyi, CL Buck, FA von Hippel, DO Carpenter. 2015. Persistent organochlorine pesticide exposure related to a formerly used defense site on St. Lawrence Island, Alaska: data from sentinel fish and human sera. J Toxicol Environ Health A78(15): 976-92. PMID: 26262441. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4547524/

REFERENCES

- Carpenter DO. 2006. Polychlorinated biphenyls (PCBs): Routes of exposure and effects on human health. Rev Environ Health 21(1):1-23.
- Carpenter, DO. AP DeCaprio, D O'Hehir, F Akhtar, G Johnson, RJ Scrudato, L Apatiki, J Kava, J Gologergen, PK Miller, L Eckstein. 2005. Polychlorinated Biphenyls in Serum of the Siberian Yupik People from St. Lawrence Island, Alaska. International Journal of Circumpolar Health 64:4. PMID: 16277117. www.ncbi.nlm.nih.gov/pubmed/16277117.
- Gilbreath S, Kass PH. 2006a. Adverse Birth Outcomes Associated with Open Dumpsites in Alaska Native Villages. American Journal of Epidemiology 164(6):518-528.
- Gilbreath S, Kass PH. 2006b. Fetal and neonatal deaths and congenital anomalies associated with open dumpsites in Alaska Native villages. International Journal of Circumpolar Health 65(2):133-147.
- Gore AC, Crews D, Doan LL, La Merrill M, Patisaul H, Zota A. 2014, December. Introduction to Endocrine Disrupting Chemicals (EDCs): A Guide For Public Interest Organizations And Policy-Makers. Endocrine Society and IPEN. http://ipen.org/documents/introduction-endocrine-disruptingchemicals-edcs

REFERENCES

- Jacobson, MH. DB Barr, M Marcus, AB Muir, RH Lyles, PP Howards, L Pardo, LA Darrow. 2016. Serum polybrominated diphenyl ether concentrations and thyroid function in young children. 2016. Environmental Research 149 (2016) 222-230. https://www.ncbi.nlm.nih.gov/pubmed/27228485
- McLaughlin J, Gessner BD. 2008, July 14. High Prevalence of Major Congenital Anomalies in Alaska, 1996-2002. Bulletin No. 16. State of Alaska Department of Health & Social Services, Section of Epidemiology. http://www.epi.hss.state.ak.us/bulletins/docs/b2008_16.pdf
- O'Brien, HT. R Blanchet, D Gagné, L Lauzière, C Vézina, É Vaissière, P Ayotte, S Déry. 2012. Exposure to Toxic Metals and POPs in Inuit Children Attending Childcare Centers in Nunavik. Environmental Science and Technology 46:4614-4623. http://www.ncbi.nlm.nih.gov/pubmed/22420632
- Schell, LM. MV Gallo, M Denham, J Ravenscroft, AP DeCaprio, DO Carpenter. 2008. Relationship of thyroid hormone levels to levels of polychlorinated biphenyls, lead, p,p'-DDE, and other toxicants in Akwesasne Mohawk youth. Environmental Health Perspectives 116, 806-813. http://www.ncbi.nlm.nih.gov/pubmed/18560538
- von Hippel FA. PK Miller, DO Carpenter, D Dillon, L Smayda, I Katsiadaki, T Titus, P Batzel, JH Postlethwait, CL Buck. (2017). Endocrine disruption and differential gene expression in sentinel fish on St. Lawrence Island, Alaska: Health implications for indigenous residents. Environ Pollut. 234:279-287. doi: 10.1016/j.envpol.2017.11.054.

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