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A Bio Monitoring and Ethnobiology Approach to Fill Gaps in Indigenous Public Health and Environmental Health

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Abstract

Ethnobiology is well positioned to collaborate with bio monitoring research to gain a better knowledge of how people interact with contaminated surroundings and how they are affected. Indigenous populations living near unconventional natural gas ("fracking") facilities confront health concerns that are frequently under- or un-evaluated. This paper examines a bio monitoring pilot study project in British Columbia (Canada), which was motivated by Indigenous peoples' worries about pollutant exposure from traditional foods and the environment. According to preliminary bio monitoring findings, pregnant Indigenous women who live near fracking activities have higher levels of a benzene metabolite than non-Indigenous women. We look at how Indigenous Peoples' concerns about industrial poisons should inform bio monitoring and toxicological research, as well as how bio monitoring studies might provide quantitative data to ethnobiological research. By focusing on environmental knowledge and human health in the context of oil and gas development, we critically examine how action, environmental justice, and scientific research can and should contribute to better ethical and methodological frameworks and practices. When ethnobiology and bio monitoring are integrated, they can help fill critical knowledge gaps in environmental health and ethical research practices.

Keywords: Ethnobiology; Bio monitoring; Environmental health; Public health

Introduction

The impacts of rapidly expanding unconventional oil and gas development (*i.e.*, hydraulic fracturing, or "fracking") in North America are raising health concerns. Unconventional oil and gas development has been linked to a growing number of scientific peer-reviewed publications in the United States. However, the studies' short length and concentration on assessing impacts on environmental "media," such as water and air, rather than human health impacts, which are inferred rather than proven, have been criticized [1].

While short-term environmental studies are vital for assessing potential health risks, data on environmental exposure to toxins directly from unconventional oil and gas operations is currently lacking, making detecting health problems difficult. Concerns have been made, for example, concerning the 600 or more chemicals used in fracking operations, 353 of which have been shown to have potentially harmful health impacts [2]. Over 75% of these compounds have the potential to affect sensory organs, as well as the respiratory and gastrointestinal systems, although the amount of adverse health effects associated with exposure has not been properly explored.

Because there appears to be a link between health risk and proximity to fracking wells, anecdotal and ethnographic evidence from people living near unconventional oil and gas operations has been utilized to assess health problems [3]. As a result, providing a space for and appreciating the observations of informed local people is an important step in bio monitoring, and ethno biology provides a useful paradigm for filling this health research vacuum.

The systematic study and observation of changes in ecosystems, species, and/or populations is known as bio monitoring. Bio monitoring data collected from humans (typically urine, blood, hair, and/or nails) can be used in health science research and toxicology to identify changes in the inhabited environment and provide explicit measures of contamination in legal and medical language (e.g., quantitative data), allowing for better risk assessment and mitigation for local communities facing health challenges [4]. Local knowledge of pollution and exposure, on the other hand, has the ability to directly inform correlations or vectors of change in body burden (as measured by bio monitoring data).

Animal and plant food collection, spiritual activities, employment, and other land-based livelihoods are all important to Indigenous Peoples in northern Canada (First Nations, Inuit, and Métis). As a result, they are both forceful and sensitive observers of environmental change and contamination, as well as experiencing increased and worsened exposure to environmental toxins [5]. We investigate how First Nation Peoples' environmental knowledge linked to unconventional oil and gas development in northern British Columbia (BC) and bio monitoring research may and should inform one another in this contribution to action ethnobiology.

We present the findings of one of the authors (Caron-Beaudoin), who was part of a Universities de Montréal research team that undertook the first bio monitoring study in Canada in 2016 to examine human exposure to pollutants associated with unconventional natural gas development [6]. The researchers conducted a pilot study with First Nation communities in northern BC (Treaty 8 Tribal Association, West Moberly first Nation, and Saulteau first Nation) to assess exposure to pollutants during pregnancy.

While the bio monitoring research was not specifically ethnobiological, we highlight aspects of the study that focused on First Nation Peoples' perceptions of the contaminated environment, such as increased health concerns from eating traditional foods (locally available and culturally accepted foods) and observations of sick or exposed animals while out on the land. We discuss the pilot study's future objectives and how bio monitoring research initiatives might be used in conjunction with ethnobiology: (1) Establish potential links between environmental health hazards and negative health outcomes associated with unconventional oil and gas operations; (2) Develop research projects in response to a call to social and environmental

action; and (3) Conduct research guided by Indigenous and local community concerns. We finish this contribution with a discussion of ethnobiological and bio monitoring research ethical frameworks and best practices, as well as the role that rigorous and ethical scientific standards can play in assisting communities with potentially higher health risks [7].

Ethnobiology and Bio Monitoring

Environmental pollutants can be ingested in a variety of ways (e.g., air, diet). Animals, in particular, are constantly exposed to air, soil, and groundwater, and their reproductive cycles are more frequent, making them a miner's canary for monitoring environmental contamination and human health (Bamberger and Oswald 2012). Concerns concerning the eating of deer, moose, and elk—major food sources in the community—were raised by West Moberly, Saulteau, Prophet, and Doig river first Nations in 2012 [8]. They noticed noticeable declines in ungulate populations, and hunters reported several abnormalities (tumors, growths) in the ungulates they hunted, which they believe could have been caused by contaminants from increased oil and gas activities in the region over the last decade, based on their observations (Fraser Basin Council 2012).

The non-profit Fraser Basin Council gave First Nations and local community members the opportunity to provide input on potential health risks and identify areas of potential concern, but observations. Many respondents said the consultation's schedule was "too short" for them to participate effectively for policy implementation contingencies in suburban US communities) [9]. The Council's report to the BC ministry of health describing health hazards and concerns included environmental observations as a more-or-less anecdotal component.

The pilot project is striving to integrate further studies on environmental knowledge and ethnobiological analyses in this setting. The challenge is to advance scholarship that aligns toxicology (e.g., Caron-(2018) Beaudoin's study's higher levels of benzene metabolites and some trace metals) with Indigenous Peoples' experiences and observations—not to bolster the observations themselves, but rather to ensure that both lines of evidence can be accurately tested against one another and held to equitable standards. The authors point out that health considerations in general are frequently left out of discussions of "risk." In truth, we recognize the special treatment that non-Indigenous Canadians receive in the extractive industries [10].

The bio monitoring study featured a number of flaws that ethnobiological research could help to overcome. To begin with, the pilot experiment did not evaluate pollutants in the participants' environment (e.g., tap water, stream water, traditional foods), making estimating exposure levels difficult. Second, the benzene metabolite t, t-MA is not totally benzene-specific. Other factors, such as sorbic acid use, can affect t, t-MA levels in addition to benzene exposure. Sorbic acid is a frequently used food preservative that is partially converted into urine t,t-MA in processed foods. Intake of sorbic acid in the diet results in urine t, t-MA levels of 78-114 g/g creatinine on average.

Plans to continue bio monitoring in communities in the Peace Valley Region will benefit dramatically from ethnographic and ethnobiological research that considers: (1) A continued assessment of participants' observations of their environment, both outdoors (air quality, animal behavior) and indoors (tap water and indoor air quality), which will include recording perceived contamination from specific foods/harvesting locations and the relative consumption of food types (traditional/mainstream); (2) Building on community members' observations and increased sampling and assessment of traditional foods and the environment (e.g., whether or not they are pregnant). The environmental knowledge gained from community interviews will be added to the superficial indicators of environmental contamination discovered in 2012.

Community members are currently aware of contamination dangers, but are unsure how to mitigate them. Environmental change observations, phenology, and other land-based knowledge will assist in identifying specific areas of concern and providing valuable feedback on exposure mitigation efforts. The preliminary findings of the pilot project, which were just published, prompted worries about possible pollution exposure in regions already dealing with health inequities and a scarcity of research into such discrepancies. As a result, exposure scientists concerned about the health of their research participants should incorporate ethnographic and ethnobiological research methodologies and observations into their monitoring of community health's sociocultural and psychological factors. This is especially true for First Nations communities, who are more vulnerable to contaminated environments than the rest of Canada's population and whose exposures are poorly recognized.

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