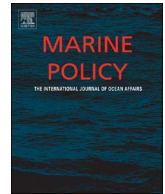




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## Stabilizing risk using public participatory GIS: A case study on mitigating marine debris in the Bay of Fundy, Southwest New Brunswick, Canada

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### ABSTRACT

While large-scale studies have quantified the extent of marine debris problems, the social factors that create and inhibit mitigation are understudied. In Canada's Southwest New Brunswick Bay of Fundy, marine debris originates from the interaction of multiple industries within a small area, including aquaculture and inshore fisheries. Conflict between these two stakeholders contributes to both debris production and failure to mitigate. Their gear entanglements create debris that threatens transportation safety, wildlife and the local economy. Public Participation Geographic Information Systems (PPGIS) mapping was used to assemble and stabilize a common view of what constituted debris, debris locations and threats. This paper reports on a subsequent project that monitored the effects of working with the PPGIS map over three years, using participant observation, stakeholder roundtables, and interviews with stakeholders. The paper first reports on the differences in risk perceptions that were barriers to collaboration, followed by the tactics used by stakeholders to influence priorities and actions and finally on how PPGIS stabilized stakeholder definitions of debris and of responsibilities. The conclusions argue that PPGIS incorporates diverse data sets generated by different stakeholders, thereby motivating interactions, reducing conflict, and encouraging negotiated understandings of risks posed by marine debris.

### 1. Introduction

The problem of marine debris and its associated impacts on the economy, tourism, transportation, safety and wildlife has been widely documented at the supranational scale [1–5], yet understudied in terms of the social factors that contribute to both debris production and mitigation. In the waters off the coast of Southwest New Brunswick (SWNB), Canada, an increase in the number and variety of stakeholders (multi-species inshore fishery, open-net finfish aquaculture, international shipping, and tourism) has led to more interactions amongst industries that result in the generation of marine debris [6]. For example, storms and tide break free large pieces of gear from inactive finfish aquaculture sites that then present a danger to navigation, fishing gear gets cut from buoys by the propellers of shipping, tourism, and aquaculture vessels, leaving ropes that entangle marine mammals [6]. This paper reports on a project that utilized Public Participatory Geographic Information Systems (PPGIS) mapping to document different stakeholders' perceptions of debris sources and risks, and to place large, non-mobile debris into GIS layers in order to identify mitigation

priorities. The project was part of a larger collaboration between faculty and students, an environmental NGO (ENGO) and a local fishermen's association.<sup>1</sup> This collaboration facilitated the testing of the ability of PPGIS to assist stakeholders in overcoming their entrenched positions while fostering collaborative mitigation arrangements. The examination of this process contributed to an understanding of the social factors affecting marine debris production and mitigation. The following analysis will focus on: 1) differences in risk perceptions that acted as barriers to collaboration; 2) the tactics and politics used by stakeholders to influence the marine debris priorities and clean-up process; and 3) how PPGIS acted to stabilize interactions and definitions of debris, and of responsibilities.

### 2. Conceptual framework

Risk has been defined as “the statistical probability of an outcome in combination with the severity of the effect construed as a ‘cost’ that could be estimated in terms of money, deaths or ill health” [7:160]. Boholm and others have gone on to point out, however, that this

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<sup>1</sup> This SSHRC Insight project (435–2014–0299), under the supervision of Melanie G. Wiber at the University of New Brunswick, included: Allain Barnett, Donna Curtis Maillet, Michael Rooney (all from UNB), Matthew Abbott (from the ENGO The Fundy Baykeeper) and Maria Recchia (Executive Director, Fundy North Fishermen's Association). A 2016–2017 SSHRC Joseph Armand Bombardier CGS-M award was also held by A. Carson Rehn.

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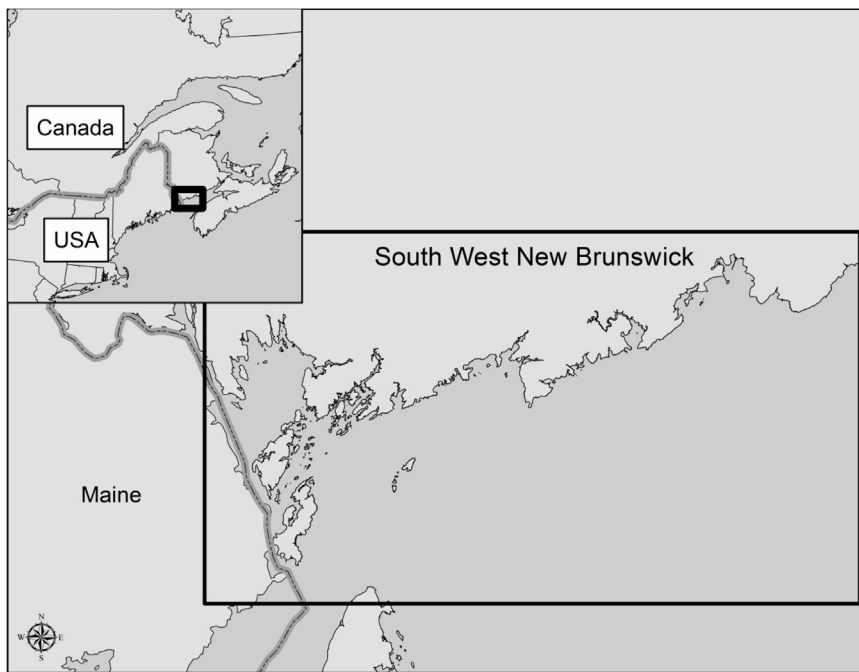


Fig. 1. Map of South West New Brunswick and adjacent waters of the Bay of Fundy.

definition of risk is inadequate given that subjective experiences of risk will vary, and when oppositional interests inform stakeholder perceptions of risk, conflict inevitably results [7,8]. Such conflict often generates different characterizations of what Boholm refers to as *objects of risk* and *objects at risk* [7]. Thus, relying solely on an objective quantification of data through GIS mapping seemed unlikely to address the marine debris problem. From a Foucauldian perspective, this is because the assemblage of risk is part of a complex politico-strategical situation, where subjective perceptions of risk are deployed within a social context, often tactically. Once engaged, these deployments limit and constrain some avenues of action while opening the door to, and indeed encouraging others [9]. Boholm [7:168] thus argues that risk should not be regarded as “a property of things perceived but as an inherently dynamic relational order of meaningful connections”. Risk is not a fixed reality; it takes shape from within a particular relational context [10], and is subject to a complex network of objects, experiences, politics and relations that are assembled around it [11–14]. This was certainly true within SWNB, where a history of conflict between aquaculture and commercial inshore fisheries represented a significant roadblock to both stabilizing marine debris and furthering mitigation. In this paper, stabilization is the process of coming to a common understanding of both objects of and objects at risk.

PPGIS has been cited as a valuable method for dealing with diverse perceptions of risk [15,16]. Stakeholders can provide geo-spatial information of interest to them, and this can be mapped onto separate layers, which can then be overlain to show spatial relationships and to compare and contrast relational disagreements. As with other maps, GIS representations are not neutral documents but are located within specific relations of power [15]. Nevertheless, literature suggests that when various GIS map layers are shared amongst a diverse group, mutual understanding, cooperation, and participation in governance processes can all be enhanced [16–21]. The “visual language” of GIS is also said to delineate responsibility while supplying common points of reference among stakeholders to identify priority for action [22,23]. This study tested whether PPGIS could incorporate a wide range of information about marine debris, including various opinions about its sources, impacts and threats. It also examined whether the resulting map effected change when shared amongst stakeholders, primarily through encouraging discussion among them with “correcting” the map as the focus.

Reality, argue Law and Urry [24:395] “... is a relational effect. It is produced and stabilized in interaction that is simultaneously material and social” (emphasis in the original). Marine debris exhibits this relational reality. Precisely because it exists in a fluid environment, making it difficult to fix geographically, and because it poses different risks to different people, it is situated at the intersection between the material and the multiple subjectivities and socio-political deployments of risk. There was a need to stabilize the object of interest in such a way as to arrive at decisions about mitigation (understood here as actions taken to reduce the severity, seriousness, or injuries arising from marine debris). This study demonstrates how the insertion of a PPGIS map into this relational field becomes an interface between the material and the social, whereby multiple subjectivities both inform and constrain the assemblage of a marine debris ‘reality’ as depicted by the map. Assemblage is thus being used in this article to denote the network of the environment, objects, and the social [25]. Scholars have used the concept of assemblage in Actor Network Theory and assemblage theory to understand how heterogeneous entities come together and stabilize towards one type of interaction and action over others, and processes (e.g. affects, shifting associations) that destabilize these relationships [26–28]. As will be shown, pre-PPGIS there were multiple “assemblages” competing to define debris and shift responsibility. With a PPGIS facilitation of discussions, these multiplicities collapse or stabilize via the map – temporarily – into a more singular conception of what constitutes debris, which subsequently enabled action. Latour has called this “the progressive composition of one common world” [25] see also [29].

### 3. Methods

A 60 × 60 km area of the Bay of Fundy is an area of high concentration of both aquaculture and inshore fishing [30]. Conflict between these two industries generated both media attention and policy reform [31,32]. A recent court case involving illegal pesticide use highly toxic to lobster exacerbated tensions [33]. These two stakeholders played key roles in this research; however, the study area was extended in order to include other stakeholders such as shipping for the port of St John and tourism operators in Passamaquoddy Bay (Fig. 1). This region has been designated an Ecologically and Biologically Significant Area (EBSA) by the Federal Department of Fisheries and Oceans

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