

Safety Risks, Institutional Responses, and Narratives in Fishery Management: A Case Study of the 2023 Commercial Glass Eel Season in Nova Scotia, Canada

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Abstract

This article investigates the criminogenic features and safety challenges in Canada's commercial glass eel fishery focusing on the 2023 season in Nova Scotia. The fishery, characterized by high value density and nocturnal harvesting, has become increasingly vulnerable to illegal fishing. The research analyzes over 1,400 pages of documents obtained through Access to Information and Privacy requests, including interdepartmental communications within Fisheries and Oceans Canada, public infraction reports, and fishery officer patrol data. Using social network analysis, the study maps communication flows among key groups mainly institutional across three operational phases. It reveals a disconnect between institutional narratives and public concerns. The study identifies two major findings. First, the crisis seemed foreseeable due to the fishery's biological and organizational traits – narrow harvest windows, accessible gear, and high market volatility – yet institutional responses were delayed and reactive. Second, institutional emphasis on media relations and symbolic enforcement actions, such as listing seizures and patrols without contextual detail, suggests a prioritization of image management over substantive risk mitigation. Ultimately, the research highlights the dual role of the state as both regulator and crisis responder, and the importance of aligning institutional actions with public safety concerns. It calls for more proactive, transparent, and community-informed governance strategies in managing high-risk, high-value fisheries like the Canadian glass eel fishery.

Keywords: illegal fishing; fisheries management; public safety risks; institutional discourse; crime reports

Introduction

Among fishing-related offences, illegal fishing or harvesting – also referred to as illegal, unreported, and unregulated (IUU) commercial fishing – is associated with serious economic, social, and environmental harm (Belhabib & Le Billon, 2022; Petrossian et al., 2022). Some species are more susceptible to illegal commercial fishing due to certain features (Moreto & Lemieux, 2015; Petrossian & Clarke, 2014), but these or their importance vary (Petrossian et al., 2015). They may also change as the animal moves through different stages of the illicit market (Moreto & Lemieux, 2015).

This study examines the Canadian glass eel fishery, which began on an experimental basis in 1989 and transitioned to commercial operations in 1996 in rural coastal regions of the provinces of Nova Scotia and New Brunswick (Ecosystems and Oceans Science, 2019; Jessop, 1998). The American eel (*Anguilla rostrata*) is fished during spring nights using nets. It originates in the Sargasso Sea and migrates via Atlantic currents to estuaries and rivers, where juveniles – known as glass eels or elvers – are commercially harvested (Dekker, 2000; Jessop, 1998).

Between 1998 and 2021, eight commercial licenses for elver fishing remained with the same companies (Ecosystems and Oceans Science, 2019; Government of Canada, 2018). Since 2022, additional community-based commercial quotas were allocated to several First Nations communities in southwestern Nova Scotia and New Brunswick (Government of Canada, 2024b). Each commercial license holder has an individual quota. Employee names must be listed in the license conditions each season. Commercial license holders share access to nearly 200 rivers, streams and brooks. These watersheds typically located in rural areas vary greatly in size. Licenses are assigned by watershed and authorized fishers are listed on the license for a specific location. These fishing areas do not overlap, which heightens risks for licensed harvesters: encountering individuals on their assigned rivers at night who are not colleagues likely indicates unauthorized fishing activity, unwanted interactions or conflicts regarding “sharing” space on the rivers. Indeed, at nighttime, an increased density of individuals on rivers becomes a criminogenic factor that elevates the risk of conflict. For one of its counterparts, the European eel, illegal fishing raises conservation concerns, as well as other various harms documented by several studies (Gutierrez & Duffy, 2024; Hutchinson et al., 2024; Pons-Hernandez, 2024). It also creates challenges for stock assessment, since the amount of glass eels harvested by unauthorized fishers remains unknown.

The East Asian market relies on wild-caught elvers, which are raised in aquaculture farms before consumption (Crook & Nakamura, 2013; Shiraishi & Kaifu, 2024). This strong demand has driven prices sharply upward, benefiting both legal and illegal North American harvesters. In the past five years, the Canadian glass eel fishery faced major disruptions: seasons were halted by ministerial orders in 2021 and 2023 (Government of Canada, 2021, 2024b) and cancelled entirely in 2024 due to illegal fishing that threatened conservation and the orderly management of the fishery.

This context underscores the need to examine how the risks emerge and how regulatory authorities respond. While not directly related to the safety of harvesters or the public, these concerns are integral to maintaining an orderly fishery. Neglecting them contributes to a “perfect storm” of unmanaged risks. This study illustrates this dynamic through the case of a particular commercial season, which ended with an early closure ordered by the Minister after risks peaked to such an extent that the fishery was disrupted by violence and illegal activities. This case study examines how technical features of the glass eel fishery, its criminogenic dimensions, and safety concerns are addressed by Fisheries and Oceans Canada (DFO), the regulatory authority for fisheries.

We examine narratives around risks and safety in Canada’s glass eel fishery during a season of heightened disruption using a triangulation of sources: interdepartmental communications within DFO, public infraction reports, and fishery officer patrol data from the 2023 commercial season. Our analysis spans over 1,435 pages, distributed across 663 documents obtained through access to information and privacy (ATIP) requests. We used social network metrics to identify key groups within DFO communication flows and their interactions with the public. Mapping guardianship structures using social network analysis can uncover passive guardians, as well as overlaps and opportunities within regulatory networks (Gibbs et al., 2025).

By cross-referencing safety-related discourses with public infraction reports, we identify both consistent and conflicting narratives regarding risks throughout the 2023 season. Descriptive statistics from patrol data contextualize these narratives through enforcement actions. We chose this crisis case study because, unlike routine situations where safety concerns might be expressed and managed informally, a total shutdown represents a context in which communication should lead to documented action, making the absence of intermediate measures revealing. In doing so, our research contributes to broader discussions on the governance of high-value, high-risk fisheries and it offers insights into institutional responses. By examining these dynamics, the study highlights the dual role of the state as both a regulatory authority and a crisis responder. It emphasizes the importance of maintaining legitimacy and public cooperation in the governance of risk-intensive fisheries.

Literature Review

Three main elements motivate our focus on Canada’s commercial glass eel fishery, each anchored in criminological literature. This makes it a rich topic for both traditional criminologists seeking to diversify their focus and green criminologists aiming to ground their work in applied research. First, its high value density and recent market dynamics make commercial glass eel fisheries susceptible to conflict and violence. As with other high-value and scarce commodities, such as illicit drugs, competition over access and control often fuels tensions. Second, biological characteristics of the eel’s life cycle and the fishery’s organization contribute to increased exposure to unauthorized harvesters. This adds an additional layer of risk for authorized harvesters and for the public living near fishing sites. Third, existing literature on natural resource management often highlights how state

responses to such crises tend to be reactive, fragmented, or perceived as ineffective. This raises questions about the legitimacy and strategic capacity of regulatory institutions in managing high-stakes fisheries.

Market Demand as a Driver of Value Density in Illegally Harvested Species

Unlawful markets introduce dynamics that can intensify uncertainty, competition, and opportunistic violent behaviour among economically motivated offenders. In illegal drug markets, value fluctuations influence the likelihood of violence, measured through homicide rates (Aziani, 2020; Castillo et al., 2020). Instability disrupts competitive balances and increases the risk of violent outcomes. Although homicide rates may appear to be an extreme indicator of violence, a study shows that they are reliable proxies for broader violent crime, with moderate to strong correlations across time and scale with offences such as theft, drug infractions, and especially other violent acts (van Breen et al., 2023). Therefore, market fluctuations are likely to shape wider patterns of violence in drug markets.

Similar trends have been observed in natural resource markets when illegal activity emerges. For example, Chimeli and Soares (2017) analyzed homicide rates in Brazil's mahogany trade between 1995 and 2013 across three key phases. The researchers observe that homicide rates rose following the suspension and prohibition of mahogany trade but declined after enforcement intensified. Their estimates account for 101% of the average increase in homicides in Pará, the state with the most mahogany activity during the studied period. These findings suggest that the illicit dimension of a market contributes to the escalation of violence.

In their recent study on European eel trafficking, Alonso & Van Uhm (2023) emphasize how legal and illegal actors interact along the supply chain. These interactions blur distinctions between lawful and unlawful actors, as legitimate businesses often provide resources for criminal networks. Canada's regulatory structure for glass eel fishing differs from that in Europe, clarifying the distinction between licit and illicit actors: boundaries at harvest are "nonporous" in the sense that rivers are assigned to specific license holders and their staff. Encountering someone other than a colleague, especially at night, is a clear signal of illicit activity.

In Europe, glass eels face challenges related to both market volatility and illicit activities (Alonso & Van Uhm, 2023). This dynamic also applies to the Canadian context. First, market fluctuations affect prices, and the extent of these variations becomes more apparent when analyzing value density over time and comparing it to other high-value-density species. According to DFO, glass eels are the most economically significant marine resource in Canada when measured by value per unit weight (Gouvernement du Canada, 2025a, 2025b). This distinction is important: species such as lobster generate the highest absolute revenue because of their large landings; in 2023, 97,465 metric tons landed corresponds to an average value of CAN\$18.10 per kilogram. By contrast, the total allowable catch for glass eels was 11,067 kilograms (wet weight), yet their average value reached

CAN\$4,416.60/kg. In other words, while lobster dominates in total earnings due to sheer volume, glass eels exhibit an extraordinary value density.

Value is known to be an attractive incentive for poachers (Petrossian et al., 2015), along with market demand (Lavadinović et al., 2021; Mir Mohamad Tabar et al., 2021). A systematic review of 211 studies on mammal, bird, and reptile poaching from 2011 to 2020 found that drivers of illegal capture were mainly socioeconomic factors (56%), particularly income generation (40%) and black-market demand (26%) (Lavadinović et al., 2021). When poachers are directly surveyed, offenders report that profit and market demand, driven by high prices, local willingness to buy, and a preference for direct sales, are key motivators for illegal fishing (Mir Mohamad Tabar et al., 2021). This aligns with previous research on European eel trafficking, which indicates that extremely high value density prices create strong incentives for crime (Alonso & Van Uhm, 2023).

Second, market fluctuations over the past two decades have dramatically increased the value density of glass eels in Canada. Since eels cannot be bred in captivity, the market relies on capturing juveniles for aquaculture. In the 1990s, East Asia sourced glass eels from local *Anguilla japonica* and imported *Anguilla anguilla* (European eel) (Ringuet et al., 2002), but declining stocks led the EU to ban European eel exports in 2010 under CITES (CITES, 2007, 2016; The Council of the European Union, 1996). This shifted demand to *Anguilla rostrata* (American eel) (CITES, 2016; Crook & Nakamura, 2013). Consequently, American eel exports from the Americas to East Asia surged from 2 tons in 2004 to 157 tons in 2022, making it the most exploited eel species worldwide (Shiraishi & Kaifu, 2024). Canada, a key exporter and transit hub, plays a central role, with Hong Kong being the top importer.

These factors have contributed to upward pressure on unit-weight pricing. Between 2002 and 2010, glass eel value in the Maritimes averaged CAN\$393/kg, ranging from CAN\$112/kg to CAN\$787/kg. In 2011, it jumped to nearly CAN\$2,000/kg and doubled in 2012 to over CAN\$4,000/kg. Values remained high, peaking at CAN\$4,685/kg in 2015 and stabilizing near CAN\$3,000/kg in 2016 (Government of Canada, 2018). More recent data show annual averages varying from CAN\$1,359/kg to CAN\$5,265/kg between 2013 and 2022 with a mean of CAN\$3,806/kg; this underscores growth in value density (Government of Canada, 2024c). To this extremely high value density is added to the use of “bags of cash for black-market transactions” (Standing Committee on Fisheries and Oceans, 2023). As drug market dynamics illustrate, when the stakes are high or they fluctuate sharply, these pressures engender conflicts. The Canadian commercial glass eel fishery offers insight into how such factors are considered by decision-makers in their narratives and actions to manage these risks.

Spatiotemporal Overlap and Accessibility in Illicit Fishing Practices

Beyond market dynamics and value density, species-specific traits and the fishery’s organization also shape vulnerability: spatiotemporal concentration of harvesting, combined with easy access to fishing sites and to unauthorized gear, increases exposure to illicit activity. Illegal fishing doesn’t occur randomly. Indeed, poaching exhibits discernible spatial

and temporal patterns (Ghoddousi et al., 2022; González-Andrés et al., 2020; Pires & Marteache, 2023). For example, a study on the Great Barrier Reef found that recreational poaching clusters seasonally. Also, repeat incidents are likely to occur within 1 kilometer and within seven days of the initial event. This indicates non-random spatiotemporal patterns (Weekers et al., 2020), which can reflect poacher strategies, as well as behaviours of the targeted species. Specific biological traits may also influence these three components in an interrelated manner.

First, the availability and abundance of a species influence where poaching occurs. Using 142 georeferenced redwood thefts in a state park in California, a recent study found higher poaching likelihood in areas where old-growth redwoods were available (Pires & Marteache, 2023). Two other studies conclude that poaching tends to occur where the targeted animal is abundant (Ghoddousi et al., 2022; González-Andrés et al., 2020). This means that offenders target areas where the sought-after species is most concentrated. Second, poachers prioritize locations maximizing the cost effectiveness of their activities, all while avoiding detection by authorities. Pires and Marteache (2023) found that redwood thefts known to rangers often occur near roads, parking areas, and trails for accessibility purposes, but farther from campgrounds to minimize the risk of being noticed. In Isla del Coco National Park, illegal fishers target remote offshore zones, where enforcement is harder to implement (González-Andrés et al., 2020).

For certain species, specific biological traits may influence not only poaching patterns but also the organization of the fishery, which can further shape illegal fishing dynamics. This is especially true in the glass eel fishery in Canada, where the harvest window is narrow due to the eel's life cycle (Dekker, 2000; Jessop, 1998). Starting from the Sargasso Sea, where adult eels spawn and die, larvae drift across the Atlantic and transform into glass eels that migrate into estuaries and rivers (Dekker, 2000; Jessop, 1998). In Canada, harvesting occurs in select rivers of New Brunswick and Nova Scotia for a few months in springtime (Government of Canada, 2018). Glass eel biomass peaks at night during high tide, prompting nocturnal commercial harvesting (Jessop, 1998). In terms of how this fishery is organized, in Canada, commercial glass eel fishing licenses are both river specific and exclusive. Only one licensee can operate a river. Consequently, authorized fishing groups do not encounter one another during harvesting. Each of the eight non-communal commercial licenses that operated in 2023 included both specific rivers and total quotas. Licensees may cease fishing at their discretion, provided the total quota has not been reached, even if individual river quotas remain unfilled (Government of Canada, 2018). Therefore, the organization of Canada's glass eel fishery aligns with the eel's life cycle, in accordance with the narrow spatiotemporal window of its annual migration and its nocturnal availability. Authorized and unauthorized harvesters risk encountering one another during this small window of activity.

Its appeal to illegal harvesters is also shaped by technical aspects of the fishery, such as the accessibility of unauthorized gear. Glass eel harvesting in Canada primarily uses manually operated fixed gear, such as dip nets and fyke nets with stationary wings, typically neglecting the use of boats (Government of Canada, 2018; Jessop, 1998). Harvesters wear

waterproof gear to wade through the water, making nets the central tool. The apparent technical simplicity and accessibility of this equipment contribute to the fishery's vulnerability to illegal activity. For example, unauthorized dip nets, like butterfly nets, can be purchased for as little as CAN\$25 (Bass Pro Shops, 2025), compared to CAN\$90 for authorized versions and approximately CAN\$2,200 for fyke nets (Filmar Exceptional Nettings, 2025; Hamilton Marine, 2025). However, fyke nets may also be stolen (also observed in Pons-Hernandez & Petrossian, 2025), which circumvents financial barriers altogether.

The apparent ease of glass eel harvesting facilitates unauthorized fishing. When illegal fishers operate alongside licensed ones, the risk of exposure and conflict increases, as both groups compete for the same resource. Yet, only one operates within the bounds of regulatory oversight (Ballesteros et al., 2024). Environmental conditions such as darkness, remoteness, and the absence of bystanders can also shape how individuals perceive and respond to threats (Slovic, 1987). In a recent study on the European eel trade, a government official highlighted similar risks, noting that the glass eel fishery operates at night in remote areas, creating conditions that attracts “characters who don't always pay their normal taxes” (Gutierrez & Duffy, 2024, p. 66). These individuals who may engage in criminal activities represent an inherent risk for licensed harvesters. This context underscores the importance of addressing safety risks within the fishery and its governance. Regulatory authorities have a duty not only to enforce protective measures but also to avoid exacerbating risks.

Enforcement Gaps: How Weak Oversight Can Fuel Illegal Harvest

Ineffective enforcement strategies can unintentionally facilitate illegal fishing activities. This dynamic is driven both by the lack of consequences for offenders and by the reluctance to report infractions, often due to mistrust in regulatory authorities. One key finding emphasized by two studies is that wildlife patrols are not always strategic and effective. For instance, in Golestan National Park, ranger patrols were concentrated in zones with low poaching activity, leaving critical hotspots largely unmonitored (Ghoddousi et al., 2022). The lack of targeted enforcement creates opportunities for offenders. In the second study, researchers observe that the perceived economic benefits of poaching often outweigh the minimal risk of legal consequences, particularly when detection is unlikely (González-Andrés et al., 2020). Rather than deterring illegal activity, weak enforcement may inadvertently encourage it. Another important point relates to the reporting of infractions. Evidence from Bukit Barisan Selatan National Park in Indonesia shows that reporting poaching to authorities was not the most common response when witnessing the crime; instead, direct public intervention was most frequent, followed by ignoring the offence altogether (Kahler et al., 2023). This pattern is often attributed to a lack of trust in enforcement; when citizens perceive rangers as ineffective, they are less inclined to report illegal activity (Kahler et al., 2023; Sjöstedt et al., 2022).

In the absence of effective guardianship by official authorities, commercial glass eel harvesters and members of the public exposed to the fishery may become collateral targets of illegal harvesters. This vulnerability is further exacerbated when enforcement is weak or

inconsistent, reducing the perceived presence and deterrent power of regulatory institutions. An industry insider in the European eel trade interviewed by Gutierrez and Duffy (2024) expressed frustration with regulatory inaction, noting that despite sending numerous warnings to authorities, illegal operations continued openly without intervention. These factors highlight the importance of examining DFO's narratives concerning safety risks, as the country's primary fisheries regulator. DFO's decisions, be they in resource management or enforcement, can either mitigate or intensify the risks linked to glass eel harvesting.

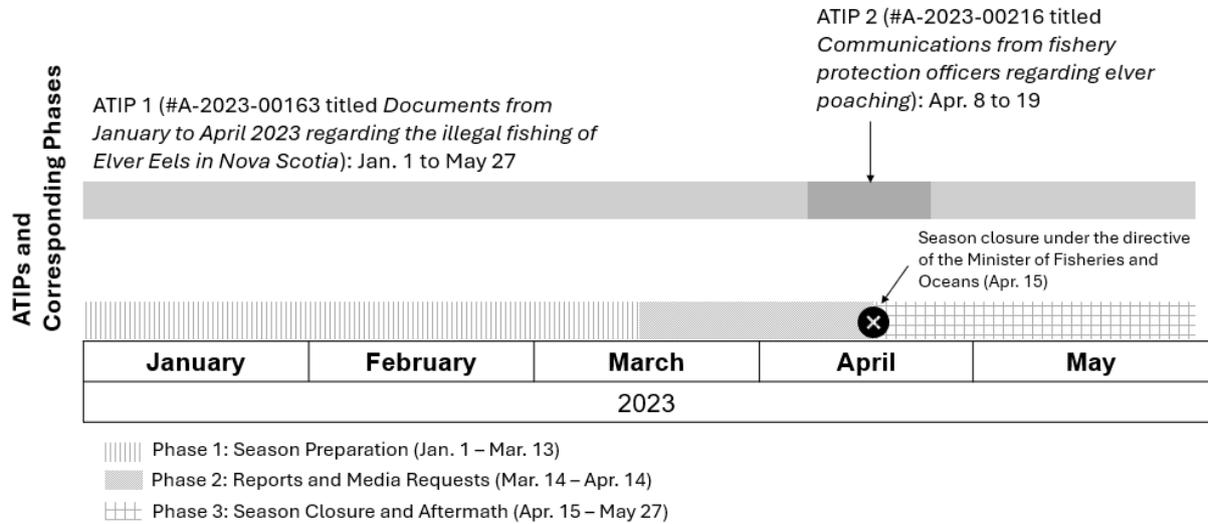
This study seeks to examine how risks and safety are discussed and managed in Canada's glass eel fishery by examining interdepartmental communications within DFO, public infraction reports, and fishery officers' patrol data from the 2023 season. The 2023 glass eel fishery closure represents a context in which communication would be expected to escalate into concrete action. In routine or low-risk scenarios, sensitive matters such as safety concerns might reasonably be handled informally through phone calls or in-person discussions, leaving limited written traces. However, when tensions reach the level of a total shutdown, the stakes are higher, and formal documentation of decisions becomes more likely. Therefore, this case study provides insight into how regulatory responses evolve under conditions of heightened risk. By analyzing narratives, understood as forms of rationality (Pires, 2004), we explore how different actors, such as DFO senior management, fishery officers, and the public, construct and communicate safety risks. We focus on how risks are framed, how communication flows respond to them, and what enforcement actions follow. Not all narratives hold equal weight: dominant discourses are legitimized through institutional authority, while others are marginalized (Pires, 2004). Cross-referencing these narratives reveals which perspectives prevail, based on the strategic position of actors within the communication network.

Data and Methods

To achieve our research objective of examining safety risk discourses in fisheries management, we used two completed Access to Information and Privacy (ATIP) requests found online relating to the 2023 season of commercial glass eel fishing in Nova Scotia (A-2023-00163 as ATIP 1 and A-2023-00216 as ATIP 2) (Government of Canada, 2024a). The season in question was closed by the Minister of Fisheries due to escalating poaching and violence. Figure 1 illustrates the timeframes covered by the two sets of documents.

Figure 1

ATIPs Timeline and Coverage Across Operational Phases of the 2023 Commercial Season



ATIP 1 spans from January 1 to May 27, 2023, while ATIP 2, represented in a slightly darker shade of grey, covers the period from April 8 to April 19, 2023. Documents from both ATIP requests were grouped into three operational phases of the season, based on their content: Phase 1 (Season Preparation, January 1 to March 13), Phase 2 (Surge in Reports and Media Inquiries, March 14 to April 14), and Phase 3 (Season Closure and Aftermath, April 15 to May 27). Notably, ATIP 2, which includes patrol reports from fishery officers, coincides with the transition between phases 2 and 3. This transition is a pivotal moment in the season, marked by intensified activity and culminating in the Minister’s decision to close the season on April 15, 2023.

Drawing from the ATIP requests, we used three primary sources of information. First, interdepartmental and public correspondence, found in ATIP 1, includes exchanges between various DFO departments and members of the public. Second, public reports of infractions, present in both datasets, consist mainly of complaints emailed directly to DFO or forwarded by local police services. Third, patrol data, which provide insight into enforcement activities, are drawn from ATIP 2 exclusively.

Correspondences as Communication Flows

ATIP 1 includes 293 unique documents totalling 762 pages of emails, letters, and meeting notes. In most cases (n=289), the sender and the recipients are known, allowing us to trace communication flows, to analyze temporal patterns, and to assign actors to groups. Group affiliation was determined by using job titles from email signatures. When absent, the Government of Canada’s employee Directory was consulted to assign each person to a single group. Table 1 Presents the seven most prominent groups, along with their frequency and proportion within the corpus.

Table 1 indicates that C&P is the most frequently represented group, appearing in more than half of the documents (169/289; 58.48%), followed by senior management, which

appears in about a third of the communications (98/289; 33.91%). Also notable in ATIP 1 is the presence of censored individuals, typically members of the public, who appear in 80 of the 289 documents, accounting for just over a quarter of the corpus (27.68%).

We applied social network analysis metrics to assess group influence and positioning across the three operational phases. Degree centrality measures display connections between groups. It reflects the number of the group's direct connections (Jackson, 2011). Betweenness centrality identifies key intermediaries facilitating communication. It indicates how often a group lies on the shortest path between others, indicating its role as an intermediary or a broker (Boivin & Morselli, 2016). Changes in these metrics, alongside each group's dominant safety narratives, reveal those shaping information flows and discourses (Borgatti, 2005). This approach was used to assess the interconnections between the government and other entities during crisis management, such as the COVID-19 pandemic (Cho et al., 2022; Samadi Foroushani et al., 2024) but also approaches to flood risk governance (Petridou et al., 2021) and safety risk factors of metro construction (Lu & Zhang, 2020). Our case study provides insights into the interplay between both safety risk management and crisis response, as revealed through this analytical approach.

Table 1

Key Organizational Groups in the Network

Group Category (labels)	Description	DFO/Public	N	%
C&P	Conservation and Protection (C&P) officers (fishery officers) and their first-level supervisors	DFO	169	58.48%
MediaRel	Individuals working in media relations and communications, excluding directors	DFO	43	14.88%
MINO	Minister's Office, including the Minister and cabinet staff	DFO	23	7.96%
SenManag	Senior management, including DFO officials with the title of director and above	DFO	98	33.91%
Censored Ind	Members of the public, such as commercial fishers or journalists	Public	80	27.68%
CommFish	Owners of a commercial glass eel fishing license and their staff	Public	13	4.50%
FNFish	First Nations from New Brunswick and Nova Scotia	Public	6	2.08%

We also coded for the presence or absence of key terms related to safety and enforcement for each document. This simple approach was appropriate given the clarity of

the dataset and the descriptive aim. Two coders assigned the codes and cross-checked results to ensure consistency and reliability.

Public Reporting

Incident reports submitted by the public are present in both ATIP requests. These include 911 calls initially handled by the police and subsequently transferred to DFO, as well as emails sent directly to C&P. These reports primarily concern theft and illegal fishing activities. To avoid duplicates, we flagged and excluded complaints with identical subject lines appearing in both ATIPs. We count a total of 162 reports over a 44-day period, from March 14, 2023, to April 27, 2023. During this time, only 7 reports were found in both data sources (n=162 unique reports). Table 2. Below presents the number of reports by data sources along with the average number of reports per day.

Table 2

Frequency, Time Period and Daily Reporting Rates of Public Reports by Data Source

Data Sources	n	Earliest Report Date	Latest Report Date	Number of days	Daily Reporting Rate
ATIP 1	128	2023-03-14	2023-04-27	45	2.844
ATIP 2	27	2023-04-08	2023-04-18	12	2.25
Both	7	NA	NA	NA	NA

Although it is not possible to determine whether all incident reports are included in these ATIP requests, there are two reasons to consider this as a sample of incident reports, allowing periods of heightened activity to be identified. First, daily reporting rates are similar across both sources, despite the limited overlap between them. In both ATIP requests, the average number of reports per day is less than three (2.844 for ATIP 1 and 2.077 for ATIP 2). Second, we observe that the distribution of reported infractions differs little between the two sources. We examined differences in daily report counts between ATIP 1 and ATIP 2 during the overlapping period. Although a discrepancy of nine calls appears on the last day of the overlapping period, reporting intensity is otherwise broadly consistent across the timeline. Call volumes range from 0 to 8, and the gap between the two ATIPs remains between -2 and 1 on all 11 days (mean = -0.454; SD = 0.934). Nonetheless, we remain cautious in interpreting these raw numbers as representative.

These reports were analyzed to reveal criminogenic characteristics mentioned in the descriptions of incidents of theft, illegal fishing or even trespassing. Such characteristics include, for example, presence of weapons, alcohol or drug consumption, and the number of unauthorized harvesters present on-site. We mapped the temporal distribution of these reports on a timeline and cross-referenced them with safety-related narratives found in the communications. This analysis was further enriched by incorporating patrol data, which serves as the third data source in this study.

Patrol Data

ATIP 2 includes 132 operational documents, 53 of which detail dated patrol and enforcement activities. These records document 126 patrols conducted between April 5 and 18, 2023, involving 52 fishery officers operating across at least 11 zones in Nova Scotia (e.g., Bridgewater, Digby, Sherbrooke and others). Time-stamped entries enable reconstruction of some enforcement efforts during this period. In some cases, patrol reports included descriptions of tasks performed, offering examples of enforcement actions.

This complements ATIP 1 by providing indicators of enforcement activity over time, enabling contextualization of network metrics and discourses. It also helps assess variations in enforcement intensity across phases. Patrol characteristics, such as timing and tasks, offer insight into on-the-ground actions. Patrol data in ATIP 2 thus provides a partial basis for comparing observed enforcement with the safety narratives articulated by different groups. Data was first compiled in Excel, then a thematic analysis was applied to identify key narratives. R (R Core Team, 2023) and Rstudio (RStudio, 2024) were used for data preparation and descriptive analysis, employing the *readxl* (Wickham, Bryan, et al., 2023), *dplyr* (Wickham, François, et al., 2023), *tidyr* (Wickham et al., 2024), *Hmisc* (Harrell, 2025), and *stringr* (Wickham, 2023) libraries for structuring, and *igraph* (Csárdi et al., 2024) for calculating network measures. This approach enables us to map intergroup relationships, to trace the evolution of safety narratives, and to evaluate corresponding enforcement actions.

Results

This section identifies key groups using degree and betweenness centrality metrics. In parallel, we examine dominant safety narratives, trends in public reporting, and patrol data (only for phases 2 and 3). This approach helps assess the alignment between discourse and enforcement. Table 3. Summarizes the network analysis by phase, showing centrality scores for each group and their evolution over time.

Phase 1: Season Preparation (January 1 to March 13)

In Phase 1, which corresponds to the preparation for the fishing season, key observations are rooted in the early emergence of safety concerns among licensees. In the first operational phase, this coincides with a highly centralized communication structure dominated by DFO senior management. Indeed, senior management holds the highest degree and betweenness centrality scores (22 and 12.47 respectively) by far exceeding the network averages (7.25 and 2.5). These metrics reflect both its extensive involvement in communications and its role as a key intermediary. Senior management is the most active node, engaging in the largest number of exchanges, particularly with commercial licensees. These interactions primarily concern seasonal preparations and proposed regulatory changes, many of which are met with resistance. For instance, a letter sent to all commercial license holders proposed mandatory river sharing, a measure unanimously opposed by all licensees due to fears of disruption and potential conflicts.

Safety concerns begin to surface among license holders during this early stage. However, these concerns are absent from the discourse of DFO representatives, suggesting a discrepancy between emerging field-level risks and institutional communication at the managerial level. Although no reports of illegal fishing were filed during the first phase and only one exchange referenced enforcement activities, commercial license holders raised safety concerns on three occasions. For example, on February 8, 2023, license holders rejected DFO's proposal to implement river-sharing arrangements, emphasizing the need to prioritize safety.

The Canadian Committee for a Sustainable Eel Fishery, an association representing five of the eight commercial license holders, stressed in a letter that licensees and their employees were facing intimidation and potential violence (ATIP 1, letter from the Canadian Committee for a Sustainable Eel Fishery to senior management, on February 8, p. 202). This expression of safety concerns could indicate that signs of danger from previous seasons were numerous and serious. We also note that fishery officers are absent in Phase 1.

DFO's discourse during this phase overlooks safety concerns. On February 24, senior management issued a *Compliance Monitoring and Enforcement Regional Operational Directive* that mentioned "risks" without specifying whether these referred to public health or safety. The context, focused on COVID-19 procedures, suggests the former, and the specific enforcement actions planned remain redacted. Based on available information, DFO did not explicitly acknowledge safety risks faced by license holders, their employees, fishery officers or the public during Phase 1. This contrasts with fears voiced by the industry before the season began, at a time when no official reports of illegal fishing had yet been filed.

Phase 2: Reports and Media Requests (March 14 to April 14)

The second operational phase represents a period of heightened activity and increased public concerns, particularly regarding safety and enforcement. This intensification of field-level issues ultimately leads to the Minister's decision to prematurely close the fishing season. This phase underscores the significance of shaping the trajectory of both public reporting and enforcement discourses. During Phase 2, DFO senior management steps back, coinciding with a surge in reported thefts and illegal fishing reports and media inquiries. At this time, C&P is the most present in email communications, but it is DFO media relations that holds the most strategic position regarding control over communications flows, as measured by betweenness centrality.

Table 3

Degree and Betweenness Centrality of the 7 Main Groups Across Operational Phases

<i>Group Category per Phase</i>	<i>Operational Phases</i>			<i>Evolution of Network Metrics</i>	
	Phase 1 Season Preparation	Phase 2 Reports and Media Requests	Phase 3 Season Closure and Aftermath	Phase 2 – Phase 1	Phase 3 – Phase 2
C&P	NA	61	104	NA	+43
Censored Ind	1	44	71	+43	+27
CommFish	13	NA	1	NA	NA
FNFish	6	1	1	-5	0
MediaRel	4	26	8	+22	-18
MINO	4	6	35	+2	+29
SenManag	22	32	71	+10	+39
Betweenness Centrality	Phase 1 Season Preparation	Phase 2 Reports and Media Requests	Phase 3 Season Closure and Aftermath	Phase 1 – Phase 2	Phase 2 – Phase 3
C&P	NA	1.180	1.116	NA	-0.064
Censored Ind	0.000	2.178	1.003	+2.178	-1.175
CommFish	0.533	NA	0.000	NA	NA
FNFish	0.000	0.000	0.000	0.000	0.000
MediaRel	6.000	7.497	0.000	+1.497	-7.497
MINO	0.000	0.000	0.600	0.000	+0.600
SenManag	12.467	2.445	19.701	-10.022	+17.256

Firstly, fishery officers play a prominent role as reports from the public start to pour in (Degree Centrality = 61). The first reported illegal fishing complaint in the corpus was received on March 14, 2023, a month before the season closure. Most communications during this time are transmitted between fishery officers. In fact, a total of 86 complaints were made by the public during this period. Some describe behaviours related to unauthorized harvesting, such as equipment theft, riverbank gatherings and trespassing, which, though seemingly minor, are perceived as more threatening when occurring at night. Others involve explicitly criminogenic elements, including intimidation, masked individuals, and firearms, with some reports suggesting links to organized crime. While the level of detail in the reports varies, redacted information is consistently present. Most complaints were filed by anonymized individuals, likely authorized fishers or individuals living near the rivers. Below is an example of a complaint filed:

complaint for address: [REDACTED] gold river. Details : illegal fishing – in progress – com reports 81 approx.. 12 people are currently fishing with lights. Complainants: [REDACTED] (ATIP 1, email forwarded by the police's Operational Communications Centre to a C&P detachment, on March 23, p. 344).

Patrol data reveals a temporal misalignment between ground patrols and reported criminal activity. Fishery officers rarely comment on safety risks via email. They also seldom engage with the public outside of crime reports. However, in one notable instance, an officer warns a member of the public to avoid engaging with illegal harvesters (ATIP 1, email from C&P to a censored individual, on April 14, p. 728).

Secondly, media relations play the most strategic role in communication flows in terms of betweenness centrality, sharing a strong connection with senior management. Media relations illustrate their significant control over information with a score 4.82 times higher than the average for the entire network (Betweenness Centrality = 7.497; Average = 1.56). Additionally, we observe that the value for senior management has decreased in relation to the previous phase (difference = -10,022).

DFO first acknowledges safety threats during the 2023 season on April 11 in media lines prepared ahead of the fishery closure. This occurred nearly a month after the industry raised the issue. The following day, DFO acknowledged fishery officers' safety for the first time, in response to external media inquiries. During this period, media relations focus on listing enforcement actions taken to curb illegal fishing and glass eel trafficking. The following media package was referenced ten times during Phase 2 in various exchanges:

From March 13 to April 10, fishery officers conducted 741 patrols of rivers where elver fishing was observed. These efforts have resulted in fishery officers seizing 35.81 kg of elver during this period. This total includes the 25 kg of elver seized at Halifax Stanfield International Airport on April 5. Fishery officers have also seized 21 nets, storage equipment, an ATV and a trailer, have arrested 12 individuals and issued 1 Summary Offence Ticket for violations of the Fisheries Act (ATIP 1, email from Media Relations to Global News, on April 13, p. 519).

This list is also reused three times in Phase 3 without being updated. With context, the enforcement efforts it highlights appear deficient. For example, the media package cites 741 patrols but omits that they rarely occurred during the night, despite glass eel fishing being a nocturnal activity. Similarly, the seizure of 35.81 kg of glass eels represents only 0.36% of the 9,960 kg Total Allowable Catch that year; only a minimal amount was confiscated on rivers (10.81 kg). The scale of enforcement is called into question by the limited number of seizures and arrests, especially when a single report noted 50 illegal fishers present at one site. Media relations present crisis management as effective by listing actions taken, suggesting sustained effort. In a broader context, these actions constitute a limited response rather than a comprehensive solution.

Phase 2 reveals a dual dynamic: rising reports of illegal activity prompt exchanges between fishery officers and anonymous citizens, while senior management engages separately in messages with the media. This layered communication suggests a gap between public concerns and image management. Although DFO presents a strong enforcement narrative, cross-referencing of complaints reveals a mismatch between perceived risks and actual enforcement.

Phase 3: Season Closure and Aftermath (April 15 to May 27)

The third phase marks the end of the fishing season and its aftermath, extending beyond the period covered by ATIP 2. Fishery officers maintain a central role; this is consistent with the previous phase. Strategically, there is a shift back to earlier patterns, with senior management replacing media relations as the primary actor. Enforcement data from ATIP 2 partially covers this phase, allowing for a comparison between official discourse, patrols and reports from the public.

Firstly, C&P remains frequently solicited during this period (Degree Centrality = 104), despite a reduction in enforcement capacity due to fishery officers being on a strike that began on April 19 (MacDonald, 2023). This strike is mentioned four times in ATIP 1, between April 24 and 27, without further details in the correspondence. A communication loop is formed, with fishery officers and senior management responding to mounting pressure from redacted members of the public, who are reporting illegal fishing. For example, between April 15 and 27, 76 incidents were recorded; despite the timeframe being much shorter. Complaints mainly mention trespassing and gatherings. Public vigilance persists; in one case, six redacted individuals reported 10 to 15 vehicles using nets to catch glass eels in the same location (ATIP 1, emails from the police's Operational Communications Centre to a C&P detachment, on April 21, pp. 661, 665).

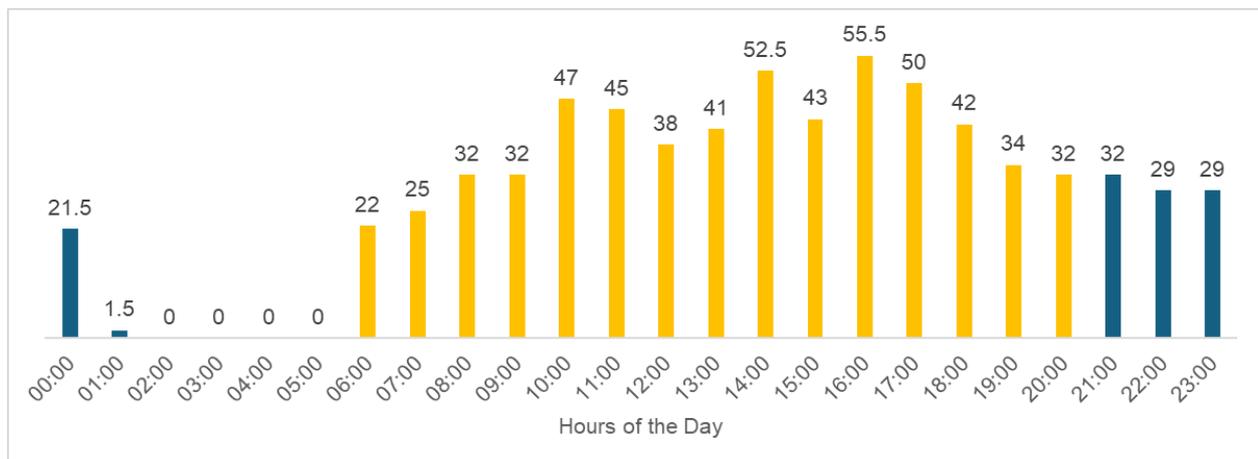
Secondly, senior management takes a central role in communications, as illustrated by the highest betweenness centrality score to date (betweenness centrality = 19.701; average = 3.203). At this stage, they exert the highest level of information control across all phases. Also, contradictions emerge in DFO's narrative on safety risks. On one hand, content analysis suggests the crisis has subsided. Media relations and senior management emphasize ongoing enforcement by C&P in the following example:

Fishery officers continue to patrol rivers and conduct surveillance and inspections to ensure compliance with the regulations related to the elver fishery. Enforcement continues and arrests and seizures have been made following the closure of the fishery. As stated previously, all elver harvesting is now prohibited and subject to enforcement action (ATIP 1, email sent from Media Relations to The Canadian Press, on April 18, p. 615).

On the other hand, fishery officers inform the federal police on April 24 that their response capacity is limited (ATIP 1, p. 699). The excerpt below illustrates continued reporting and mounting frustration, suggesting the issue is far from resolved.

I'd like to once again report the repeated poaching of elvers on multiple rivers in Nova Scotia [...]. This is the 9th report of illegal fishing I've made in the 10 days since the fishery was closed by FMO, putting 200 fishermen out of work. We have witnessed no enforcement action during those 10 days. [...] We don't know why you refuse to direct your staff to enforce, but it's apparent that you will not act to enforce the FMO closure. We can only assume that you've been given that directive from the minister's office (ATIP 1, email from a censored individual to C&P, senior management, politicians, and the Minister's office, on April 25, p. 701).

Institutional discourse conveys messages that reinforce a positive image; in this case, DFO highlights the visible presence of fishery officers on patrol to signal ongoing enforcement efforts (ATIP 1, email from Media Relations to The Canadian Press, on April 18, p. 615). However, it fails to mention that patrols are primarily conducted during the day. Figure 2. shows the aggregated hourly distribution of fishery officers, based on time-stamped data collected over 4 days in April 2023. The highlighted yellow bars indicate hours with probable exposure to sunlight. The comparison highlights temporal mismatches between enforcement efforts and reported incidents. Although glass eels are nocturnal, nighttime patrols were uncommon, representing only 16.051% of all recorded presence ($113/704=0.16051$). In contrast, sun-exposed presences accounted for more than three-quarters of all hourly presences ($591/704=0.8394$). These patrols involved hanging posters on trees stating that the fishing season is closed. The locations of these posters were recorded using handwritten geographic coordinates. These elements, rooted in image management, appear designed to shape public perception. Yet, whether this reflects deliberate intent or a lack of understanding of eel ecology and of the need for exclusive nighttime patrols is unclear, as intent is not explicit in written communications.

Figure 2*Aggregated Hourly Presence of Fishery Officers (April 15–18, 2023)*

Discussion

This study examines discourses regarding safety risks in the 2023 commercial glass eel fishery season in Nova Scotia. Social network analysis metrics were employed to identify key groups in communication flows throughout three operational phases. Comparisons between discourses, public complaints, and patrol data revealed discrepancies between these groups. Analyzing how various entities frame safety risks revealed two key findings. First, the crisis appears foreseeable, suggesting a failure in risk management, given the fishery's criminogenic characteristics. Second, there is an apparent prioritization of image management over problem-solving grounded in the biological traits of glass eels and the structural organization of the fishery.

Foreseeable Crisis and Missed Signals: Risk Management in a Criminogenic Fishery

Despite repeated warnings from industry stakeholders, DFO was slow to address safety concerns in its public discourse. A comparison of its communications, implemented measures, and public feedback reveals significant discrepancies, highlighting both internal incoherence and a disconnect between institutional actions and some public expectations. This outcome is unsurprising, given senior management briefings in both ATIP requests and existing research, which both overlook value density as a comparative metric (Lavadinović et al., 2021; Mir Mohamad Tabar et al., 2021; Petrossian et al., 2015), despite its potential to better capture the exceptional high-value outlier status of glass eels relative to other high-value species. Such insights only emerge with comparisons across species. Unlike general value, value density refers to the economic return relative to the physical volume of the species. Glass eels' high value density is a unique trait that sets the fishery apart, making it particularly susceptible to illegal fishing and justifying proactive enforcement measures. Our study contributes to knowledge by introducing how the economic value concentrated in a small physical quantity of a resource (*value density*) is an element of risk. We also use the

ways in which this concentration varies across species as a lens to explain why certain species create unique dynamics that standard regulatory approaches may not anticipate.

Another critical factor is market fluctuation, which, as shown in studies on illicit commodities, is linked to conflict and violence (Aziani, 2020; Castillo et al., 2020). In the case of glass eels, such volatility creates a “perfect storm”, where heightened market value increases the species' attractiveness and the likelihood of illegal harvesting. This, combined with the narrow space-time window for harvesting and the easy accessibility of fishing gear, raises the probability of physical encounters or proximity between illegal harvesters and the public, posing significant safety risks. This emphasizes the importance of timely interventions during high-risk periods to prevent escalation.

Illegal fishing follows identifiable patterns shaped by both species' biological traits – such as predictable biomass presence patterns, as shown in studies by Ghoddousi (2022) on ungulates, by González-Andrés et al. (2020) on yellowfin tuna and silky sharks, and by Jessop (1998) on glass eels – and the regulatory structure of the fishery, which determines when and where fishers operate (Government of Canada, 2018). These factors make these risks somewhat predictable. The institutional response, however, remains notably misaligned with public concerns, raising questions about its rationale. While some illegal fishing involves minor infractions, early public complaints point to serious risks, especially when unauthorized harvesters operate at night in large numbers. The institutional response, though delayed by several weeks, was abrupt and resulted in the cancellation of the commercial fishing season. This highlights how formal and informal guardians interact within a regulatory system, representing another key contribution of this research.

Symbolic over Substantive Action

The late timing of safety narratives expressed by DFO may indicate that decision-making was influenced by other priorities at the senior management level. Alternatively, this could reflect that safety information was shared outside written communication. These interpretations should be considered within the limitations of the available data. However, the apparent lack of coordination in patrol deployment, combined with a communication strategy oriented toward media relations rather than operational transparency, raises questions about the underlying priorities guiding institutional responses.

On one hand, the inadequacy of patrol deployment is, in some respects, unsurprising, as similar challenges have been documented globally. For instance, Ghoddousi et al. (2022) found that enforcement efforts were often focused on areas with low poaching pressure rather than regions with high prey biomass. This highlights issues regarding how patrol decisions are made and whether they could be reoriented to strengthen oversight of poachers. Surveying poachers in Iran revealed that, from the offender's perspective, the absence of a capable guardian is a strong factor enabling illegal fishing (Mir Mohamad Tabar et al., 2021). Misaligned enforcement fails to promote compliance, and it reduces the likelihood of detection, allowing illegal fishers to operate with relative impunity (González-Andrés et al., 2020). In our case study, capable guardians, such as fishers, are present, yet two issues arise:

deterrence may require more than physical presence alone, and guardianship becomes ineffective when poachers vastly outnumber locals. This might turn observers into potential liabilities rather than deterrents.

On the other hand, senior management's reliance on media relations at the peak of the crisis cannot be overlooked. Cross-referencing of patrol and incident data suggests this strategy prioritized image management over effective problem-solving. Fishery officers were caught between institutional directives and public expectations. This, along with the closure, appeared largely ineffective in curbing unauthorized fishing practices. This extreme measure reflects the failure of preventive management. For example, the media package mentions the seizure of 21 nets over nearly a month. To put this number into perspective, a single licence holder purchased and later retired adult eel licences that included at least 12 weirs, 210 fyke nets, and 475 pots (Government of Canada, 2018). In this context, 21 nets represent a relatively small proportion of potential gear in circulation, especially given that the type of nets seized (fyke nets or dip nets) is not specified in the media lines. Also, although the overall approach regarding unauthorized glass eel fishing appears inexpensive and accessible, this is only partially true. As noted earlier, fyke nets cost around CAN\$2,200; targeted large-scale equipment seizures may affect poachers operating at a higher level, who invest in costly gear. Similarly, the confiscation of vehicles can have an equivalent or even greater impact on those opting for less expensive equipment, as it significantly raises the cost of non-compliance.

Indeed, we found no clear evidence of intermediate measures being taken, reflecting a lack of graduated responses between business-as-usual approaches and a full-blown closure to address the issue. While such measures may have occurred outside written communication and thus escaped this dataset, they would likely have appeared in action lists or conflict management records if documented. Examples of intermediate enforcement include targeted monitoring of markets and high-risk zones, systematic seizures of illegal equipment, and thorough investigations into equipment theft. Surveillance timing and resource allocation should be guided by spatiotemporal patterns of unauthorized fishing activity – specifically when and where infractions are most likely to occur – along with species availability and criminogenic factors, with an emphasis on early detection of potential violence. Incorporating warnings from fishers and non-fishing citizens reporting rising tensions can also serve as a valuable early risk management tool.

Conclusion

Overall, this study highlights discrepancies between DFO's official discourse and its apparent actions, and the narratives emerging from the public. This gap indicates the presence of blind spots in the management of the commercial glass eel fishery. Specifically, management practices during the 2023 season failed to fully acknowledge the criminogenic risks and the direct exposure of fishers to illegal harvesters as integral public safety concerns. At the very least, these risks were not explicitly addressed.

These blind spots, particularly regarding public safety, raise questions about the moral responsibility of institutions to protect Canadians, a responsibility grounded in the fundamental right to security, enshrined in the Charter of Rights and Freedom, even if not formally part of DFO's mandate. These risks nonetheless fall within DFO's operational domain, as the incidents occur directly under its jurisdiction. This raises concerns about whether the inadequacy of the institutional response may erode community trust toward DFO, especially since authorities depend on communities to report violations because fishery officers cannot be everywhere (McMullan & Perrier, 2002). As observed in other contexts, when trust declines, reporting decreases, and individuals may resort to direct intervention or inaction (Kahler et al., 2023). Both of which can exacerbate conflicts.

This study offers a significant scientific contribution by questioning whether the distribution of risks across different fisheries is adequately considered. In the case of glass eels, biological characteristics play a key role in shaping exposure to illegal harvesting. However, other relevant factors might emerge through comparative case studies involving different species or crises within resource management institutions.

This case study illustrates an institutional response that appears misaligned with public input. It prompts reflection on the contribution of citizen knowledge to preventive crisis management in the context of natural resource governance. It also contributes to the literature on guardianship by demonstrating that community guardianship is often contingent upon the actions and decisions of regulatory guardians. When regulatory guardians falter or fail, community guardians – and, as illustrated in our case study, the broader public – bear the consequences of this dependency. This underscores the hierarchical nature of guardianship within regulatory frameworks and highlights the vulnerability of community actors when institutional mechanisms do not function as intended. In terms of recommendations for practitioners, we conclude that a more participatory approach in both resource management measures and enforcement could improve the anticipation, targeting, and de-escalation of crises.

Limitations

This study presents two main limitations associated with the nature of the data. First, communication among individuals does not occur solely in written form. While we have access to emails and letters, other forms of interaction, such as phone calls, are not captured through ATIP requests. Nevertheless, the available documents provide valuable insight into official and institutional positions. Informal exchanges are absent from our dataset, which may particularly affect our understanding of frontline fishery officers' interactions, as they are more likely to engage verbally with the public. Second, the documents may not encompass all reported incidents. However, they contribute to forming the base of the communication flows analyzed in the current study.

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