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The Managed Erosion of Conservation Priorities for Pacific Salmon

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ABSTRACT

Conservation policies worldwide promise to halt biodiversity loss, yet implementation frequently lags intent. We examine this disconnect through wild Pacific salmon (*Oncorhynchus* spp.) in Canada, where sustained declines have occurred despite the federal Wild Salmon Policy and legal protections available under the Species at Risk Act. Drawing on population data, policy analyses, and documented governance failures, we show that conservation outcomes have been compromised by declining monitoring capacity, weakened scientific integrity and independence, and limited political willingness to act on evidence. Long-term monitoring has declined substantially, leaving many populations data-deficient and delaying detection of risk. Scientific advice has at times been compromised by political and sectoral pressures that weaken evidence-based decision-making. Governments have repeatedly failed to implement timely protections for at-risk populations despite clear scientific warnings. Together, these failures illustrate how discretionary governance and weak institutional safeguards can undermine conservation commitments. Canada's experience illustrates a broader global challenge: conservation policies lacking accountability mechanisms, enforceable obligations, and safeguards for scientific integrity are unlikely to deliver intended biodiversity outcomes. Preventing further loss will require sustained investment in monitoring and assessment, timely conservation action, and governance systems capable of translating scientific evidence into effective protection.

1 | Introduction

Global biodiversity loss is accelerating despite decades of conservation commitments and increasingly ambitious policy targets (Díaz et al. 2019; Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services [IPBES] 2019). Governments worldwide have adopted frameworks intended to halt or reverse species declines, yet conservation outcomes frequently fail to match stated objectives (Tittensor et al. 2014). This shortfall is widely attributed to persistent implementation gaps, governance constraints, and weak science-policy integration that limit the translation of commitments into effective action. Across terrestrial and aquatic systems, conservation efforts are often undermined by limited institutional capacity, fragmented authority, and decision-making processes that inadequately incorporate or act upon scientific evidence (Young et al. 2014; Díaz et al. 2019). As a result, biodiversity continues to decline even in regions with well-articulated conservation policies, particularly for exploited

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species whose persistence depends on effective management and science-informed decision-making. This pattern highlights a critical challenge in conservation governance: effective biodiversity protection depends on the institutional capacity, accountability mechanisms, scientific integrity, and political willingness needed to translate conservation commitments into practice (Bell-James et al. 2024).

Wild Pacific salmon (*Oncorhynchus* spp.) exemplify these challenges, as their persistence depends on effective monitoring, evidence-based decision-making, and timely management intervention. Salmon are among the most ecologically, culturally, and economically significant taxa in North America, yet they have experienced long-term declines in both abundance and diversity over the last century (Slaney et al. 1996; Price et al. 2021). As highly diverse, locally adapted populations, salmon play a disproportionate ecological role: they transport marine-derived nutrients across ecosystems supporting complex food webs, sustain Indigenous cultures, and underpin commercial and recreational fisheries worth billions of dollars annually (Schindler et al. 2010; Atlas et al. 2021). Through these cross-ecosystem linkages, salmon amplify the ecological effects of both their recovery and decline. Consequently, weaknesses in monitoring, scientific integration, or precautionary management undermine both salmon persistence and the broader biodiversity they support.

In Canada, where Pacific salmon are among the most intensively managed wildlife species, conservation is guided by a comparatively ambitious policy framework for exploited species: the federal Policy on the Conservation of Wild Pacific Salmon (Wild Salmon Policy [WSP]; DFO 2005). Introduced in 2005, the WSP was intended to operationalize a "conservation first" approach by safeguarding salmon biodiversity through systematic monitoring, science-based risk assessment, and proactive management before populations require legal protection. Yet, since the WSP's adoption, salmon outcomes have continued to deteriorate across much of their range. In British Columbia, assessed populations show widespread and persistent declines (Pacific Salmon Foundation [PSF] 2025); commercial salmon fisheries have contracted to historic lows; and annual food, social, and ceremonial harvest needs of Indigenous communities are increasingly unmet (Reid et al. 2022). This mismatch between policy ambition and ecological and social outcomes raises a central question: what prevents a well-articulated conservation framework from delivering protection in practice? Here, we use Pacific salmon as a case study to examine three interdependent dimensions of conservation governance that strongly influence whether precautionary conservation policies succeed in practice: (1) the capacity to monitor populations, (2) the integrity and independence of scientific advice, and (3) the political and institutional willingness to act on evidence. Together, these dimensions shape whether conservation commitments can be implemented credibly and consistently. These challenges are not unique to salmon or to Canada. Globally, conservation outcomes are strongly influenced by governance features, such as enforceability, institutional accountability, transparency, monitoring requirements, and the insulation of scientific advice from political interference (Cooke et al. 2013; Goldman et al. 2017; Cheung et al. 2023). Pacific salmon therefore provide a useful lens through which to examine why conservation policies often fail in practice.

2 | Policy Context

Pacific salmon in North America are managed under a layered system of national laws, policy guidance, and international treaty obligations. In Canada, the WSP provides a high-level decision-making framework for maintaining healthy populations of the five commercially exploited Pacific salmon species, assessed at the level of Conservation Units—genetically and geographically distinct populations within each species. The Policy was designed to enable proactive conservation measures before formal listing under the Species at Risk Act (SARA), helping to prevent both endangerment and costly socio-economic consequences. When populations nevertheless face imminent risk of extinction, the SARA provides a formal legal backstop for protection based on independent assessments from the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). However, listing decisions occur at the discretion of the federal Cabinet, are frequently delayed or politically contested, and have often failed to provide timely protection for aquatic species at risk (McDevitt-Irwin et al. 2015; Jeanson et al. 2025).

Salmon governance in British Columbia is further complicated by fragmented jurisdictional authority. While Fisheries and Oceans Canada (DFO) is responsible for fisheries management and fish habitat protection under federal legislation, many activities affecting salmon habitat in freshwater environments—including forestry, mining, road development, and water management—are primarily regulated by the Province of British Columbia. This division of authority can create gaps in accountability and constrain coordinated conservation responses.

Despite this combination of policy guidance, legal safeguards, and shared jurisdictional responsibility, wild Pacific salmon in Canada have continued to decline. The magnitude of loss is substantial: currently, two-thirds of regional populations with available data are below their historical abundance average (PSF 2025). By the mid-1990s, an estimated 140 spawning populations were already considered extinct (Slaney et al. 1996), and the current number is unknown due to an erosion of monitoring effort (Price and Moore 2026). Among populations with sufficient information, many continue to decline despite the WSP's stated intent to safeguard diversity. For example, 30 Conservation Units in northern British Columbia have declined in both abundance and risk status since the Policy's inception (Price et al. 2017), and 47 Pacific salmon populations assessed over the last decade by COSEWIC are at risk of extinction (Government of Canada 2026). Fisheries exploitation and habitat degradation are well-established drivers of salmon decline (Slaney et al. 1996). However, continued declines under a policy framework explicitly designed to prevent such outcomes suggest important gaps between conservation objectives and implementation.

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3 | Erosion of Conservation Commitments

3.1 | Monitoring

Monitoring is essential for tracking and reporting changes in biodiversity. As the first of the three dimensions of conservation governance identified above, monitoring capacity shapes whether conservation commitments can be translated into action by providing the data needed to detect decline, assess risk, guide interventions, and evaluate whether management actions are achieving intended outcomes. In the Canadian context, this responsibility rests primarily with DFO, the federal agency charged with implementing the WSP and conducting population monitoring and assessment. Recognizing this, Canada explicitly identifies systematic monitoring as a core pillar of its "conservation first" policy approach, requiring regular assessments of salmon returning to spawning grounds (DFO 2005). Monitoring under the WSP reflects a much longer history of salmon stewardship. Long before colonial management, Indigenous governance systems sustained salmon for millennia, with hereditary leaders stewarding individual populations and enforcing conservation measures (Atlas et al. 2021). Federal monitoring began in the 1930s and has evolved into one of North America's longest running time series for exploited species.

That record, however, has been steadily diminishing since the late 1980s, tracking the collapse of salmon abundance and related fisheries. Historically, population surveys were designed to support commercial fisheries. As salmon abundance declined and fisheries closed, monitoring effort contracted. The introduction of the WSP was meant to usher in a new era, shifting monitoring from harvest management to conservation. Monitoring effort nevertheless continued to erode: annual population surveys have dropped by one-third since the adoption of the Policy, and coverage is now at a historic low (Price and Moore 2026). As a direct consequence, nearly half of Canada's Pacific salmon Conservation Units lack sufficient information to assess risk status (Figure 1; see Supporting Information). Data-deficient but declining populations may therefore continue to diminish—or disappear—undetected, precluding timely interventions and constraining recovery potential. This erosion of monitoring capacity creates a reinforcing feedback mechanism: declining monitoring reduces the ability to detect risk, assess status, and justify conservation intervention, which in turn further weakens future decision-making capacity. Because status assessments rely on multi-year trends, current data gaps will impair risk evaluations for years to come, even if monitoring improves. As information quality declines, conservation actions become increasingly reactive and uncertain. Without restored monitoring capacity, effective conservation responses will remain compromised. Such erosion of monitoring reflects global patterns, where inadequate institutional commitments and shifting priorities have undermined ecological datasets (Lindenmayer and Likens 2010).

Erosion of monitoring also imposes an economic cost. Fisheries cannot be safely reopened without reliable information on population health. Without adequate monitoring, managers lack the information needed to determine whether salmon runs can sustain exploitation pressure, leaving fishing opportunities indefinitely out of reach or managed in the dark. Inadequate population monitoring further precludes fisheries from participating in seafood sustainability ecolabels, which can provide fishers with both access to international markets and a higher sale price. By contrast, renewed investment in monitoring delivers dual benefits: strengthening conservation while laying the foundation for sustainable fisheries and the economies that depend on them.

Importantly, improved monitoring and governance alone cannot fully offset many of the large-scale drivers affecting Pacific salmon, including climate-driven ocean warming, changing marine food webs, and large-scale international hatchery releases. However, robust monitoring and precautionary governance remain essential prerequisites for detecting change, adapting management responses, and maintaining resilience under increasingly uncertain environmental conditions.

3.2 | Scientific Integrity

Reliable monitoring is effective only when the information it provides is interpreted and applied with integrity within science policy decision-making processes. Science-policy interfaces are unavoidable in democratic governance, where elected decision makers are responsible for balancing ecological, economic, social, and cultural objectives. Scientific integrity instead depends on ensuring that scientific advice remains independent, transparent, and free from systematic distortion or political interference. Yet, Canada's federal government has often allowed political and sectoral pressures to compromise evidence-based recommendations. Despite formal commitments to impartial science, the Canadian Science Advisory Secretariat (CSAS)—the main science advisory body for DFO—has produced assessments distorted by such pressures, fundamentally undermining salmon conservation (Godwin et al. 2023).

One example is DFO's handling of parasite and disease threats to wild salmon from open net-pen aquaculture. Coastal salmon farms act as reservoirs for sea lice and microbial pathogens, which spread to migrating wild salmon with potentially severe impacts (Krkosek et al. 2024). While independent studies have documented these risks, DFO has repeatedly downplayed them. Canada's Office of the Auditor General, the Chief Science Advisor, and the House of Commons Standing Committee on Fisheries and Oceans have all raised concerns about advice that lacks independence, transparency, and adequate peer review (Godwin et al. 2023). A 2022 CSAS report, for instance, concluded that sea lice on juvenile wild salmon were not significantly associated with nearby farms despite its own data showing the opposite (Krkosek et al. 2024). That report selectively excluded key findings, ignored a large body of peer-reviewed literature, and was not reviewed independently prior to release. Following subsequent academic scrutiny, the report's authors re-analyzed their data and concluded that farm-derived infestation pressure does in fact increase sea lice on wild juvenile salmon (Jeong et al. 2025). That this error was identified through external review rather than internal quality-control processes highlights a systemic weakness in the science advisory process.

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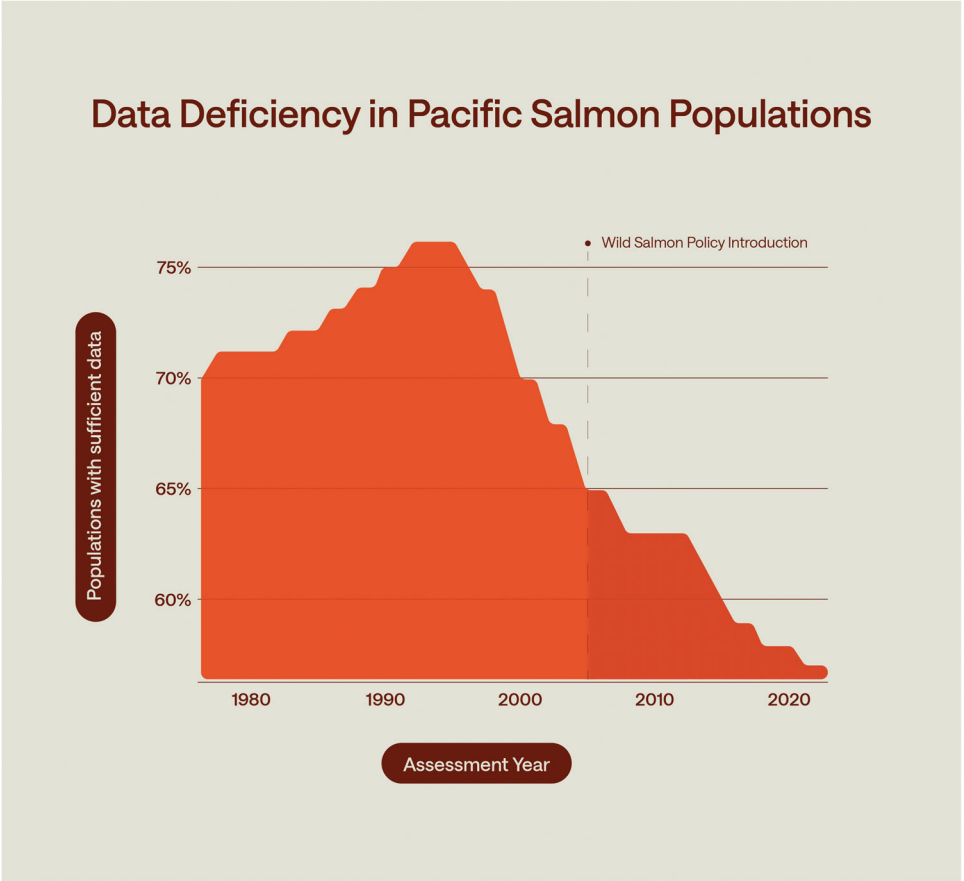

FIGURE 1 | Percentage of Pacific salmon Conservation Units (i.e., populations) with sufficient data to assess biological status each year based on the three-generation trend metric. The vertical dashed line marks 2005, the year in which Canada's Wild Salmon Policy was introduced.

Another breakdown in scientific integrity emerged in the case of two highly diminished steelhead trout (*Oncorhynchus mykiss*) populations native to British Columbia. After a greater than 80% decline in mature individuals in both populations, the COSEWIC assessed the Thompson and Chilcotin River steelhead as endangered and recommended their emergency listing under the SARA (Government of Canada 2026). Instead, Canada's federal government declined to list these populations and pursued a non-legally binding Steelhead Action Plan guided by a CSAS assessment (Jeanson et al. 2025). However, the subsequent CSAS report—meant to provide rigorous science advice on threats to these steelhead populations—was modified after review. DFO downplayed key threats, particularly incidental catch and mortality in non-selective salmon fisheries (Godwin et al. 2023). The original science advice document that was subsequently altered has never been released to the public. As a result, these two steelhead populations remain endangered without legal protection and are subject to annual capture in commercial fisheries. Concerns about compromised scientific integrity are not unique to Canada but reflect a broader global challenge, with political interference, selective use of evidence, and institutional pressures undermining science-based decision-making across multiple jurisdictions (Goldman et al. 2017). These examples also illustrate that scientific integrity alone is insufficient for effective conservation; governments must ultimately be willing to act on scientific evidence.

3.3 | Political Will

Political will ultimately determines whether conservation frameworks, scientific assessments, and legal protections are translated into action. In Canada, this is expressed through federal Cabinet listing decisions, ministerial discretion, regulatory enforcement, and budgetary allocation. Even when strong legal frameworks exist, conservation action is often deferred when it conflicts with short-term sectoral or political interests.

One of the most striking examples in Canada is the federal government's repeated failure to implement timely protections for salmon populations assessed as at risk under the SARA despite scientific advice recommending legal protection. Over the past decade, the COSEWIC has assessed 47 Pacific salmon populations as at risk across four species, yet none have received formal listing under the SARA (Government of Canada 2026; Figure 2). A well-documented case is the decision not to protect Sakinaw and Cultus Lake sockeye salmon (*Oncorhynchus nerka*) populations. Severe declines in Cultus sockeye during the 1990s prompted an emergency assessment request in 2002. The COSEWIC confirmed the population's endangered status and recommended emergency listing under the SARA (Cohen 2012). However, DFO advised against legal protection, asserting that discretionary management measures could address the identified threats; subsequent assessments indicate that these measures did

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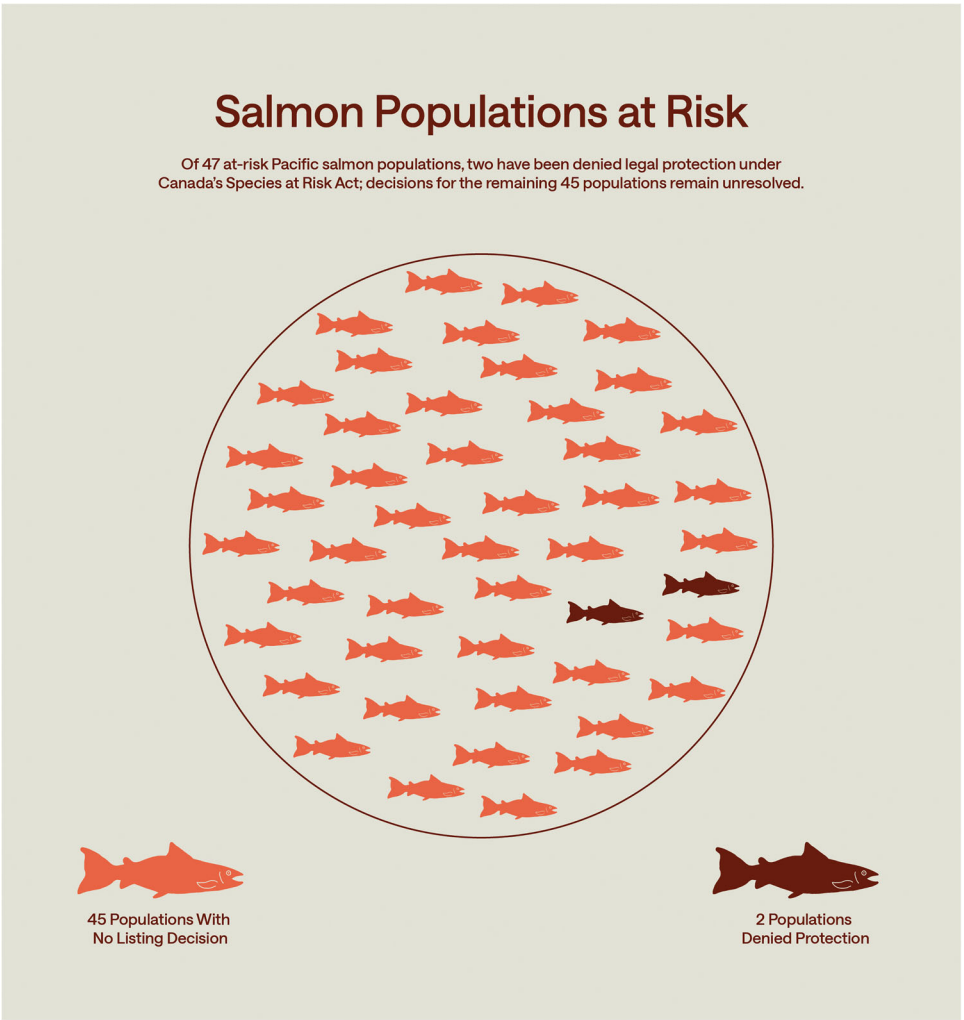

FIGURE 2 | Number of at-risk Pacific salmon populations eligible for legal listing under the Species at Risk Act (SARA). Each fish represents one at-risk population; orange indicates populations awaiting listing decisions, and dark-red denotes those denied legal protection.

not reverse the decline (Government of Canada 2026). Listing was further deferred on socio-economic grounds that overstated short-term costs and ignored long-term recovery benefits (Cohen 2012). Both populations were re-assessed as at risk in 2017, and no listing decision has yet been made; they remain in immediate danger of extinction.

More recently, the Thompson and Chilcotin River steelhead populations met established criteria for emergency listing, but the federal government denied protection (Jeanson et al. 2025). A final decision on whether to list them under the standard (non-emergency) process has yet to be made. For all other at-risk salmon populations assessed by the COSEWIC, listing decisions have been delayed—some for nearly a decade (Government of Canada 2026). Although the SARA contains statutory timelines for federal listing decisions, delays before recommendations reach Cabinet can stall cases for years in practice, leaving populations without the legal protections recommended by science and weakening public accountability. Comparable patterns of politically motivated delay or inaction have been documented internationally, where conservation decisions are frequently deferred or weakened when they conflict with short-term sectoral or political interests, highlighting a widespread challenge in translating scientific assessments into protective action (Cooke et al. 2013; Cheung et al. 2023). At the same time, some salmon recovery efforts demonstrate that positive outcomes remain possible when sustained monitoring, long-term institutional commitment, and collaborative stewardship are maintained. For example, recent improvements in some Skeena River sockeye populations have been associated with fisheries reform, coordinated governance, and strong Indigenous leadership (Atlas et al. 2026). This example illustrates that salmon populations can respond positively when timely conservation actions are implemented consistently and supported by long-term institutional investment. Ultimately, conservation succeeds only when monitoring, science, and political willingness reinforce one another; failure in any one link undermines the whole.

4 | Conclusion/Policy Recommendations

Wild Pacific salmon are imperiled because Canada's conservation framework has lacked the institutional safeguards, accountability mechanisms, and consistent implementation needed to translate commitments into effective protection. Strengthening conservation outcomes therefore requires governance structures

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that constrain discretionary inaction, enforceable timelines for conservation decisions, sustained investment in long-term monitoring and assessment, stronger legal obligations to act on scientific risk assessments, and greater insulation of scientific advisory processes from political or sectoral interference. International examples illustrate several potential approaches. In the United States, the Magnuson-Stevens Act mandates rebuilding plans for depleted fish populations at biologically meaningful scales, while the Endangered Species Act (ESA) imposes stronger legal obligations and timelines for protection decisions than Canada's SARA (Waples et al. 2013). ESA-listed Pacific salmon populations have shown more positive abundance trajectories than many comparable non-listed populations (Ford et al. 2025). Similarly, New Zealand's science advisory system has emphasized clearer institutional norms around scientific independence and transparency. Transparent accounting of conservation benefits and the costs of delayed action may strengthen accountability in species-at-risk decision-making (Rosenfeld 2025).

Recent governance trends in Canada suggest continued weakening of the institutional safeguards required for effective conservation. Monitoring has eroded, scientific advice has been compromised, and governments have repeatedly declined to act on evidence through available legal mechanisms, even as populations approach extinction. At the same time, policy shifts aimed at accelerating industrial development are proceeding alongside substantial budget cuts to DFO, creating a growing mismatch between the pace of development in salmon-sensitive watersheds and the federal capacity for environmental oversight (Price and Berchtold 2026). Together, these failures have undermined the abundance and diversity needed for salmon to adapt to accelerating environmental change. The patterns documented here—policy ambition unaccompanied by accountability, discretionary decision-making overriding science, and chronic delays in protective action—are not unique to salmon or to Canada.

More broadly, this case illustrates a pervasive challenge in conservation governance worldwide: policies that articulate strong conservation objectives often fail to deliver outcomes when they lack enforceable obligations, transparent implementation requirements, and institutional safeguards for scientific integrity (Tittensor et al. 2014; IPBES 2019; Bell-James et al. 2024). Although shaped by Canada's specific governance context, these broader challenges are increasingly evident across biodiversity conservation globally (IPBES 2019; Cheung et al. 2023). As environmental pressures intensify, conservation success will increasingly depend on governance systems possessing the capacity and political commitment necessary to implement them credibly and consistently.

Author Contributions

M.H.H.P., A.M.D., and J.D.R. conceptualized the study. M.H.H.P. conducted the methodology, formal analysis, and visualization. M.H.H.P. and G.J.M. wrote the first draft of the manuscript. All authors contributed substantially to manuscript revision and approved the final version for submission.

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Ethics Statement

Ethical approval was not required for this study because no live organisms were involved. All data used in the analyses were obtained from publicly available sources.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

All data used for this study are from public sources stewarded by Fisheries and Oceans Canada and the Pacific Salmon Foundation; data and code are archived at Zenodo: https://doi.org/10.5281/zenodo.17147980.

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Supporting Information

Additional supporting information can be found online in the Supporting Information section.

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