ASSESSMENTS OF SPECIES AT RISK ON TWO PROPERTIES IN SOUTHWESTERN NEW BRUNSWICK AND PREPARATION OF A SHORT FILM HIGHLIGHTING THE BIODIVERSITY AND SPECIES DEVELOPMENT IN THE AREA

by

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The Bay of Fundy, spanning 1,394 acres between New Brunswick and Nova Scotia, is known for its record tides and rich biodiversity (Delong, 1996). Understanding its current state requires looking at its geological history, which shaped its landscape and established the foundation for its ecosystem. Human activity has also left lasting impacts on the bay's land, water, and wildlife. By examining these historical layers, we can gain insights into its evolution, the role of human influence, and how to protect it for future generations.

The geological history of the Bay of Fundy stretches back 300 million years, beginning with tectonic activity that formed the Appalachian Mountains. Over time, erosion and sediment deposition gradually shaped the bay's sandstone and shale formations, which now support a diverse range of species. Beneath these layers lies the 622-million-year-old Blacks Harbour granodiorite, which, as it weathers, releases nutrients that help promote plant growth, biodiversity, and soil formation (Hinds, 2024; Wild et al., 2009; Napieralski et al., 2020). Additionally, ongoing wave action continues to reshape the coastline, revealing these ancient layers and enhancing the bay's ecological and aesthetic value (Daborn, 2018).

These layers also tell the story of the Bay of Fundy's long-standing connection to humanity, starting with the Indigenous peoples, including the Mi'kmaq and Maliseet, who lived sustainably off its abundant resources for thousands of years before European contact. These communities developed intricate knowledge of the bay's ecosystems, relying on fishing, hunting, and gathering to sustain their way of life, with the seasonal migrations of fish, such as salmon and mackerel, being central to their diets and cultural practices (Cameron & Hwang, 2016). In the 17th century, European explorers arrived in the region, attracted by its abundant natural resources. The French then established settlements, which led to conflicts with the British and ultimately the Acadian Expulsion in the mid-18th century, a forced displacement that profoundly impacted the demographic and cultural landscape of the area (Beck, 2011).

Since this time, the Bay of Fundy has long been central to the maritime economy, supporting fishing, trade, and shipbuilding. Its rich fishing grounds have sustained local communities, while its unique tidal ecosystems continue to drive ecological research, conservation, and tourism. The bay's exceptional tidal range, caused by its funnel shape, the Coriolis effect, and the gravitational pull of the moon and sun, creates both challenges for development and opportunities for research and ecotourism (Parks Canada, 2023). Deadman's Harbour, referenced as early as 1780 (Blacks Harbour (N.B.), 1987), has played a vital role in the local fishing industry. Purchased by Judy and Ernie Edwards in 2004, it remains integral to the community, supporting recreational and small-scale fishing, with visible remnants of past activities highlighting its historical and cultural significance.

Upon arrival to the property, visitors will be welcomed by a mosaic of life and a spectacle presented by the dynamic seiche effect, which drives nutrient-rich waters to the surface and fosters a vibrant and diverse intertidal zone (Parks Canada, 2023). However, what visitors will come to discover is that beneath this surface beauty lies a story of struggle, as the delicate balance of this ecosystem is increasingly threatened by climate change and growing impacts of the fishing industry, including overfishing and disruption of marine habitats threatening the long-term health of the ecosystem. In addition to these pressures, Deadman's Head Forest faces challenges like rising storm intensity and coastal erosion driven by climate change (Miller, 2017) among other perils like rising sea levels and temperatures posing significant challenges to the myriad species that have inhabited these shores for

generations. Still, despite these difficulties, the forest stands as a resilient living laboratory, showcasing the intricate interconnections within its ecosystem. Through proactive conservation efforts, there is a clear opportunity to protect this unique environment, ensuring that Deadman's Harbour continues to thrive as a vital community resource and sanctuary for wildlife for generations to come.

Studying the rich intertidal zone, reveals a variety of invertebrates, including sea stars, crabs, snails, and barnacles, thrive here. The muddy and rocky shores provide essential habitats for organisms such as blue mussels, lobsters, scallops, clams, and rockweed. Yet, native species like the Horse Mussel are grappling with salinity changes and rising temperatures (Lesser & Kruse, 2004; Ning et al., 2015; Buzeta, 2014). Particularly concerning is the rapid decline of the Common Sea Star, a crucial player in this ecosystem, which is now facing extinction due to rising temperatures (Wahltinez, 2023). Adding to the ecological challenges in the intertidal zone, invasive species like the European Green Crab are taking advantage of these environmental shifts, further jeopardizing the balance of the bay's ecosystem (NB ISC, 2023).

Amidst this turmoil, harbor seals and gray seals are commonly found in the Bay of Fundy, often seen basking on rocks or hunting for fish in its waters (Buzeta 2014). These seals, along with occasional sightings of dolphins and porpoises, play vital roles in the marine food web, emphasizing the importance of protecting this unique and fragile ecosystem.

Additionally, the salt marshes surrounding the Bay of Fundy are critical ecosystems that provide habitat for numerous plant species, including salt-tolerant grasses like Spartina (Byer's et al 2007). These marshes act as nurseries for fish and serve as feeding grounds for birds and other animals. They also play a role in protecting coastlines by absorbing storm surges and filtering pollutants from the water.

Moreover, the Bay of Fundy is one of North America's most significant stopping locations for migrating shorebirds (Buzeta, 2014). Every year, millions of shorebirds, notably semipalmated sandpipers, plovers, and dunlins, congregate on the bay's mudflats to feed on microscopic crustaceans, especially as they travel from the Arctic to South America. The mudflats, particularly those in the Minas Basin, provide an important feeding habitat for these birds to establish fat reserves.

The impact of these changes reaches far beyond the shoreline. For instance, the bay supports more than 100 species of fish, including commercially important species like Atlantic herring, cod, and haddock (Buzeta, 2014). However, many fishing communities that have thrived for generations are now confronting uncertain futures as species become increasingly threatened by climate change and overfishing (COSEWIC, 2010a; COSEWIC, 2010b). Aside from providing summer feeding grounds for numerous whale species such as humpback and fin whales, the bay is a critical habitat for the endangered North Atlantic Right Whale (Woodley et al, 1996, Askin et al, 2017). The right whale, emblematic of resilience, is also battling an ocean filled with new perils (COSEWIC, 2013b). In recent years, conservation efforts have concentrated on safeguarding these whales from ship strikes and fishing line entanglements.

Transitioning from the lively shores, we venture into the quieter realm of the Deadman's Head Forest, where another fight for survival unfolds. Here, keystone species like Monarch Butterflies and bees are vital to maintaining the forest's delicate balance. These species play a crucial role in the ecosystem—without them, everything would change. Monarch Butterflies, for example, help pollinate the plants of the forest, supporting biodiversity. Without their presence, the diversity of plants would

decline, and many other species that rely on these plants for food would suffer (Monarch Joint Venture, 2022). Bees, as the planet's primary pollinators, are equally important. Without bees, plants would not be fertilized, and many species would lose their food sources (CPAWS, n.d.). Comparatively, the Bald Eagle, once a symbol of freedom, is now forced to migrate north as rising temperatures make its habitat less livable. By 2080, extreme weather and rising temperatures could make 84% of its current range uninhabitable (Audubon, 2014). Monarch Butterflies are also struggling. The Monarch Butterfly's migratory journey to Deadman's Head Forest, where it seeks nourishment from meadows, is fraught with peril. Climate change disrupts their migratory routes and threatens their primary food source, Milkweed. A devastating storm in Mexico in 2022 wiped out 80% of the overwintering population, posing a severe setback for the species. Estimates indicate a staggering 57% chance of extinction by 2036 if conditions do not improve (UN, 2020).

Despite this, in this intricate web of life, Asters emerge as unsung heroes. These unassuming plants bloom in late August, signaling Monarchs to embark on their migration while providing essential nectar for their journey (Woodbury, 2017). Nevertheless, Asters themselves are not immune to the pressures of a changing climate, as they adapt to grow in new areas—an indication of an ecosystem on the brink of transformation

As we turn our attention to tree species within the forest, we uncover a compelling narrative of resilience and adaptation. Among the vast expanse of Deadman's Head Forest, a lush canopy shelters countless organisms. Approximately 57% of this area is classified as very dense forest, creating microclimates that provide refuge from extreme conditions (Trimble, 2020). This layered structure not only enhances biodiversity but also supports soil health and offers varied habitats for wildlife, including squirrels and birds (Trimble, 2021).

Many tree species are also experiencing significant issues due to climate change. For example, it is anticipated that the balsam fir, which was once indicative of colder northern climates, may move further north because of rising temperatures and growing humidity (Puisis, 2022). Based on the RCP 8.5 scenario, which predicts an average temperature increase of 4.3°C by the end of the century, Natural Resources Canada's models show a stark future for this tree species (Climate Nexus, 2019). Likewise, it is anticipated that birch trees, which are susceptible to heat and drought, may move northward in pursuit of more favorable weather (Rojo et al., 2021). In addition, Mountain Ash may suffer major habitat loss, and Red Spruce has an unclear future due to mounting climatic stresses.

Conversely, the White Pine, which is predicted to thrive despite these challenges, sticks out as a sign of optimism (Bourque et al., 2022). These shifts will eventually cause old-growth woods that were originally found in cold areas to give way to more resilient species like Sugar Maple, White Pine, and Black Cherry (de Graaf, 2019).

Adding complexity to this ecosystem is the presence of dead trees—approximately 500 per hectare—which introduces another vital dimension. While some areas lack these remnants, others, particularly near the coast, are strewn with fallen giants that have succumbed to severe storms and shifting weather patterns. This trend of tree loss in Canada highlights the dual nature of dead trees: while they signify change, they are also essential to the forest ecosystem, supplying nutrients and habitats for various wildlife species (Government of Canada, 2021; Parks Canada Agency, 2021).

The urgency of survival resonates across North America, as over 2,000 species—including fish, shrubs, and insects—migrate northward at an astonishing rate of 5 meters per day to escape the effects of climate change, raising critical concerns about the impact of this influx (CBC News, 2011). The arrival of new species can disrupt fragile ecological balances, leading to fierce competition for resources and threatening native species with extinction, particularly as some carry harmful diseases (Mazerolle, 2018). As temperatures rise, pest infestations are expected to surge in the Acadian Forest, placing crucial habitats like Deadman's Head Forest at risk. Among the looming threats, the Emerald Ash Borer threatens to decimate Ash populations, while Balsam Fir Sawflies could inflict severe damage on local Balsam Fir trees (Natural Resources Canada, 2015). The White Pine Weevil and invasive European Gypsy Moth, which feasts on Birch leaves, further complicate the scenario. Each species presents unique challenges, jeopardizing the future of Deadman's Head Forest (Government of Canada 2013, Government of Canada 2015).

The Bay of Fundy and its surrounding ecosystems weave an intricate tapestry of biodiversity and resilience. However, as climate change increasingly impacts these areas, the need for conservation and protection becomes ever more urgent. The fate of countless species hangs in the balance, underscoring the interconnectedness of life as both a source of strength and a call to action.

In response to these challenges, Ernie and Judy Edwards, the owners of Deadman's Head Forest, have adopted a minimal disruption approach to land management. Their focus on preserving the forest's natural state reflects a deep commitment to reducing human impact and allowing the area to thrive as a sanctuary for biodiversity. While remnants of fishing equipment serve as evidence of past human activity, these disturbances are balanced by efforts to mitigate harm and promote conservation.

Working alongside The Nature Trust of New Brunswick, the Edwards are helping ensure that the forest remains a resilient "living laboratory" for research and education. This partnership fosters responsible stewardship, illustrating that even amid the pressures of climate change and human activity, hope remains. The Bay of Fundy's ecosystems remain a powerful testament to resilience. Through thoughtful conservation and sustainable management, we can protect cherished sites like Deadman's Head, ensuring they continue to inspire education, deepen our connection to nature, and instill hope for future generations.

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Appendix A: Interview Questions

Monica (Wolastoqey Nation of New Brunswick)

"Our challenges stem from limited access to land in our traditional territory, provincial policies that impose harmful management practices, and exclusion from key decision-making processes. Despite understanding the interconnectedness of ecosystems, we often lack the power to protect them or even access the land to care for it properly."

1. "We face significant challenges due to limited access to our traditional territory."
2. "We currently only have access to about 29% of the crown land in our territory."
3. "Most of the land in our territory has been given away, leaving us with limited resources."
4. "Provincial policies enforce management practices like clear-cutting, planting, and spraying on crown land."
5. "These mandated practices are often harmful to the land and ecosystems we depend on."
6. "We are excluded from important decision-making processes that affect our land."
7. "There is insufficient consultation and accommodation regarding development projects and policy creation."
8. "Despite understanding that ecosystems work as a system, we cannot stop harmful practices."
9. "We often lack the power to protect the land from destructive actions."
10. "In many cases, we cannot even access the places in our traditional territory that need care."

Bob Armstrong (Local Fisherman)

1. "The lobster industry has exploded, but with fewer small fish to sustain them, the balance of our ecosystem is suffering."
2. "The salmon industry was meant to support fishermen, yet it has caused significant environmental degradation that the government refuses to acknowledge."
3. "We need to prioritize the recovery of herring populations and protect their spawning grounds to restore biodiversity in our waters."
4. "The decline in fish variety is alarming; we are witnessing a significant loss of biodiversity in our oceans."
5. "Cage farming practices in the salmon industry have detrimental effects on wild fish populations."

6. "Regulatory enforcement is lacking, leading to overfishing and unsustainable practices."
7. "The government must take responsibility for the mismanagement of our fisheries and implement effective quotas."
8. "Without immediate action, we risk losing not just fish species, but the entire marine ecosystem."
9. "The health of our oceans is directly tied to the livelihoods of our fishing communities."
10. "We must advocate for sustainable practices that protect both our fisheries and the environment for future generations."

Matthew Abbott (Conservation Council of New Brunswick)

1. Attention to Important Issues: "Sometimes you're working on something really important, and you can't get any attention for it."
2. Resilience in Conservation: "Failures aren't failures, and it's OK to not win every fight."
3. Collaboration: "You have to find a way to maintain relationships even when working against each other."
4. Political Challenges: "We've been fighting for better regulation over the years."
5. Keystone Species: "We should do whatever we can to make sure Pollock are at home here again."
6. Education and Advocacy: "Education is a big part of conservation success."
7. Long-term Commitment: "We've been working together for 10 years, you know, 15 years and you have to just keep on this stuff."
8. Impact of Climate Change: "We are in one of the global warming hotspots."
9. Community Engagement: "Trust has been built over years, not months."
10. Hope for Future Generations: "It's about laying the groundwork now so that future generations can thrive."