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**Riparian Zones and Their Historic Management Through Fixed-Width Buffers**

Riparian zones are vital ecosystems that can be substantially impacted by forest harvest. Riparian zones are terrestrial biomes that act as the intermediate transition area between the terrestrial and aquatic landscapes of watersheds. Typically, riparian zones are characterized by their proximity to streams and their composition of soils, plant communities, and biodiversity. A riparian zone provides a myriad of ecosystem functions, from the trap and storage of sediment to the filtration and buffering of water, and, in turn, provides substantial ecosystem services such as flood control and support for agriculture. Importantly, the riparian zone provides critical habitat for both terrestrial and aquatic communities and supports up to 80% of the biodiversity in a watershed. Early studies, even those dating back to the early days of logging, show that forest harvest activities in riparian zones can reduce the shading of streams, resulting in warmer water temperatures immediately to and downstream of the affected area. Forest harvest can also influence how wood enters the stream by reducing the structural integrity of riverbanks and altering the mix of materials inside and outside the stream that contribute to its ecosystem complexity.

Despite the longstanding and well-studied impacts forest harvest can have on riparian zones, science that has informed the development of policy for managing forest harvest in riparian zones has been rare. Until 1965, logging activities and licensees were regulated via the provincial Forest Act, which lacked specific provisions for protecting and managing riparian zones from logging-related damage. Forestry practices before 1965 involved harvesting trees down to water edges, even using streams and lakes to transport logs. Then, in 1965, mounting evidence of the negative impacts of logging on stream ecosystems prompted the development of an interagency referral system, where licensees would submit logging plans to the Department of Fisheries and Oceans (DFOBC Ministry of Water, Land and Air Protection (WLAP), for reviews that aimed to increase protection of riparian habitat by decreasing logging practices, reach and impact. Still, the integrated referral processes’ effectiveness in the protection of riparian zones was hindered by the high volume of logging, insufficient information provided by logging companies, limited workforce and financial resources within regulators, and the voluntary nature of guidelines for riparian zones, resulted in many streams still being harvested right to the bank in the 1970s and 1980s.

By the turn of the 1980s, mounting evidence for the efficacy of riparian buffers in specific regions throughout Northwestern North America prompted the development of riparian fixed-width buffer policies for some rivers with fish. Riparian fixed-width buffers are strips of forest preserved along streams post-harvest with designated widths based on the stream’s characteristics. A few studies throughout the late 1970s and early 1980s showed that widths had to be 30 m on each side of a stream to protect most of the aquatic community (Richardson et al., 2012). Along with these studies, the Forest Ecosystem Management Assessment Team (FEMAT) proposed a strategy for federal lands that used the average height of dominant trees in their mature state as the basis for buffer widths (1993). Notably, most of these studies and the FEMAT strategies were primarily focused on the moist, coastal forests of western North America. Between 1988 and 1993, the Coastal Fish/Forestry Guidelines (CFFGs) were established by the BC Ministry of Forests, introducing the first stream-reach classification system to protect fish habitats by assigning habitats a value from Class I (highest) to Class IV (lowest) and detailing specific forestry operation guidelines based on these classifications. Key to the CFFGs were Streamside Management Zones (SMZs) for Class I and II streams, mandating fixed-width buffer strips and selective logging to safeguard streams without heavy machinery use.

Following the CFFGs, two major policy reforms established fixed-width buffers as standard practice for riparian management in BC. First, in 1995, the BC government enacted the Forest Practices Code of British Columbia Act (FPC). The FPC built upon the SMZ framework from the CFFG, renaming them to Riparian Management Areas (RMAs), expanding fixed-width riparian buffers to S3 and S4 class rivers, and establishing regulatory rules for harvest within each RMA class. Broadly, the FPC was managerially too difficult for the MOF to uphold

Forest and Range Practices Act (2002) allows managers to use discretion when setting harvesting plans to achieve appropriate results. However, most practitioners have adhered to fixed-width buffers because of their simplicity and uncertainty of potential outcomes of deviation from the fixed width.

**Contemporary Riparian Management: The Forest and Range Practices Act and the Riparian Management Guidebook**

In British Columbia, Canada, the Ministry of Forestry's Riparian Management Area (RMA) guidebook outlines objectives to minimize the impacts of forest and range uses on aquatic ecosystems, water quality, and adjacent wildlife habitats while allowing for sustainable forest and range use. These objectives include reducing windthrow risk, retaining wildlife attributes, providing shade, reducing microclimate changes, and maintaining bank stability. The province adheres to four certification systems—Sustainable Forestry Initiative (SFI), Canadian Standards Association Forest Certification (CSA), Forest Stewardship Council (FSC), and ISO 14001 Environmental Management System—each complying with provincial guidelines and the RMA guidebook, but without specifying buffer widths. FSC and SFI offer additional guidelines for minimizing flow disruption and sedimentation and maintaining stream shading and temperature. Stream classification (S1-S6) dictates specific rules, with the presence of fish being a key factor; non-fish-bearing streams require no riparian reserve but have a 20-30m management zone, whereas fish-bearing streams necessitate a forested reserve of 20-50m plus a management zone of 20-100m, both contingent on stream size.

- Outline the evolution of ecosystem-based approaches to riparian management, emphasizing the role of fish presence in shaping policy directions.

Riparian Management First came into

- Describe the legislative background, including key acts and standards that define the riparian management framework.

The Riparian Management Area Guidebook Today and the FRPA Defaults

- Discuss the objectives and strategies outlined in the policy document for managing riparian zones, including the classification of water bodies and the establishment of RMZs and RRZs.

The FSP and the Opportunity for Results-based Innovations

**Pitfalls and Shortcomings of The Forest and Range Practices Act**

Critical Examination of Defaults and FSPs under the FRPA

- Analyze the scientific basis of riparian management objectives, considering the debate on relying solely on game fish presence for policy formation.

- Evaluate the alignment between current policy objectives and principles of ecosystem-based management.

Critical Examination of FSPs under the FRPA

- Identify research gaps and propose areas where scientific inquiry could contribute to more effective riparian management policies.

- Suggest a detailed research program aimed at bridging identified gaps and enhancing policy outcomes.

These buffers are believed to safeguard aquatic ecosystems by moderating terrestrial-aquatic energy exchanges through various biological, physical, and chemical processes. However, the effectiveness of these buffers in protecting aquatic environments dramatically depends on factors such as climate, geology, riparian forest types, local environmental conditions, and harvesting techniques (Richardson & Béraud, 2014). Despite this variability, a simplistic "leave a buffer" rule is commonly enforced without accounting for these critical conditions (Richardson et al., 2012).

**The Introduction of Forestry Landscape Plans and Opportunities for Real Innovation**

1. \*\*Designing a Research Program\*\*

- Outline a research program that combines hydrological, ecological, and biological studies to inform and improve riparian management policies.

- Emphasize the interdisciplinary nature of the proposed research and its potential to contribute to policy development.

Impact and Implementation

- Discuss how the research findings could influence policy decisions and practical management strategies, identifying key stakeholders and beneficiaries.

- Outline approaches for integrating scientific insights into policy revisions and management practices.

Personal Reflection and Application

1. \*\*Connecting Research to Policy\*\*

- Reflect on personal research interests and career objectives, considering how they align with the goals of advancing riparian management policies.

- Identify strategies for engaging with policymakers and contributing to the science-policy dialogue.

Take-Home Lessons

- Summarize critical lessons on the importance of linking scientific research with policy development, focusing on the need for clear communication and stakeholder engagement.

- Reiterate the importance of science-based policy development in effective riparian ecosystem management.

- Highlight the ongoing need for research to inform policy decisions and address the challenges facing riparian management.