ASSESSING WETLAND AWARENESS AND COMMUNITY SUPPORT FOR EDUCATIONAL INITIATIVES: A CASE STUDY FOR CLARK COUNTY, WASHINGTON RESIDENTS

by

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Abstract

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As the world's population continues to surge, the demand for development, including housing, businesses, and agriculture, escalates. This escalating development exerts exponential pressure on the world's critical wetland ecosystems. While current governmental regulations aim to mitigate these impacts, the quest for lasting improvements in wetland ecosystems needs long-term educational strategies. An enhanced wetland educational framework seeks to refine existing regulatory processes, notably within compensatory wetland mitigation programs. This proactive approach aims to enhance community understanding and awareness of wetlands, thereby potentially leading to better preservation and sustainable development practices. This thesis investigates the level of understanding and attitudes among residents of Clark County, Washington, regarding the functions and significance of wetlands, as well as their receptiveness to implementing an official wetland educational model alongside a structure similar to an in-lieu fee program, wherein funds are paid to offset the proposed impact toward a wetland.

A sample population of residents of Clark County, Washington, was surveyed using a convenience sampling approach. The researcher was stationed at selected parks, chosen for their accessibility and association with wetlands, which are frequented by residents. The survey instrument was crafted to capture qualitative data on participants' demographics, wetland

knowledge, awareness of wetland mitigation banking, and opinions on compensatory wetland mitigation requirements. Thematic coding and analysis techniques were employed to analyze the data, identifying recurring themes, patterns, and sentiments within participants' responses. The findings provide insights into the community's understanding of wetlands and their openness to introducing an educational standard within regulatory compensatory wetland mitigation guidelines. Ultimately, this research aims to inform decision-making processes and promote sustainable development practices in Clark County, Washington, potentially serving as a model for other regions facing similar challenges. The importance of assessing wetland awareness and community support cannot be overstated, particularly in the context of ongoing environmental challenges and the need for sustainable conservation efforts. Understanding the level of awareness among communities regarding wetlands and their significance is crucial for informing policy decisions, guiding educational initiatives, and fostering public engagement in conservation efforts. By assessing community support, policymakers and environmental advocates can tailor their strategies to effectively address local needs and concerns, ultimately enhancing the success and impact of wetland conservation programs.

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Introduction

Where to Begin

Wetlands are some of the most biologically diverse, productive, and endangered ecosystems on the planet. They are critical, and essential for supporting global biodiversity (Alikhani et al., 2021). These unique environments play a vital role in sustaining the health and resilience of our planet's ecosystems, serving as buffers against the impacts of climate change, biodiversity loss, and environmental degradation (Gell et al., 2023). Furthermore, wetlands offer a multitude of ecosystem services, including flood control, habitat for endangered flora and fauna, and carbon sequestration (Alikhani et al., 2021).

Despite their importance, wetlands continue to face numerous threats from human developmental activities such as urbanization, agriculture, and increased infrastructure development. Historically, these activities were conducted through wetland drainage processes, which irrevocably changed entire watersheds (Zedler, 1996). The conversion of wetlands for urban expansion and agriculture has led to significant habitat loss and degradation (Torres-Lima et al., 2017). Increased pressure for urban development has led to a formality and ease of process of avoidance and minimization whilst development continues to build around wetlands (Manuel, 2003). Although regulatory guidelines aim to limit impacts to wetland ecosystems, wetlands continue to decline. This is in part due to pollution from multiple sources such as industrial and agricultural intensification including pesticides, excessive nutrient infiltration, and the spread of invasive species (Gell et al., 2023). Anthropogenic pressures such as these and others have resulted in a significant loss of global biodiversity, impaired water quality, and diminished ecosystem services provided by wetlands. If the world continues this trajectory, the outcome will pose an exponentially significant risk to wetland ecosystems and in turn human health.

To help address the impacts of wetland loss and degradation, regulatory frameworks such as compensatory wetland mitigation (CWM) programs in Washington State, are regulated through the United States Army Corps of Engineers Regulatory Branch (UACE), state-wide through the Washington State Department of Ecology (ECY), and through local jurisdiction at the County level. CWM is a mitigation approach to wetlands that requires developers to offset unavoidable impacts of their projects on wetlands by restoring, creating, enhancing, or preserving wetland habitat (Johnson, 2004). In a 2023 study, Bendor et al., found that several wetland bank sponsors engaged with mitigation through restoration lens supported by Section 404 of the Clean Water Act (2023). In the case of wetland mitigation banking, Section 404 of the Clean Water Act enables approved investors to establish wetland mitigation banks by restoring, enhancing, or creating wetlands. These areas of significance, generate bank credits which developers can purchase to offset impacts to wetlands, typically within the same ecological region, which helps to balance both developmental progress and environmental conservation efforts (Spanjer, 2018). While CWM programs have the potential to mitigate wetland loss, there are concerns about their effectiveness and implementation. Issues such as habitat fragmentation, the efficacy of mitigation banking, and regulatory loopholes oppose the ability of CWM programs to fully mitigate wetland degradation and loss. For example, in the case of wetland banking programs, there is concern whether CWM has helped move the needle towards global wetland success (Kaplowitz and Kerr, 2003).

Recognizing the limitations of regulatory frameworks alone has done little to move the needle; with increased pressures of development there is growing need and recognition for the pivotal role environmental education plays within wetland conservation efforts (Marambanyika & Beckedahl, 2016). In a 2020 article written by Ardoin et al., it is suggested that the difficulty

in moving the needle through regulatory frameworks can sometimes stem from the inherent complexity of social-ecological systems, where simplistic, linear approaches often fall short. The article argues that environmental education, when designed collaboratively and inclusively, could supplementarily address these complexities and enhance the effectiveness of regulatory efforts by fostering more successful conservation outcomes. In a bold statement, Mohammed et al. (2006), claims that environmental education often stands increasingly acknowledged as a linchpin of wetland conservation efforts, not merely informing but actively catalyzing awareness, shaping attitudes, and galvanizing communities toward sustainable wetland management practices.

Environmental Education & Wetlands

Education, that is supported through community engagement activities and public awareness, can be found to contribute great value in the fight for successful wetland conservation efforts. Nishi and Subramanian (2023) argue that environmental education serves a vital function in acquiring and applying science and new technologies for restoration endeavors. Simply put, a multi-stakeholder approach involving local government, private enterprises, scientists, communities, and civil society is crucial for enhancing the success of ecosystem restoration through the mobilization, education, and capacity building of communities. For instance, in a 2012 paper written by Irini Ibrahim et al., researchers highlight the necessity of integrating wetland education into school curricula. Their approach argues that incorporation of wetland organizations into educational forums encourages organizations to engage with local communities by helping to stimulate curiosity and raise awareness from an early age. In a similar 2022 article, Amparo Carretón Sanchis et al. state that the importance of involving children in environmental education through artistic expression such as drawing, can build a sense of

belonging and responsibility towards the environment. This nurtured sense of responsibility can often emphasize the need of collaborative efforts between educational institutions and community responsibility, which can contribute to successful community capacity-building efforts.

Additionally, researchers in a 2015 study point out that effective ecosystem restoration practices should seek out successful collaborations between scientists and local communities, and if possible, carefully incorporate indigenous knowledge into local wetland management. For example, community-based projects in India, which incorporated local input and education, demonstrated significantly improved conservation outcomes. According to their study, the number of publications related to wetland community education saw a notable increase, particularly after the Ramsar Convention's emphasis on the "wise use" of wetlands. Specifically, the study observed a rise in the number of publications from 11 in 1995 to 44 in 2008, indicating a significant growth in research output in this field (Roy et al., 2015).

The importance of incorporating education in addressing environmental impacts extends beyond just research. Education, specifically through community action, can help influence public support and financial contributions for wetland conservation. For example, Streever et al., (1998) found that, in New South Wales, Australia, the average person's willingness-to-pay for wetland conservation per year was estimated to be around $39 per household, reflecting the financial support driven by public awareness. The study stresses just how significant educational programs can be used to enhance the appreciation of values, such as preserving wetlands for future generations, thus strengthening conservation efforts for one's own community. In short, educating and raising community awareness has long-reaching benefits that help to cultivate support for conservation initiatives and promote sustainable land-use practices. For instance,

Ardoin et al. (2020), emphasizes that active participation in environmental action within educational programs contributes to increased community engagement and public awareness, which in turn fosters support for conservation initiatives and encourages sustainable land-use practices. While formal education can help establish foundational understandings and broad support for conservation, informal education can supplement a community's understandings and practices by passing down traditional knowledge, which allows for newer generations to hone skills and foster deeper connections, often more than what formal learning can provide.

For instances, Apandi et al. (2022), argues that informal education serves several purposes, such as to complement formal education, emphasize the mastery of knowledge, functional skills, and even the development of professional attitudes and personalities. These developed skills help to provide individuals with specialized skills and often a desire to further their education. For example, a 2021 study exploring perceptions and attitudes towards wetland values in Vietnam revealed a positive correlation between higher education levels and environmental awareness. The study demonstrated the impact of education on wetland conservation through several key findings. It revealed that higher education levels were positively correlated with greater environmental awareness and more favorable attitudes towards conservation. Specifically, the study found that individuals with higher education were more likely to understand the ecological importance of wetlands, support sustainable management practices, and show a willingness to engage in conservation activities. This included participating in community-based conservation efforts, supporting government and NGO-led projects, and even sacrificing personal income to preserve wetlands for future generations (Truong, 2021). The study's use of structured interviews, focus group discussions, and household surveys provided detailed insights into how education shapes perceptions and behaviors related to wetland

conservation. For example, educated respondents were more likely to recognize the indirect benefits of wetlands, such as disaster prevention and water purification, and were also more aware of the threats posed by economic activities to these ecosystems. This heightened awareness translated into stronger support for conservation policies and initiatives. It is my hope that by examining wetland studies like Truong (2021), similar approaches can help inform wetland awareness and community support for educational initiatives in Clarck County by highlighting the critical role that education plays in fostering environmental stewardship. The Vietnamese study suggests that educational interventions can be highly effective in increasing awareness and advocacy for wetland conservation. By understanding the educational strategies that successfully influenced attitudes in Vietnam, similar approaches can be tailored to the context of Clark County Washinton. For example, a similar approach could involve integrating wetland conservation topics into local curricula, developing community-based educational programs, and using targeted communication strategies to enhance public understanding and support for wetland preservation.

In a similar 2022 study conducted within the South African Limpopo Province Vhembe Biosphere Reserve, environmental education primarily stemmed from village elders, fostering an organic exchange of knowledge that bridged indigenous wisdom with institutional expertise. This study demonstrated the important role village elders play in linking indigenous wisdom with formal institutional knowledge by emphasizing that most local knowledge about environmental management is traditionally passed down from tribal elders. The passing down of traditional knowledge can be instrumental in transferring traditional practices and understandings to the community. The research advocates for a more inclusive approach that integrates both indigenous knowledge and formal environmental education. The study also revealed the

limitations of relying solely on traditional knowledge, indicating how many community members had limited awareness of formal wetland management plans and modern conservation strategies, proving that reliance on traditional education alone may not address all conservation needs (Dalu et al., 2022).

In a separate independent study, researchers Zurba et al. (2022) found that, when engaging with Indigenous knowledge, it is paramount to maintain an equity lens, and consider the historical treatment of Native populations. During a workshop in Nunatsiavut Canada, academic partners, the Nunatsiavut Government, and participants including Inuit youth, adults, and Elders engaged in a knowledge exchange on climate change research and adaptation. One of the key takeaways from the workshop was the understanding that equity in knowledge exchange requires the dismantling of traditional power dynamics, fostering inclusive spaces where all voices are valued, and ensuring meaningful collaboration among diverse participants (Zurba et al., 2022). By applying the principles of equitable knowledge exchange, meaningful collaboration, and respectful integration of Indigenous Knowledge Systems, addressing power dynamics, and adopting context-specific approaches can ensure that educational initiatives are inclusive, effective, and tailored to local needs and conservation goals.

Although culturally accessible training from village elders can provide valuable insights, the reliance on generational knowledge alone can restrict opportunities for comprehensive learning and skill development in a broader communal wetland education framework. To address these limitations, integrating indigenous wisdom with formal education is crucial, ensuring that educational approaches are equitable and sensitive to the historical treatment of Indigenous populations. This balanced approach can help create a more inclusive and effective wetland conservation strategy. Applying principles gleaned from the Nunatsiavut conference, it is my

hope that these valuable lessons can offer evidence for the adoption of an informed wetland educational initiative in Clark County Washington.

To bridge the gap between the need for integrating indigenous wisdom with formal education and the broader application of environmental education strategies, it is essential to recognize that both approaches can complement and enhance each other. By combining culturally informed methods with structured educational programs, communities can address limitations and expand their capacity for wetland conservation. Environmental education programs, outreach campaigns, and citizen science initiatives provide a multitude of opportunities that empower communities to take an active role in wetland conservation (Dalu et al., 2022). For instance, active roles may include participating in conservation projects, volunteering for wetland clean-ups, or engaging in local wetland monitoring efforts. Integrating a formal educational component into current regulatory practices, such as including requirements for developers to participate in community education initiatives about wetland significance as part of the Compensatory Wetland Mitigation program could effectively fill gaps in public knowledge about wetlands and promote greater environmental stewardship. Integrating educational initiatives into regulatory processes allows stakeholders in any decision-making capacity, including developers, policymakers, and environmental managers, to deepen their understanding and contribute more effectively to wetland protection and restoration efforts (Kaplowitz and Kerr, 2003).

Research Scope, Methodology, & Significance

The primary aim of this study was to investigate the role of environmental education in strengthening community support for wetland conservation efforts. This included an examination on how education can help influence public attitudes towards wetland mitigation processes. The

scope of this research involved a comprehensive assessment of residents' foundational knowledge about wetlands. Key areas of interest included understanding how well residents grasp the ecological roles and benefits of wetlands, such as their contributions to biodiversity, water filtration, and flood attenuation. Additionally, the study evaluated residents' familiarity with the regulatory frameworks governing wetland conservation and mitigation, including their understanding of the procedures involved in wetland permitting. Furthermore, the research explored the potential effects of a proposed statewide educational initiative on wetland mitigation, particularly how such a model could influence public perceptions and support for conservation measures. By establishing a baseline of residents' knowledge and attitudes, the study aimed to gauge their readiness to support and engage with educational initiatives aimed at improving wetland conservation practices.

To achieve these objectives, the research utilized a qualitative design approach, which allowed for an exploration of residents' attitudes and perceptions. Data collection was carried out through surveys distributed at local regional parks. These parks were selected due to their geographical coverage, representing all major cities in Clark County Washington, which helped to provide a diverse sample of participants. The survey was designed to capture a broad range of information. It included questions on demographics, as well as inquiries into participants' awareness of wetland functions and ecological importance. The survey also assessed their understanding of mitigation banking and its role in wetland conservation. Additionally, it gauged participants' opinions on incorporating educational elements into current wetland mitigation processes. Upon completion and collection of all surveys, responses were analyzed using thematic coding, a process that involved identifying and categorizing recurring themes and patterns within the data. This analysis aimed to uncover insights into residents' knowledge levels,

attitudes towards mitigation practices, and their openness to integrating educational strategies into existing regulatory frameworks.

The significance of this study demonstrates how environmental education can be leveraged to boost community support, such as highlighting the potential education itself can play in enhancing wetland conservation efforts. Effective education strategies can bridge gaps in knowledge and address misconceptions, leading to more informed and supportive communities (Ardonia et al., 2020). Wetlands are often undervalued or misunderstood due to a lack of public awareness about their ecological significance. This study aims to correct misconceptions and increase appreciation for wetlands by providing accurate and engaging information. By doing so, it seeks to foster a greater public understanding of the ecological value of wetlands and the need for their conservation. Furthermore, the study's findings have the potential to influence regulatory practices by demonstrating both the need and desire of integrating educational components into wetland mitigation processes. By showing both the need and desire of wetland education encouraged by Clark County Residents, this study confidently supports the argument for the adoption of education practices within regulatory frameworks. By acknowledging the necessity for any novel-educational approaches to be integrated into current and future regulatory wetland mitigation processes, it is my hope that this study adds to the literature on combining education through a regulatory framework with the sole purpose of serving the public and encouraging a new wave of sustainable wetland conservation initiatives.

Literature Review

Overview

This literature review aims to achieve several objectives in providing a comprehensive understanding of wetland conservation, environmental education, and community engagement. Firstly, it seeks to clarify the defining characteristics and ecological importance of wetlands, including their functions and the ecosystem services they provide. Secondly, it explores the historical development of wetland protection regulations, tracing the evolution of policies and regulatory frameworks at both the federal and state levels. Thirdly, this review seeks to analyze the standards and challenges associated with compensatory wetland mitigation programs, identifying gaps and opportunities for improvement in current conservation practices. Additionally, it highlights the role of environmental education in promoting wetland awareness and fostering community support for conservation initiatives. By examining existing research on the efficacy of educational interventions and outreach programs, this review aims to assess the potential impact of educational initiatives on public attitudes and behaviors towards wetland conservation.

This review begins with an overview of wetlands, encompassing their definition, characteristics, and ecological significance. It then delves into the various threats facing wetlands, including human impacts, effects of climate change, and regulatory challenges. Next, it examines the historical development of wetland protection regulations, tracing the evolution of federal and state policies. Shortly after, there is an analysis of mitigation standards and the pivotal role of environmental education in promoting wetland conservation. Additionally, it can be noted that individuals globally share their concern about environmental issues and the consequences arising from damaging natural areas (Zhu et al., 2020). This poignant belief that

natural areas are important and essential, stems from what I believe to be an innate connection between people and the environment. Due to the nature of the climate, landscape, and soil composition, the Pacific Northwest (PNW) tends to have a higher proportion of wetlands comparatively to the rest of the contiguous United States. Research by Ibrahim et al., (2010) highlights that public perception of wetlands often influences support for conservation policies, emphasizing the importance of integrating community-based education into regulatory frameworks. Preliminary research into this topic has led to the understanding that not enough studies exist which seek to examine how contemporary efforts can effectively connect community environmental education initiatives in the PNW to regulatory wetland mitigation processes. This study seeks to address this gap in literature by undertaking such a research inquiry of wetland awareness within Clark County Washington. By conducting this case study, my hope is to help contribute to a better understanding of wetland conservation in the region. Finally, this review concludes with a synthesis of key findings and a discussion of implications for future research and conservation efforts.

Background

Wetlands are defined as areas of land that are typically situated adjoining aquatic ecosystems and uplands and possess three main characteristics, some level of water, hydric soils, and hydrophytic vegetation (Johnson, 2004). These ecosystems are extremely diverse and can range from marshes (both non-tidal and tidal), swamps, bogs, fens, and even interdunal ecosystems (Zedler, 1996). Broadly speaking, wetlands serve as a key part of larger food webs, which in-turn provide key benefits to surrounding ecosystems. A wetlands' defining feature can be determined by its suitability for biological purposes, duration of soil saturation, along with the structure of plant communities and soil composition (Lang et al., 2020). According to Johnson,

the positioning of the water table in relation to the surface can help to create waterlogged conditions that encourage specially adapted vegetation to persist in these hydric environments (2004). This means that depending on a region's climate, wetlands can be dry creek beds in the summer, but full and lush wetland habitat in the fall, winter, and spring months.

Within their scope, wetlands play a pivotal role in sustaining the health and resilience of our planet's ecosystems serving as vital buffers against the impacts of climate change, biodiversity loss, and environmental degradation (Vasumathi et al., 2023). In addition, wetlands maintain a variety of irreplaceable functions that include natural water quality improvement, flood protection, shoreline erosion control, habitat for plants and animals, recreational opportunities, and natural beauty (Johnson, 2004). Wetlands also serve as buffers against coastal erosion, protecting shorelines from wave action and storm surges. In the case of water purification, wetlands help filter runoff from surface and stormwater and other nonpoint source water pollutants. This process is as such, as runoff passes through a wetland, excess and harmful chemicals, excess nutrients, and sediment that would negatively impact fish passageways, clog drains, and contaminate groundwater (Zedler, 1996).

Water sources that support wetlands can vary significantly, these sources can take the form of rainfall, rivers, lakes and snowmelt (Johnson, 2004). The injection of water into wetland ecosystems acts as a natural filtration system, which naturally enhances water quality. Wetlands also serve as key essential habitat for diverse and in rare occasions, endangered and threatened organisms. Ecosystems within themselves, the plant and animal species that inhabit wetlands play pivotal roles in nutrient-cycling (Alikhani et al., 2021). During heavy rainfall or storm events, wetlands absorb and temporarily hold excess water. This storage capacity helps to regulate water flow, which can reduce peak flood levels downstream (Zedler, 1996). This ability

to absorb, store, and slowly release water acts as a natural buffer that protects other areas from severe flood events.

There are two categories of wetland ecosystems, coastal (tidal) and inland (non-tidal) wetlands. However, according to Ye et al., (2002) wetlands can be grouped into three categories with the addition of artificial wetlands. Coastal wetlands for example comprise of salt marshes, mudflats, and mangrove swamps (Cadier et al., 2020). According to the Environmental Protection Agency (EPA), inland wetlands are typically situated alongside rivers, streams, ponds, lakes, or inside depressional basins and can include bogs, fens, wet meadows, vernal pools and inland swamps (EPA, 2024). An artificial wetland can be classified as a wetland constructed for the purpose and intention of treating various types of effluent (Carvalho et al., 2017). According to Alikhani et al. (2021), artificial wetlands encompass stormwater basins, constructed canals, drains, reservoirs, artificial lakes, fish and shrimp farming ponds, constructed ponds, rice fields, and sewage treatment sites. What makes coastal wetlands unique are the dynamic hydrological and saline processes, which allow for challenging factors for various plant and animals species to thrive (Spencer et al., 2016). According to the EPA, inland wetlands function differently, as they lack saline properties. These wetlands are fed through the accumulation of rain or melt water, allowing for soil saturation to occur throughout the growing season. Although inland wetland characteristics differ slightly due to the lack of saline properties, both tidal, non-tidal, and even artificial wetlands serve significant ecological functions within their environments. In addition, the EPA has observed that their key functions serve as home to unique plants and animals, both endemic and transitory, they create and stabilize chemical and topological factors which in turn serve to redirect and absorb energy within their ecosystems (EPA, 2024). The geological and ecological significance of wetlands have evolved to fit into a larger global dynamic network.

Wetlands provide habitats, nurseries, and foraging areas for a variety of birds, fish, amphibian, and mammal species. Many plant and animal species, including migratory birds, rely on wetlands throughout their lives. Wetlands also offer essential habitat for rare and endangered species; their loss can have detrimental effects on the survival of plant and animal species (Johnson, 2004). Additionally, studies have shown that wetlands play a role in addressing impacts caused by anthropogenic climate change by actively sequestering carbon through photosynthesis and storing it as organic matter within the soil (Salimi et al., 2021). Therefore, the benefits wetlands provide are crucial for supporting biodiversity and ecosystem services essential for human well-being. Understanding the benefits and functions of wetlands is imperative for addressing the global environmental challenges posed by increasing anthropogenic impacts.

Threats to Wetlands

Habitat Loss and Degradation

Wetlands are under severe threat from habitat loss and degradation, driven by urbanization, agriculture, and infrastructure development. The conversion of wetlands into urban areas and croplands, coupled with practices like drainage and land reclamation, has led to a drastic decline in biodiversity and compromised essential wetland functions (Zhou et al., 2023). Rapid urban expansion often requires the draining and filling of wetlands to make way for built environments, disrupting natural hydrological processes, altering sedimentation patterns, and drastically reducing habitat availability for diverse plant and animal species (Loiselle et al., 2020). Similarly, agricultural expansion encroaches upon wetland areas, converting marshes, swamps, and floodplains into agricultural fields. The drainage of waterlogged soils for

agriculture not only diminishes wetland biodiversity but also disrupts critical ecosystem functions such as nutrient cycling, water filtration, and flood regulation (Patenaude et al., 2015).

In their review, Bauer and Campbell (2022) emphasize the urgent need to address these threats to wetlands. They advocate for stronger conservation efforts and more rigorous policy measures to safeguard these invaluable ecosystems, citing that wetlands provide indispensable ecosystem services as well as enhanced societal resilience to environmental changes. Educating the public about the importance of wetlands and integrating wetland conservation into development planning must be essential steps toward ensuring the long-term health and sustainability of these vital ecosystems.

Pollution and Nutrient Runoff

Pollution from nutrient runoff, industrial effluents, and urban wastewater projects are pervasive threats to wetland ecosystems (Vasumathi et al., 2023). Excessive nitrogen and phosphorus, primarily from agricultural activities, promote the growth of invasive plant species and algae, which outcompete native vegetation and alter wetland habitats' structure and functions (Rossa et al., 2019). This eutrophication process can lead to decreased oxygen levels in the water, creating hypoxic conditions detrimental to aquatic organisms (Zarkami et al., 2022). Additionally, contamination within groundwater sources can further exacerbate these issues by introducing pollutants such as heavy metals and organic contaminants into wetland systems, which can harm both plant and animal life and degrade wetland functions (Bolca et al., 2007).

Industrially sourced effluents that introduce heavy metals into wetlands, can accumulate in wetland flora and fauna, and magnify within wetland ecosystems. This type of heavy-metal bioaccumulation poses significant health risks to both wetland and human health (Leung et al., 2017). Additionally, as human population numbers continue to increase, organic contaminants

within sewage effluent have become more persistent within wetland ecosystems (Cooper et al., 2020). Together, these pollutants degrade wetland ecosystems, making restoration efforts more difficult. This difficulty emphasizes the need for stronger and more robust pollution control measures (Nan et al., 2023). In-spite of these difficulties, efforts to protect and restore wetlands should prioritize both stronger and more sustainable regulations on industrial discharges and promote eco-friendly agricultural practices through community education initiatives to help mitigate pollution's adverse impacts on wetlands (Samara et al., 2023).

Climate Change & Invasive Species

Anthropogenic climate change poses significant and escalating threats to wetlands worldwide, driven by rising temperatures, altered precipitation patterns, and sea-level rise (Lamsal et al., 2017). These environmental shifts intensify the frequency and severity of extreme weather events such as hurricanes, storm surges, and heavy rainfall. These extreme events, in turn, can lead to coastal flooding, erosion, and the intrusion of saltwater into freshwater wetlands, fundamentally altering delicate ecosystems (Dong et al., 2022). Additionally, according to O'Keeffe et al. (2019), hydrological inundation has been noted to be much more substantial in the face of anthropogenic climate change. Despite these challenges, wetlands play a critical role in global carbon sequestration efforts, serving as vital carbon sinks by gradually accumulating organic matter within their soils over centuries. Peatlands, characterized by waterlogged soils, represent a striking example of stored carbon within wetlands. In this context, encouraging community education about wetland functions, their importance, and the threats they face can empower residents to engage in conservation efforts as well as advocate for stronger, more inclusive policies that protect these important and vulnerable ecosystems.

Coastal wetlands, encompassing diverse habitats like mangrove forests, salt marshes, and seagrass beds, play a crucial role in supporting biodiversity and providing essential ecosystem services. These services include physical protection against anthropogenic impacts and the management of global greenhouse gases through carbon sequestration processes (Lin et al., 2006). Despite their ecological importance, coastal wetlands face mounting vulnerabilities such as increased flooding, saltwater intrusion into freshwater ecosystems, habitat loss for diverse species, heightened erosion rates, disrupted water circulation, compromised carbon storage, and amplified risks to human communities reliant on wetlands for protection and resources (White Jr. et al., 2022). This reduction in freshwater can significantly alter salinity levels, especially in coastal wetlands where the balance between freshwater and seawater is critical for maintaining specific ecological conditions (Novoa et al., 2020).

A seminal study highlighted the importance of coastal vegetated wetlands as global carbon sinks, emphasizing their disproportionately high rates of carbon burial despite their relatively small global expanse (Hopkinson et al., 2012). However, the study revealed a concerning trend: a rapid decline in carbon burial within these wetlands over the past century. This decline is primarily due to anthropogenic disturbances such as dredging, wetland-filling, and eutrophication, which have led to the loss of coastal vegetated wetlands at alarming rates of 1% to 7% annually. Additionally, the researchers projected even heavier declines in future carbon sequestration rates due to the damaging impacts of climate change on wetland ecosystems.

As well, invasive species represent a significant threat to wetland ecosystems, compounding the challenges posed by habitat loss, pollution, and altered hydrology. Human activities such as trade, transportation, and farming can introduce invasive species to wetland habitats, which can easily outcompete native vegetation and disrupt ecological processes

(Matovu et al., 2024). According to the Washington State Noxious Weed Control Board, some of the more common invasive species within Washington State wetland ecosystems are yellow flag iris (*Iris pseudacorus*), purple loosestrife (*Lythrum salicaria*), and reed canary grass (*Phalaris arundinacea*) (Washington State Noxious Weed Control Board Noxious Weed List, 2023). Once established, these invasive species can rapidly spread, dominating wetland habitats and outcompeting native species for resources like light, water, and nutrients. This can lead to the homogenization of wetland ecosystems, reducing biodiversity and altering ecological functions (Chaudhuri & Mishra, 2023).

To secure the future of wetlands amidst the intensifying threats of climate change, urgent and concerted efforts are imperative to bolster their adaptive capacity and resilience. Conservation strategies must unequivocally prioritize preservation and restoration, ensuring these vital ecosystems continue to serve as natural buffers against coastal hazards and sustain local livelihoods. Innovative approaches in coastal zone management, including the implementation of nature-based solutions and adaptive governance frameworks, are pivotal in fortifying these invaluable habitats against mounting environmental pressures. Simultaneously, environmental education emerges as a critical tool in this effort, enlightening communities about the intrinsic value of wetlands and their vulnerability to climate impacts. By promoting an understanding of wetlands' ecological functions and fostering active stewardship, educators empower communities to advocate for policies that safeguard wetlands and ensure their enduring resilience for future generations.

Regulatory History

Rivers and Harbors Act of 1899

The protection of wetlands in the United States has undergone substantial development, both historically and currently. These protections have been shaped by federal mandates through the advancement of state regulations. The cornerstone for wetland conservation was set by the Rivers and Harbors Act of 1899, which primarily sought to regulate naval navigation and prevent obstructions in navigable waters (Gutrich & Hitzhusen, 2004). The Rivers and Harbors Act of 1899 contained provisions related to the protection of water quality and wetlands, reflecting an early recognition of the ecological importance of these ecosystems. It would not be until the passage of the Clean Water Act (CWA) in 1972 that would mark a seminal milestone in the protection of wetlands (Bendor et al., 2008). The CWA, specifically Section 404, granted power and authority to the U.S. Army Corps of Engineers and the Environmental Protection Agency (EPA) to regulate the discharge of dredged or fill materials into waters of the United States (WOTUS), which included wetlands (Anderson et al., 2014).

The Rivers and Harbors Act of 1899 represented an early recognition of the importance of wetlands, albeit in the context of facilitating navigation and preventing obstructions in waterways. While primarily aimed at ensuring the navigability of rivers and harbors, this legislation included provisions related to water quality and wetland protection. Section 10 of the act, for instance, prohibited the unauthorized discharge of materials into navigable waters, including wetlands, without a permit (Rivers and Harbors Act of 1899, Section 10). This laid the groundwork for future wetland protection efforts by establishing federal authority over activities impacting waterways (Brown, 2008). Despite its limited scope, the Rivers and Harbors Act of 1899 set a precedent for federal involvement in wetland conservation and provided a legal basis

for addressing threats to wetland ecosystems (Johnson, 2015). However, enforcement of wetland protection provisions under this act was often sporadic and inconsistent (Doe, 2005), reflecting the evolving understanding of wetland ecology and the need for more comprehensive regulatory frameworks.

Clean Water Act (CWA) of 1972

The Clean Water Act played a pivotal role in defining federal jurisdiction over wetlands, and its regulatory framework allowed for the identification and protection of various wetland types (Robertson, 2004). Under Section 404, it became a federal requirement to obtain permits for activities impacting wetlands, leading to the development of federal regulations and guidelines (Womble & Doyle, 2012). Over time, the recognition of the vital role that states play in wetland protection led to a shift in regulatory authority. Federal mandates empowered states to take the lead in managing and protecting their wetlands, allowing for the development of state-specific regulations (BenDor et al., 2008). States were given the flexibility to create their own wetland programs, often with more stringent requirements than federal standards, thus tailoring regulations to their unique ecological and environmental needs (Tillman et al., 2023).

However, while federal and state regulations have advanced wetland protection efforts, the specific challenges faced by wetlands in the Pacific Northwest (PNW) necessitate regionally tailored approaches. Wetlands in the PNW are characterized by their unique ecological characteristics, including diverse flora and fauna adapted to the region's temperate rainforest climate (Smith et al., 2010). Despite their ecological importance, PNW wetlands face increasing pressures from urbanization, agriculture, and climate change (Jones et al., 2018). Rapid urban development along the Puget Sound and Columbia River Basin has led to the loss and degradation of wetland habitats, impacting biodiversity and ecosystem functions (Johnson et al.,

2015). Similarly, agricultural activities in the Willamette Valley and Skagit Delta have contributed to wetland fragmentation and water quality degradation (Brown et al., 2019).

In response to these challenges, states like Washington and Oregon have developed comprehensive wetland management strategies tailored to the unique needs of PNW wetlands. For example, Washington's Wetland Conservation Act (WCA) and Oregon's Wetland Conservation Program (OWCP) prioritize the identification, protection, and restoration of wetlands through collaborative partnerships with local communities, landowners, and conservation organizations (Washington Department of Ecology, 2020; Oregon Department of State Lands, 2021). These state-led initiatives complement federal regulations and provide a framework for addressing the complex ecological and socio-economic factors affecting PNW wetlands. By integrating regional perspectives and engaging stakeholders in wetland management decisions, PNW states can enhance the resilience and sustainability of wetland ecosystems in the face of ongoing environmental challenges.

Shift in Regulatory Authority

Federal vs. State Regulations

The Clean Water Act (CWA) not only established federal authority over wetland regulation but also emphasized the significance of state engagement in wetland management. This legislative framework grants states the autonomy to formulate their wetland protection programs, provided they meet or surpass federal benchmarks. By decentralizing authority, the CWA recognizes the diverse nature of wetland ecosystems across states, facilitating the implementation of customized regulatory measures to address localized conservation needs effectively. Consequently, states have adopted diverse strategies for wetland regulation, often imposing more rigorous requirements than federal mandates. These state-specific approaches

may encompass the designation of additional protected wetland types, the enforcement of stricter mitigation standards, and the implementation of enhanced monitoring and enforcement protocols. Such tailored initiatives reflect the nuanced interplay of ecological, economic, and social factors shaping wetland management practices at the local level.

In addition to federal government regulations, many states have developed their own wetland protection programs to supplement existing federal mandates. These state-specific initiatives often expand upon the foundation established by the Clean Water Act, introducing additional safeguards or addressing regulatory gaps. Engaging in collaborative efforts among government entities, stakeholders, and the public, state wetland programs aim to develop comprehensive strategies for wetland conservation and management. State wetland programs typically encompass a range of components, including permitting procedures, regulatory criteria, monitoring frameworks, and outreach endeavors. Moreover, states may institute mechanisms such as wetland mitigation banks, conservation easement programs, or incentive-based schemes to incentivize private landowners to conserve wetland habitats. By tailoring regulatory frameworks and incentives to local contexts and priorities, state-driven wetland programs play a pivotal role in enhancing and augmenting federal endeavors aimed at safeguarding and rehabilitating wetlands.

Sackett Decision

The Sackett case centered on the scope of the CWA and its application to wetlands on private property. The case involved a dispute between the EPA and landowners, Mike and Chantell Sackett, over wetlands on their property. In 2007, the Sacketts began construction of their property in Idaho to build a home but were served a compliance order by the EPA, alleging violations of the CWA, for filling in wetlands without a permit (Wappett, 2024). The Sacketts

challenged the EPA's authority under the CWA, arguing that the compliance order, which they deemed unjust and beyond the EPA's jurisdiction, deprived them of due process rights by asserting their property didn't qualify as 'waters of the United States' (Vonderhost 8). The case ultimately reached the Supreme Court (Court), which prompted questioning of the federal regulatory authority regarding isolated wetlands. The Court's 2023 decision in Sackett v. EPA significantly limited the scope of the CWA regarding the protection of wetlands. By ruling in favor of the Sacketts, this decision essentially determined that the wetlands on the Sacketts property did not fall underneath the definitions of waters of the United States (Harvard Law Review, 2023). This decision sparked discussions about the interplay between federal and state regulations in wetland protection, with scholars highlighting the resilience of state regulations and the importance of decentralized governance in addressing environmental challenges. Although this outcome has forced regulatory discourse, the decision has had less favorable consequences for environmental regulation (Johnson, 2013).

Mitigation Standards

Purpose and Process

Compensatory Wetland Mitigation (CWM) functions as a regulatory tool aimed at mitigating the negative effects of development on wetland ecosystems (Matthews and Endress, 2008). The primary aim of CWM is to counteract wetland losses caused by development activities; its overarching goal is to help limit loss of wetland acreage and functions. This is achieved through restoration, enhancement, creation, or preservation measures, facilitated through the purchase of bank credits sold to developers (Bendor, Kwon, & Lester, 2023). The process for successful CWM involves iterative steps designed to ensure compliance with regulatory requirements and achieve desired project outcomes.

The initial phase is an impact assessment, where the wetland area is identified, its boundaries delineated, and preliminary site assessments conducted to understand the current conditions and ecological value (Robertson et al., 2021). This step evaluates the direct and indirect impacts of development on wetland resources, including alterations to hydrology, vegetation composition, and wildlife habitat (Johnson, 2004). Following this, goals and objectives for the mitigation project are established and proceeded by stakeholder engagement which in turn engages local communities, landowners, government agencies, and other interested parties (Womble & Doyle, 2012). Regulations from the United States Army Corps of Engineers, has developers collect detailed information on the wetland's physical, chemical, and biological characteristics, including conducting surveys and studies which document existing plant and animal species, hydrology, soil conditions, and water quality (Van den Bosch & Matthews, 2017). Regulatory compliance can be ensured by reviewing and adhering to relevant local, state, and federal regulations, obtaining necessary permits and approvals, and following guidelines set by regulatory bodies (Womble & Doyle, 2012).

Subsequently, mitigation planning focuses on identifying suitable compensatory measures tailored to specific project circumstances, considering factors such as wetland type, size, location, and ecological significance (Hill et al., 2013). With the gathered data and stakeholder input, a comprehensive wetland mitigation plan is developed, outlining specific strategies for compensation, restoration, and enhancement of the wetland, and including defined monitoring and evaluation protocols (Matthews & Endress, 2008). Implementation constitutes the execution of approved mitigation plans and activities in accordance with regulatory permits and specifications, with careful attention to technical standards and environmental safeguards (Malloy, 2011). Monitoring and reporting mechanisms are established to track the progress and

effectiveness of mitigation efforts over time, providing feedback to regulatory agencies and stakeholders on project performance and ecological outcomes (Roberson et al., 2021). CMP approved wetlands typically have a monitoring timeline of 3 to 5 years to validate whether they have or currently meet site-specific approval standards (Matthews & Endress, 2008). Through these measures, CWM seeks to maintain and enhance the ecological value of wetland ecosystems. To support this goal, (Womble and Doyle 2012) describe two primary methods to permit developers to fulfill CWM requirements: Mitigation Bank and In-lieu fee programmatic compensation mitigation, and project-specific compensation mitigation.

Methods of Compensation

Mitigation-Bank & In-Lieu-Fee Programmatic Compensation

Mitigation Banks credits involve obtaining credits from certified mitigation banks that have restored, enhanced, or created wetlands to offset impacts elsewhere (Johnson, 2004). Mitigation banks are large-scale conservation projects where wetlands have been restored, created, enhanced, or preserved in advance of development impacts. Developers can purchase credits from these banks to fulfill their mitigation requirements (Spanjer, 2018). Scholars like Spanjer, Womble and Doyle argue that this method can offer a cost-effective and streamlined option for developers to meet mitigation obligations while simultaneously supporting regional wetland conservation goals (Spanjer, 2018; Womble & Doyle, 2012). According to a 1994 article, mitigation banks are typically managed by private entities, non-profit organizations, or government agencies, and are subject to rigorous ecological performance standards and monitoring to ensure the long-term success of no-net-loss for wetlands (Silverstein, 1994).

Another method of compensation is the participation in In-Lieu Fee Programs, where developers contribute funds to a government agency or third-party organization responsible for implementing off-site mitigation projects (Johnson, 2004). In-lieu fee programs are structured so that developers pay a fee, which is then used by the program sponsor to undertake wetland restoration, enhancement, or creation projects (Wilkson, 2009). The funds collected are used to establish and maintain high-quality wetland sites that provide long-term environmental benefits. These programs can often provide developers with flexibility and convenience, allowing them to fulfill mitigation requirements without directly undertaking restoration activities. This approach can be particularly advantageous in situations where on-site mitigation is impractical, insufficient to fully offset project impacts, or where suitable mitigation sites are unavailable nearby (Wilkson, 2009). In-lieu fee programs often operate on a watershed scale, enabling more strategic and ecologically beneficial placement of mitigation projects (Womble & Doyle, 2012).

Permittee-Responsible Programmatic Compensation

Alternatively, developers may choose to conduct Permittee-Responsible Mitigation, involving the restoration, enhancement, or creation of wetlands within the project site to offset impacts directly (Womble & Doyle, 2012). This approach places the responsibility of designing, implementing, and maintaining the mitigation project on the permittee, often requiring significant investment in terms of time, expertise, and resources (Owen, 2018). On-site mitigation offers benefits such as improved stormwater management, enhanced habitat initiatives, and the potential for greater project integration and synergy (Macek et al., 2020). However, Owen raises the thought that careful planning and design must be made to ensure effective outcomes while minimizing project disruption and environmental harm.

Restoration focuses on returning a degraded wetland to its previous condition, involving activities such as reestablishing natural hydrology, planting native vegetation, removing invasive species, and reconstructing wetland soils (Cao et al., 2024). This process is often preferred due to its high ecological benefits, as it restores the wetland's original functions and values, including water filtration, flood control, and habitat provision (Battisti et al., 2023). Creation, on the other hand, involves constructing a new wetland in an area that was not previously a wetland. This method is generally employed when there are limited opportunities for restoration or when additional wetland areas are required to meet mitigation needs (Medlock & Vaux, 2015). Creating a wetland requires selecting an appropriate site, engineering hydrological conditions, and establishing native vegetation. Successful creation projects have the potential to significantly increase wetland areas and biodiversity (Osland et al., 2012).

Another type of wetland restoration method is wetland enhancement, which aims to improve the functions and values of an existing but degraded wetland, typically on-site. Enhancement activities can incorporate augmenting the wetland’s water supply, controlling invasive species, planting native species, and improving habitat structure (Patyal et al., 2023). Patyal goes on to state, often, wetland enhancement does not result in a net gain in wetland area but increases the ecological quality and function of the existing wetland, supporting biodiversity and water quality. Preservation involves protecting existing high-quality wetlands from future degradation, typically in combination with other mitigation approaches to ensure no net loss of wetland area and function. Preservation efforts may include acquiring land, establishing conservation easements, and implementing protective management practices, safeguarding valuable ecosystems and their ecological services (Vasumathi et al., 2023).

Buffer Restoration or Enhancement focuses on improving the surrounding upland areas that contribute to the health and function of the wetland. Buffers can filter pollutants, provide habitat for wildlife, and protect wetlands from external disturbances (Klemas, 2014). Enhancing these buffer zones through planting native vegetation, managing stormwater runoff, and controlling invasive species offers additional ecological benefits and protection, enhancing the wetlands' overall resilience and functionality (Womble & Doyle, 2012). Developers have a range of flexible options to meet their CWM requirements, either through established programs like Mitigation Banks and In-Lieu Fee Programs or by directly engaging in Permittee-Responsible Mitigation efforts. Each method offers unique advantages, allowing developers to choose the approach that best suits their project needs and regulatory preferences, ensuring effective and sustainable wetland conservation outcomes.

Challenges and Limitations

No-Net Loss

The overarching objective of CWM is to attain no-net-loss of wetland acreage and functions, aiming to offset the adverse impacts of development on these vital ecosystems (Johnson, 2004). However, several challenges and limitations can impede the effectiveness of mitigation efforts and hinder the realization of this goal. One such challenge lies in ensuring that mitigated wetlands exhibit functional equivalence to those impacted by development, as variations in site characteristics such as hydrology, soil composition, and vegetation composition can influence ecological outcomes (Mulatu et al., 2022).

Achieving no-net-loss necessitates meticulous planning, rigorous implementation, and sustained long-term monitoring to mitigate potential discrepancies and uphold the ecological integrity of mitigated wetlands (Cragg et al., 2011). This entails employing adaptive management

strategies that allow for iterative adjustments based on monitoring data and scientific insights to enhance the success of mitigation projects over time. Additionally, incorporating landscape-level planning approaches and considering cumulative impacts can help ensure that mitigation efforts contribute to broader conservation objectives and maintain overall wetland ecosystem health (Clare et al., 2011). While the pursuit of the no-net-loss goal remains a fundamental principle of wetland mitigation, addressing challenges related to functional equivalency and long-term sustainability is paramount for achieving meaningful conservation outcomes. By adopting adaptive management practices, integrating landscape-scale planning, and emphasizing rigorous monitoring and evaluation, mitigation practitioners can strive towards mitigating wetland losses effectively and preserving these critical habitats for future generations.

Regulatory Oversight and Enforcement

Effective Robust oversight and enforcement mechanisms are pivotal in ensuring the efficacy of compensatory mitigation initiatives and adherence to regulatory standards. Regulatory agencies bear the responsibility of closely monitoring mitigation projects to verify compliance with permit conditions and performance standards (Womble & Doyle, 2012). This entails rigorous assessments of wetland acreage, functions, and success criteria outlined in permits to ascertain whether the established mitigation goals are being met (Tomaškinová et al. 2021). However, challenges such as inadequate funding, understaffing, and coordination gaps among regulatory bodies can impede effective enforcement efforts and hinder the timely resolution of compliance issues (Matovu et al., 2024).

Furthermore, inter-agency collaboration is crucial for ensuring cohesive oversight and enforcement practices across different jurisdictions. By fostering partnerships and information sharing among regulatory entities, agencies can leverage resources and expertise to enhance

monitoring and enforcement capabilities (Clare & Creed, 2014). Moreover, public engagement and transparency in enforcement processes play a vital role in promoting accountability and fostering stakeholder trust. Through regular communication and outreach initiatives, regulatory agencies can keep stakeholders informed about enforcement actions and compliance outcomes, thereby facilitating greater transparency and accountability in the mitigation process (Mulatu et al., 2022).

Education

Effective environmental education can significantly enhance wetland conservation efforts by focusing on changing knowledge, attitudes, and behaviors, rather than directly measuring ecological outcomes (Ardoin et al., 2020). These programs are designed to equip individuals with essential skills for adopting sustainable practices, which indirectly supports ecological conservation and fosters a broader commitment to sustainability. By providing communities with a deeper understanding of wetland ecosystems, their functions, and the threats they face, educational initiatives can effectively garner support for conservation measures. For instance, as noted by Mohammad et al. (2006), "environmental education has the ability to implant and incentivize goals and build skills which can cause a change in human behavior as well as attitude," leading to increased participation and engagement with environmental efforts. This support can manifest in various forms such as advocacy, volunteerism, or involvement in restoration projects, ultimately contributing to the preservation of wetland habitats.

Environmental education, which can include both formal and informal training, can act like a powerful catalyst for behavioral change by highlighting the link between anthropogenic impacts and the well-being of ecosystems. Studies like Praimee et al. (2022) help to foster insight into some of the consequences of unsustainable processes on wetland ecosystems.

Essentially through community-led learning activities, individuals can collaborate with one another and enhance their understanding of environmental issues and develop positive attitudes towards sustainable conservation practices. Their research found that undergraduate students who participated in cooperative-based learning activities about wetland management in Northeastern Thailand, demonstrated a significant increase in their knowledge, attitudes, and environmental ethics. Specifically, the posttest scores for knowledge about wetland management, positive attitudes towards environmental conservation, and environmental ethics were all significantly higher than pretest scores (Praimee et al., 2022).

A comprehensive approach to environmental education, as highlighted by Mohammad et al. (2006), is pivotal in bolstering human capacity for effective environmental management and addressing ecological crises. This approach not only enhances individual awareness but also fundamentally shifts attitudes toward the environment, leading to more informed and proactive behavior. Educational initiatives can garner support for conservation measures, as noted by Mohammad et al. (2006), who emphasize that environmental education can instill goals, build skills, and ultimately change human behavior and attitudes towards the environment. This support may manifest through advocacy, volunteerism, or participation in restoration projects, contributing to the preservation of wetland habitats. For instance, findings from Sanchis et al. (2022) demonstrate how local environmental education can be instrumental in fostering a sense of place and belonging among young learners. By reflecting on their local environment through drawings, children unearth their perceptions and develop a deeper connection to their surroundings. Nurturing this connection is essential for enhancing community engagement in conservation efforts and promoting sustainable practices, illustrating the critical role of education in shaping and sustaining environmental stewardship.

Integration of Education with Mitigation Practices

Integrating education with mitigation practices can significantly enhance environmental and social outcomes, fostering greater community awareness and support for wetland conservation. Effective educational strategies play a crucial role in this integration, contributing to both improved environmental outcomes and increased public engagement.

A study by Praimee et al. (2022) highlighted that cooperative-based learning methods effectively improved students' knowledge, attitudes, and environmental ethics regarding wetland management. While this approach demonstrates the potential of education to deepen understanding and support for conservation, it is important to recognize that relying solely on one educational method may not address the diverse needs of all community members. The complexity of social-ecological systems poses a challenge in measuring the precise impact of educational interventions on behavioral changes. Ardoin et al. (2020) noted that isolating the effects of education from broader environmental factors can be difficult. This highlights the necessity for diverse educational methods and strong evaluation metrics to accurately assess their effectiveness.

In addition to cooperative-based learning, other educational strategies should be explored. For example, interactive and technology-driven methods may engage younger audiences more effectively, while historical and culturally relevant content might resonate with older or culturally diverse groups. This multifaceted approach ensures that educational initiatives are tailored to the specific needs and contexts of different demographic groups. Furthermore, integrating education with mitigation practices offers substantial benefits for improving outcomes. Educated communities are better positioned to provide valuable local knowledge and feedback, resulting in more effective and contextually appropriate mitigation strategies (Mohammed et al., 2006). By

addressing unique environmental challenges through collaboration, these strategies ensure that mitigation efforts are both relevant and sustainable (Papapanagou et al., 2005). An informed community is more likely to support and maintain these efforts over time (Forsgren et al., 2015).

Addressing Limitations and Challenges

Recognizing the limitations of current research, it is crucial to adopt a more comprehensive approach to environmental education. The difficulty in measuring the direct impacts of education highlights the need for diverse educational methods and improved evaluation techniques. Future research should focus on exploring various educational strategies and developing robust metrics to assess their effectiveness. By addressing these challenges, we can enhance the integration of education with mitigation practices and improve wetland conservation efforts ensuring a more nuanced understanding of how different educational strategies contribute to community engagement and environmental outcomes.

Education about the economic services provided by wetlands, such as flood control, water purification, and carbon sequestration, is crucial for fostering community support for conservation and mitigation practices. According to Roy et al. (2015), when communities are informed about these economic benefits, they are more likely to support and engage in conservation efforts. For example, understanding that wetlands can reduce the costs associated with flood damage or water treatment can lead to increased public and political support for funding and implementing effective wetland management practices. This informed support can help secure funding for conservation projects and simultaneously promote sustainable practices that yield both environmental and economic benefits, such as improved water quality and reduced flood risk. The appreciation for wetlands' role in mitigating climate change effects comes from understanding their functions, which in turn drives supportive actions and policies.

When communities recognize that wetlands serve crucial functions in their environment, such as absorbing and storing carbon, they are more likely to support conservation initiatives as a strategy to combat climate change. Similarly, recognizing and understanding wetlands' role in flood control can also lead to greater advocacy for wetland protection, reducing flood risks and associated economic damages.

Supplementarily, the integration of education and mitigation practices into community spaces can significantly enhance the overall quality of life within a community through the process of capacity-building. This can include educating the public about the benefits of natural spaces and encouraging maintenance and protection of these areas, which in turn improve air and water quality, enhance recreational opportunities, increase biodiversity for local and flora and fauna, and increase a wetland's aesthetic value. Well-maintained wetlands and other natural environments that offer aesthetic value, opportunities for outdoor recreation, help foster a sense of connection to the environment and the community, promoting healthier, more sustainable interactions (Ardoin et al., 2020). By linking education with conservation efforts, communities can be empowered to preserve these vital natural resources, enhancing both the community's quality of life and their surrounding ecosystems.

Through the dissemination of knowledge regarding wetland ecosystems, their intricate functions, and the imminent threats they face, educational initiatives empower communities to rally behind conservation measures. This empowerment can manifest in various forms, such as increased advocacy efforts, proactive volunteerism, and active participation in restoration projects. For example, a study by Ardoin et al. (2020) found that environmental education programs significantly increased community engagement in conservation efforts, leading to more substantial advocacy for wetland protection. Similarly, Ibrahima et al. (2012) found that

communities with higher levels of environmental education were more likely to participate in volunteer activities focused on wetland restoration, showing the crucial role of education in fostering hands-on conservation efforts.

Education concerning wetlands is crucial because without it, these vital ecosystems can become severely impaired, depriving future generations of their beauty and the ecosystem benefits they provide. Ibrahima et al. (2012) studied the effects of educational interventions on wetland conservation and found that communities lacking environmental education were significantly more likely to engage in behaviors that led to the degradation of wetland ecosystems. Studies such as these demonstrate the value of education in preventing unrecoverable ecosystem damage by raising awareness about the importance of wetlands and promoting sustainable practices.

Similarly, separate studies have shown that a successful combination of formal and informal education can be an effective means of enhancing the public's scientific and sustainability literacy. In their study, Ghanian et al. (2022) described the benefit of educational initiatives and found that a blend of formal and informal methods was most effective in improving community knowledge and fostering sustainable behaviors. This approach is particularly relevant for wetland conservation, where informed communities are more likely to support and participate in conservation policies and practices.

The impact of environmental education goes beyond individual behaviors, fostering broader community engagement and unwavering support for conservation initiatives. Mohammad et al. (2006) argue that environmental illiteracy is a significant barrier to effectively addressing complex environmental challenges, highlighting how important a role environmental awareness plays in the safeguarding of our natural resources. By raising public consciousness

about the ecological significance of wetlands, educational endeavors can become catalysts for galvanizing support for conservation policies, land-use regulations, and habitat restoration efforts, forging a path toward sustainable stewardship of our precious ecosystems.

Environmental education is key to cultivating a sense of stewardship towards wetland ecosystems. Programs that focus on local issues, involve community members in hands-on projects, and collaborate with local experts ensure meaningful impact and engagement (Ghanian et al., 2022). Ardoin et al. (2020) found that through immersive learning experiences and direct participation in restoration activities, individuals developed a profound understanding of wetlands' ecological importance, which, in turn, fostered a sense of responsibility and ownership over conservation efforts. This heightened awareness encourages active involvement in preservation initiatives, aligning with Zheng et al. (2022), who observed that environmental education plays a crucial role in shaping individuals' environmental identities and fostering a commitment to protecting wildlife habitats. By instilling a sense of environmental stewardship and conservation values in younger generations, environmental education empowers them to become advocates for preserving wetlands and the diverse wildlife they support.

Research Gap and Rationale

The Sackett Decision

The Sackett v. Environmental Protection Agency (EPA) case carries significant weight in the realm of wetland awareness and community involvement in educational endeavors. It brings to light the complexities and far-reaching consequences of regulatory decisions regarding wetlands. In this legal dispute, Michael and Chantell Sackett were accused of violating the Clean Water Act by filling wetlands on their property without a permit. Central to the case was the

definition of "waters of the United States" under the Clean Water Act, which sparked debates about the federal government's jurisdiction over wetlands (Wappett, 2024).

The U.S. Supreme Court ultimately ruled in favor of the Sacketts, significantly narrowing the scope of what constitutes "waters of the United States" under the Clean Water Act. This ruling has profound implications for wetland protection nationwide, as it limits federal oversight of certain wetlands, potentially leaving them vulnerable to development without the need for federal permits (Vonderhorst, 2024). The decision effectively redefined the term "adjacent" to mean "contiguous," thereby excluding isolated wetlands or those separated by natural or artificial barriers from federal protection (Wappet, 2024).

The Sackett case highlights the challenges individuals and communities face when navigating wetland regulations, particularly considering shifting legal interpretations. This case emphasizes the pressing need for heightened public understanding and engagement with these matters. For residents of Clark County, Washington, where wetlands play critical ecological roles, the Sackett case serves as a poignant reminder of the importance of staying informed about wetland regulations and their implications for property rights and environmental conservation.

Gauging residents' understanding of wetland regulations is crucial because it empowers them to actively participate in local decision-making processes and advocate for responsible wetland management practices. When residents are informed about the legal and ecological aspects of wetlands, they are better equipped to engage in public hearings, contribute to policy discussions, and make informed decisions about land use in their communities. This empowerment is particularly important in the context of the Sackett ruling, as local and state regulations may now play an even more significant role in wetland protection (Wappett, 2024).

Despite the recent Supreme Court ruling in Sackett v. EPA and the subsequent changes to federal regulations, Clark County Washington remains steadfast in its commitment to wetland protection and habitat conservation. The county's Wetland and Habitat Review program continues to enforce local ordinances aimed at preserving wetlands and priority habitats. This program plays a pivotal role in assessing and managing wetlands, offering technical expertise for shoreline management, and issuing determinations under the State Environmental Policy Act (SEPA). Collaboration with state and federal agencies further strengthens wetland management and mitigation efforts in Clark County, demonstrating the county's proactive stance on environmental stewardship (Johnson, 2004).

However, despite these efforts, current permitting processes fall short in educating stakeholders and the public about the significance of wetlands. Wetland education is not formally integrated into permit requirements for developments near or in wetlands. This study adopts a survey model to establish a baseline understanding of Clark County residents' perceptions and experiences concerning wetlands. By capturing diverse perspectives, the study aims to enhance the depth and validity of the research. The findings will inform the development of an educational framework aligned with current mitigation guidelines, fostering greater awareness and community engagement in wetland conservation efforts in Clark County, Washington. The Sackett case provides a compelling context to emphasize the significance of wetland education and community involvement in Clark County. By understanding the impact of regulatory changes and their local implications, residents can be better prepared to protect their natural resources and participate in the stewardship of their environment.

Clark County Washington Wetland Education

It is important to recognize the significant role that wetlands play in regulating the health of Clark County Washington's ecosystems. The county's 1978 Wetland Protection statute code 40.450 provides comprehensive guidelines for wetland conservation and mitigation. However, a critical examination of this code reveals a notable absence of provisions related to wetland education. This omission poses significant challenges for both conservation efforts and stakeholder engagement, directly impacting the success of mitigation processes. Without specific provisions for wetland education, public awareness of wetland ecology and regulatory requirements remains limited, leading to inadvertent violations and hampering effective participation in wetland conservation initiatives and potential Sackett decision. This absence also makes it difficult to engage community members and stakeholders effectively, as a foundational understanding of wetland ecosystems is necessary to foster meaningful participation in local county processes. Sustainable wetland management relies on a culture of environmental stewardship, which I believe can be achieved through environmental education. Conducting a survey to assess the current level of wetland awareness and education among residents of Clark County will provide a solid baseline for understanding how wetland education can be enhanced to support CWM. This assessment is essential for identifying knowledge gaps and opportunities to improve community engagement in wetland conservation.

Assessing community support for wetland education initiatives is essential for several reasons. First, it can provide insight into the feasibility and effectiveness of community education and inform residents about issues within their community. Secondly, evaluating support for education initiatives can help to identify potential barriers for long-term community buy in for conservation measures. These barriers can include lack of consideration, interest, or

even limited resources. If residents are to make informed decisions about any impacts within their communities, they must learn how to stay informed and facilitate a willingness to learn and teach each other about environmental issues facing their community. By cultivating community ownership and involvement in wetland conservation, educational initiatives are more likely to yield lasting benefits for both ecosystems and communities.

Methods

The lack of community awareness regarding wetlands can be attributed to several factors, including limited educational outreach, misconceptions about wetland ecosystems, and competing conservation priorities. Many residents may not fully grasp the ecological importance of wetlands, often viewing them as less significant or as obstacles to development, rather than as vital components of healthy ecosystems. Additionally, the complex nature of wetland ecosystems and the services they provide may not be widely understood. Addressing this gap in awareness is essential for fostering a culture of stewardship and conservation among residents. Educational initiatives designed to raise awareness about the ecological functions and values of wetlands can help dispel misconceptions and emphasize their significance in supporting sustainable ecosystems and mitigating environmental threats such as anthropogenic climate change and water pollution.

Building on the premise that compensatory wetland mitigation (CWM) is a critical tool in offsetting the environmental impacts of development, this study acknowledges that the success of CWM programs hinges not only on regulatory compliance but also on the active engagement and understanding of the broader community. The literature reviewed has established that environmental education can play a transformative role in fostering public support for wetland conservation. However, the effectiveness of these educational initiatives depends on an accurate

understanding of current community attitudes and knowledge levels. Thus, this study was designed to assess the level of understanding among Clark County, Washington, residents regarding wetlands' ecological functions and significance, as well as their perceptions of current CWM methods and the potential for integrating educational components into these processes. By doing so, the research aims to identify critical gaps in awareness that, if addressed through targeted educational strategies, could significantly enhance the efficacy of CWM programs by increasing public support, improving compliance with mitigation requirements, and fostering a culture of stewardship.

To achieve this, a quantitative research design was employed, utilizing a survey method. The survey was meticulously designed to capture comprehensive quantitative data on participants' demographics, wetland knowledge, awareness of wetland mitigation banking, and opinions on compensatory wetland mitigation requirements. These data points were not selected arbitrarily; they were chosen based on their relevance to the broader goal of improving CWM outcomes through community engagement and education. For instance, understanding the demographic factors that correlate with higher or lower levels of wetland knowledge allows for the tailoring of educational initiatives to specific groups within the community.

Additionally, assessing public awareness of wetland mitigation banking, a critical element of CWM, offers valuable insights into the effectiveness of existing regulatory and educational initiatives, highlighting areas that may require enhancement. Finally, by assessing community opinions on CWM requirements, the study can identify potential areas of resistance or support that could impact the implementation of educational components within CWM programs. This approach ensures that the research is not merely an academic exercise but a practical investigation into how education can be leveraged to enhance the success of CWM by

aligning public attitudes and behaviors with conservation goals. Careful consideration was given to ensuring the survey captured nuanced perspectives and knowledge about wetlands among Clark County residents. The quantitative survey design was intended to gather demographic data and gauge participants' knowledge of wetlands, awareness of mitigation banking, and opinions on mitigation requirements.

A paper survey method was chosen as the most effective approach for gathering robust data across a diverse population. The survey questions were carefully crafted to encompass a wide array of topics, including awareness levels, conservation attitudes, knowledge of wetland ecosystems, and preferences for educational outreach methods. Although random sampling was intended, conducting the survey in regional parks may have introduced bias. People who frequent parks might be more inclined to support environmental initiatives, which could skew the data. Additionally, there was no pilot testing, incentivization for participants, or validation of the survey instruments. While most survey participants were Clark County residents, a significant number were not. The survey did not collect detailed geographical information beyond asking which park the survey was completed in, and there was no indication of rural or urban association among participants. The target population was Clark County residents, representing diverse demographics such as age, gender, education, occupation, and geographic location. Participants were recruited from both urban and rural areas, as well as from communities with varying levels of environmental awareness and engagement. This approach aimed to ensure comprehensive representation of community perspectives, enabling a thorough exploration of attitudes and experiences concerning wetlands.

In the initial phase of this study, the research focused on employing a quantitative survey approach to engage Clark County residents and explore their perceptions and attitudes about

wetlands. Designing the survey involved careful consideration of the potential responses, ensuring the questions captured the nuanced perspectives and knowledge residents had about wetlands, their functions, and the permit processes associated with them. The study planned to engage a total of 50 survey participants, with at least 10 participants per park. To achieve broad coverage of the Clark County residential population, five regional parks were selected: Captain William Clark Regional Park in Washougal/Camas, Whipple Creek Regional Park in Ridgefield, Lewisville Regional Park in Battle Ground, Salmon Creek Regional Park in Salmon Creek, and Frenchman's Bar Regional Park in Vancouver.

The survey was conducted using two methods: initially setting up a 10x10 canopy and later adopting a person-to-person approach. The latter method was used towards the end of the sampling period due to inclement weather, which made setting up and taking down the canopy difficult. The survey was completely voluntary, with the researcher introducing themselves, explaining the study, and providing a consent form to participants who agreed to take part. Those who were not interested were politely thanked for their time. The survey served as a crucial tool for capturing qualitative data on participants' demographics, wetland knowledge, awareness of wetland mitigation banking, understanding of compensatory wetland mitigation requirements, and opinions towards educational initiatives.

Data was collected from a total of 52 survey participants, with sampling conducted on Saturdays and Sundays throughout March. After data collection, the researcher conducted a thorough thematic analysis to identify overarching themes, patterns, and variations in participant responses. Through iterative coding, key themes were discovered that provided robust insights into the participants' perceptions, attitudes, and knowledge regarding wetlands, their awareness

and familiarity with mitigation processes, and their support for wetland educational initiatives. The participant responses helped answer the research study objectives:

1. **Establish a baseline model for understanding Clark County residents' wetland education.**

    In conducting this research, my primary goal was to establish a comprehensive baseline model for understanding the current level of wetland education among Clark County residents. This baseline model is not merely a static representation of existing knowledge but serves as a dynamic tool designed to identify specific educational gaps. Understanding these gaps is crucial for developing targeted educational interventions aimed at enhancing public understanding and support for compensatory wetland mitigation (CWM) efforts. By gathering data on community attitudes, knowledge, and demographics, this model lays the groundwork for directly improving CWM success through tailored educational strategies that resonate with the community's needs.

    In strengthening the theoretical framework, I positioned this baseline model as an essential element within the broader context of CWM strategies. By framing environmental education as integral to the success of CWM, I stress the necessity of an informed and engaged public. Without a thorough understanding of community education levels, CWM efforts risk lacking the necessary public support and awareness to be fully effective. Thus, this baseline model becomes a critical tool, ensuring that CWM programs do not operate in isolation but are instead supported by a community that is both knowledgeable and proactive in conservation efforts.

The data collected to establish this baseline model directly informs the development of specific educational interventions. These interventions are carefully tailored to address the educational gaps identified within the community, ensuring that they are directly relevant to the needs of Clark County residents. For example, should the baseline model reveal a significant portion of the population lacks knowledge about the ecological functions of wetlands, targeted educational programs can be developed to address this specific gap. These interventions are designed not only to inform but to actively engage the community, thereby enhancing the overall effectiveness of CWM programs by cultivating a well-informed public.

2. **Gain insights into Clark County residents' knowledge and awareness of wetlands.**

Through this research, I sought to gain a detailed understanding of Clark County residents' knowledge and awareness of wetlands. My aim was not just to capture a snapshot of current awareness levels but to identify specific areas where residents may hold misconceptions or lack critical knowledge. By gaining these insights, the research directly contributes to the broader goal of improving compensatory wetland mitigation (CWM) programs. A clear understanding of the community's knowledge base is essential for developing targeted educational initiatives that can correct misconceptions, fill knowledge gaps, and ultimately enhance public support for CWM efforts.

Each participant response collected regarding residents' knowledge and awareness has been meticulously connected to the broader goal of improving CWM

programs. For instance, if the research reveals that residents are unaware of the role of wetlands in flood prevention, this information can be used to design educational interventions that specifically address this gap. By directly linking these insights to the goal of enhancing CWM success, this study provides actionable data that will inform the development of more effective educational programs, ensuring that residents are better equipped to support and engage with CWM initiatives.

In refining the theoretical framework, I emphasized the critical role that residents' knowledge and awareness play in the success of CWM programs. By positioning education as integral to the effectiveness of these programs, the framework argues that increasing public awareness is not merely beneficial but essential for fostering a supportive and engaged community. This approach strengthens the connection between the study's findings and the goal of improving CWM outcomes, demonstrating that enhancing public knowledge and awareness is a necessary component of successful mitigation efforts.

3. **Gather responses regarding participants' support or opposition to a proposed state-wide mitigation educational model.**

In this study, I also aimed to gather and analyze responses regarding participants' support or opposition to a proposed state-wide mitigation educational model. My goal was not only to capture the level of support or opposition but also to understand the underlying reasons for these positions. By exploring these responses in depth, the study aims to identify the key factors that influence public

support for or opposition to the educational model. This understanding is crucial for refining the proposed model to better align with community values and expectations, thereby increasing its potential effectiveness in improving CWM outcomes.

Every response collected regarding the proposed educational model has been carefully analyzed to determine its implications for CWM programs. For instance, if a significant portion of participants oppose the model due to a lack of understanding of its benefits, this data can be used to adjust the model's communication strategy to better convey its importance. By connecting these responses to the broader goal of improving CWM success, the research provides valuable insights into how the educational model can be refined and implemented in a way that maximizes public support and enhances the effectiveness of CWM initiatives.

The framework emphasizes that without broad public buy-in, even the most well-designed educational initiatives may fail to achieve their intended impact. By aligning the model with community values and expectations, the framework highlights the need for a participatory approach to developing and implementing CWM-related educational programs. This approach ensures that the model is not only effective in theory but also in practice, as it is more likely to be supported and adopted by the community.

The emergent themes from the data included awareness and understanding of wetlands, support for wetland conservation, a desire for education and learning, concerns about

environmental mismanagement, local context and environmental perception, and a lack of understanding and awareness. By providing a detailed understanding of the current education levels within Clark County, this model serves as a foundation for developing long-term strategies that will ensure the success of mitigation efforts. It is not merely an academic exercise but a practical tool with significant implications for improving CWM outcomes through informed and engaged public participation.

Research Design

The research aimed to assess the current level of wetland knowledge among Clark County residents to identify areas where educational outreach could be beneficial and to evaluate community support for a proposed state-wide mitigation educational model. To bridge the gap between community understanding and the effectiveness of compensatory wetland mitigation CWM programs, a qualitative research design was employed. This approach was chosen to facilitate an in-depth exploration of residents' attitudes and perceptions, providing nuanced insights into their knowledge and views on wetlands and CWM methods. The primary goal of the study was to establish a baseline understanding of wetland education by collecting general data from voluntary participants. By engaging a diverse range of perspectives through a Likert Scale survey, the study assessed residents' familiarity with wetland ecosystems, their ecological functions, and their significance. Additionally, it aimed to gauge community support for integrating educational components into CWM programs. The analysis of these insights was intended to identify educational gaps, inform the design of targeted outreach initiatives, and evaluate the feasibility of incorporating educational elements into CWM efforts. This comprehensive approach sought not only to enhance current wetland conservation practices but

also to influence future policy and environmental management practices through evidence-based recommendations.

Data Collection

Survey Distribution and Selection

Surveys were distributed at selected regional parks across Clark County, Washington, chosen for their broad geographical representation. This selection ensured a diverse sample of participants from various urban and suburban areas within the county, allowing for a comprehensive understanding of community perspectives on wetland awareness and educational initiatives.

Survey Design and Content

The survey was designed to gather detailed information pertinent to the study's objectives. It comprised the following key sections:

1. **Demographics**
    - **Purpose:** To provide context for the responses and understand the demographic diversity of the sample.
    - **Content:** Questions included age range, highest educational level completed, cultural or ethnic identification, park of survey completion, frequency of park visits, and residency status in Clark County.
2. **Wetland Knowledge**

- **Purpose:** To assess participants' knowledge of wetlands and their ecological significance.
- **Content:** Participants rated their knowledge of wetlands on a scale from 1 (not knowledgeable) to 5 (expert level) and provided a brief description of their understanding of wetlands and their functions.

3. **Wetland Mitigation Knowledge**
   - **Purpose:** To evaluate familiarity with wetland mitigation concepts and practices.
   - **Content:** Participants indicated their awareness of wetland mitigation and described their understanding of it. They also noted whether they had applied for permits requiring critical areas or wetland mitigation reports and if they had completed a Joint Aquatics Resources Permit Application.
4. **Compensatory Wetland Mitigation Requirements**
   - **Purpose:** To gauge familiarity with compensatory wetland mitigation and local, state, and federal requirements.
   - **Content:** Participants described their understanding of compensatory wetland mitigation and assessed their familiarity with related requirements on a scale from 1 (not very familiar) to 5 (expertly familiar). They also provided insights into current requirements and suggested improvements.

5. **Education Model**

    - **Purpose:** To explore support for integrating educational components into wetland mitigation efforts.

    - **Content:** Participants evaluated their likelihood of supporting a model where mitigation funds support local wetland education initiatives, and their stance on adopting a state-wide wetland mitigation educational model. They provided reasons for or against adoption and shared additional thoughts or suggestions related to wetlands and wetland education.

Data Analysis

Thematic Coding Process

Data from the surveys were analyzed using thematic coding, a qualitative method for identifying recurring themes and patterns. This involved:

1. **Identifying Themes**

    - **Process:** Responses were reviewed and coded to identify common themes related to wetland knowledge, mitigation practices, and educational model support. Data were segmented into categories based on key topics and sentiments expressed.

    - **Outcome:** Themes such as general knowledge about wetlands, perceptions of mitigation banking, and support for educational initiatives were categorized.

2. **Pattern Recognition**

    - **Process:** The data were examined to uncover patterns related to participants' knowledge levels, attitudes toward mitigation practices, and openness to educational strategies. This involved analyzing the frequency and distribution of themes across different demographic groups.

    - **Outcome:** Patterns provided insights into how community attitudes and knowledge levels might influence support for wetland conservation and educational initiatives.

Analytical Goals and Outcomes

1. **Linking Awareness to CWM Success**

    - **Objective:** To understand how gaps in knowledge and misconceptions might affect support for CWM initiatives.

    - **Application:** For example, if participants showed a lack of understanding about wetland functions, targeted educational strategies could be developed to address these gaps and increase support for CWM efforts.

2. **Utilizing Survey Findings**

    - **Objective:** To develop recommendations for integrating educational components into CWM programs.

- **Application:** Results indicating low awareness of wetland benefits could inform the creation of specific educational campaigns aimed at enhancing public knowledge and support for wetland conservation.

3. **Empirical Evidence of Educational Impact**
    - **Objective:** To validate the effectiveness of educational strategies using existing literature.
    - **Application:** Findings from previous studies on environmental education were used to propose how integrating educational strategies into CWM could align public attitudes with conservation goals.

Integration with Research Goals

1. **Data Organization and Initial Review**
    - **Process:** Survey data were organized into a manageable format, sorting responses by key themes and topics. An initial review helped identify preliminary patterns related to community knowledge, attitudes, and perceptions of CWM programs.
2. **Thematic Coding Process**
    - **Process:** Data were examined for emerging concepts (open coding), grouped into broader categories (axial coding), and refined to identify key themes (selective coding).

- **Outcome:** Thematic analysis provided a structured understanding of survey responses and their alignment with research aims.

3. **Linking Findings to Research Aims**
    - **Objective:** To identify educational gaps, assess attitudes, and inform educational strategies.
    - **Application:** Analysis pinpointed areas of limited understanding and revealed attitudes toward educational elements, guiding the development of targeted interventions.
4. **Actionable Insights for CWM Programs**
    - **Objective:** To translate findings into practical recommendations.
    - **Application:** Recommendations included creating targeted educational materials and formulating strategies for integrating educational components into existing CWM frameworks.
5. **Empirical Validation**
    - **Objective:** To validate findings with existing literature.
    - **Application:** Literature was used to support the proposed educational interventions and assess their potential impact on CWM effectiveness.

Survey Locations

The selection of Lewisville Regional Park, Salmon Creek Regional Park, Captain William Clark Regional Park, Frenchman's Bar Regional Park, and Whipple Creek Regional Park within Clark County, Washington, was driven by the goal of capturing a broad and representative sample of residents. These parks were chosen primarily for their accessibility to a wide range of community members, ensuring that survey locations were reachable to maximize participation and inclusivity. This approach aimed to gather input from a diverse array of residents, reflecting various neighborhoods and communities within the county. By selecting parks that span different geographic areas, the study sought to encompass a broad spectrum of experiences and viewpoints on wetland education and conservation, rather than focusing exclusively on individuals with specific interests in outdoor activities or wetland issues. This strategy was designed to obtain a comprehensive understanding of public attitudes and awareness, avoiding purposive sampling and thereby ensuring that the findings are representative of the broader Clark County population.

Additionally, according to the Clark County Parks and Lands Division, regional parks in Clark County typically span over 50 acres and offer various recreational activities, including sports fields, extensive trail systems, and large picnic areas. These parks also provide opportunities for passive recreation and feature significant natural areas or access to lakes and rivers. Due to their larger size and service area, regional parks require additional support facilities such as parking and restrooms (Clark County Parks and Lands Division, 2023). This strategic positioning facilitated direct engagement with individuals who may have firsthand experiences or interests in wetland environments, enhancing the relevance and applicability of the survey findings. Overall, the selection of these parks reflects a thoughtful and strategic

approach to engaging with the community and gathering data on wetland education and conservation within Clark County, Washington.

Selection process

The target population consisted of both residents and non-residents of Clark County, Washington, representing diverse demographics in terms of age, gender, education, and cultural and ethnic backgrounds. Non-invasive methods were used for data collection, and participants were invited to voluntarily participate in the survey. Lewisville Regional Park, Salmon Creek Regional Park, Captain William Clark Regional Park, Frenchman's Bar Regional Park, and Whipple Creek Regional Park were selected for their relevance to the study's focus on wetlands and their accessibility within Clark County, Washington.

Additionally, the survey included exploratory questions (questions 18 and 19) aimed at gathering further insights and suggestions related to wetlands, wetland mitigation banking, current compensatory wetland mitigation requirements, and wetland education. These questions served to supplement the data collected and provided a more comprehensive understanding of participants' perspectives on wetland-related issues. Thematic analysis and content analysis techniques were employed to identify recurring themes, patterns, and sentiments within interview transcripts. Thematic analysis facilitated the systematic coding of interview data to categorize and organize responses, while content analysis aided in scrutinizing interview content to extract meaningful insights.

The selection of a survey method for data collection was justified due to its capability to gather a baseline understanding of Clark County residents' perceptions and experiences related to wetlands. The survey comprised questions addressing participants' demographics, wetland

knowledge, awareness of wetland mitigation, and opinions on compensatory wetland mitigation requirements. Additionally, questions explored the likelihood of supporting an educational model for wetland mitigation and gathered feedback on the adoption of a state-wide wetland mitigation educational model.

Rationale for Survey

These locations were chosen due to their strategic proximity to wetlands, ensuring direct engagement with individuals who are likely to have firsthand experiences or interests in wetland environments. Moreover, these regional parks, Lewisville Regional Park, Salmon Creek Regional Park, Captain William Clark Regional Park, Frenchman's Bar Regional Park, and Whipple Creek Regional Park, were chosen due to their accessibility to all residents of Clark County, thereby maximizing inclusivity and representation within the survey sample. Additionally, since these parks fall under the jurisdiction of Clark County, Washington, conducting the survey within these locations facilitated seamless coordination and compliance with local regulations, enhancing the efficiency of data collection efforts.

To thoroughly address the research aims, this study employed a qualitative design to explore Clark County residents' understanding and attitudes towards wetlands and compensatory wetland mitigation (CWM) programs. A key component of this investigation was a carefully designed survey distributed at strategically selected regional parks across the county, ensuring a diverse representation of the community. This survey was structured to capture a broad spectrum of information. It consisted of Likert Scale questions that assessed participants' familiarity with wetland ecosystems, their understanding of mitigation banking, and their opinions on incorporating educational elements into CWM frameworks. Additionally, open-ended questions provided participants with the opportunity to express their views and insights more freely. The

survey’s design aimed to gather comprehensive data that would inform the identification of educational gaps and measure community support for integrating educational models into existing CWM processes.

The analysis of the survey responses involved thematic coding, which helped to categorize and interpret the data effectively. By examining recurring themes and patterns, the analysis revealed critical insights into residents' knowledge levels and attitudes towards wetlands and CWM programs. The thematic coding process enabled the study to pinpoint specific areas where educational outreach could be beneficial and to evaluate how current perceptions might impact the feasibility of incorporating educational components into CWM frameworks. This approach ensured that the research findings were not only descriptive but also actionable, providing evidence-based recommendations for enhancing CWM effectiveness through targeted educational interventions. By connecting the survey’s structure and contents with the research goals, the study was able to provide a foundational approach for community engagement and inform potential policy changes that could improve wetland conservation efforts.

Results

Awareness and Understanding of Wetlands

The survey results revealed a spectrum of awareness and understanding of wetlands among the Clark County community. I began by coding the responses to uncover recurring themes related to wetland awareness, identifying key themes such as “Ecological Functions of Wetlands,” “Importance of Wetland Conservation,” and “Misconceptions about Wetlands.” Notably, while some participants demonstrated robust knowledge and strong support for wetland conservation, others exhibited significant gaps, particularly regarding the ecological functions of wetlands and the principles underlying compensatory wetland mitigation. To ensure a qualitative statistical approach, I recorded the frequency with which these themes appeared. For example, the theme “Ecological Functions of Wetlands” was evident in 60% of the responses, indicating that a majority of participants recognized the role wetlands play in biodiversity and ecosystem services. Conversely, “Misconceptions about Wetlands” appeared in 30% of responses, highlighting areas where participants' understanding was limited or incorrect.

The thematic analysis unveiled a surprising trend among survey participants, showcasing diverse levels of awareness and comprehension regarding wetlands. Remarkably, over half of the individual participants demonstrated a keen understanding of wetland ecosystems, recognizing them as pivotal habitats crucial for biodiversity and essential ecosystem services. For instance, a participant from Captain William Clark Regional Park remarked, *"Wetlands provide an important space for wildlife and migrating birds. This migration is needed due to birds’ seasonal and reproductive needs."* Similarly, a participant from Whipple Creek Regional Park stated, *“I think wetlands offer home to many native plants and animals and give me an opportunity to learn*

more about my environment." These responses, gathered from question eight of the survey which inquired about participants' prior exposure or experience in wetland areas, illustrate a deep understanding and recognition of wetlands. However, the analysis also revealed that roughly a third of participants exhibited misconceptions or limited awareness of wetlands. A participant from Salmon Creek Regional Park mentioned, *"I don't know much about wetlands. The only times would be if any local Vancouver parks contain them."* Another participant from Whipple Creek Regional Park stated, *"I have spent time in wetland areas, but have little knowledge of them and their functions."* These responses reflect an acknowledgment of wetlands but a lack of understanding about their functions and the processes that impact them.

These findings are pivotal for several reasons. First, they highlight the urgent need for targeted educational interventions to address these knowledge gaps. The data suggests that many residents may not fully grasp the critical role wetlands play in maintaining ecosystem health and mitigating environmental threats such as flooding and water pollution. By identifying these gaps, this research provides a roadmap for developing educational initiatives that can effectively convey the importance of wetlands and the necessity of compensatory wetland mitigation programs. Such initiatives could include community workshops, informational campaigns, and school-based education programs, all designed to increase public understanding and support for these efforts. This, in turn, could lead to greater compliance with mitigation requirements, more effective community advocacy for wetland protection, and ultimately, improved outcomes for wetland conservation and restoration efforts.

Support for Wetland Conservation

The survey responses revealed distinct yet interrelated themes regarding wetland conservation and educational initiatives. The most prominent theme, “Support for Conservation,” was evident across the data, reflecting a broad and passionate endorsement for preserving wetland ecosystems. A significant majority of participants articulated a strong commitment to conservation, accentuating their recognition of wetlands' roles in maintaining biodiversity, improving water quality, and providing essential habitats for wildlife. For instance, a participant from Captain William Clark Regional Park expressed, *"I think we need to preserve wetlands,"* while another from Frenchman’s Bar Regional Park asserted, *“Similar to carbon offsets, we need to preserve and increase current wetlands.”* Additionally, a respondent from Lewisville Regional Park remarked, *“I feel conservation is important and education is a very valuable component to create awareness."* These responses highlight a deep-seated belief in the value of wetlands and an eagerness to support their conservation.

However, this enthusiastic support was tempered by a significant theme of “Concerns about Effectiveness.” Despite the general endorsement of conservation efforts, several participants raised doubts about the efficacy of educational initiatives alone in driving meaningful change. They questioned whether educational programs would sufficiently alter behaviors or achieve their intended outcomes without accompanying practical measures or policy actions. For example, a participant from Captain William Clark Regional Park noted, *"I have doubts that education would have much impact. I think requiring mitigation action is better,"* and another from the same park commented, *"It sounds like a good idea, but education shouldn’t be the only alternative."* These critiques reflect a concern that while education is

valuable, it may not be a standalone solution for addressing the complex issues surrounding wetland conservation. To validate these findings, I cross-referenced responses across different parks and demographic groups. This cross-referencing revealed a consistent theme of support for conservation across locations such as Captain William Clark Regional Park, Whipple Creek Regional Park, and Salmon Creek Regional Park. Participants from diverse parks demonstrated a unified stance on the importance of conserving wetlands.

Conversely, concerns about the effectiveness of educational initiatives varied among respondents. While some expressed skepticism, others remained optimistic about the potential impact of education. This variation in responses indicates a broader debate on the most effective strategies for promoting conservation. These insights highlight the necessity for a comprehensive approach that combines the strong support for conservation with strategies to address concerns about educational effectiveness. The widespread endorsement of conservation provides a solid foundation for educational initiatives, yet the skepticism emphasizes the need for integrating educational efforts with practical, action-oriented measures. By addressing these concerns and enhancing the impact of educational programs, we can better align public attitudes with actionable conservation efforts, ultimately leading to more effective wetland preservation and restoration.

Desire for Education and Learning

Many survey participants exhibited a strong desire for further education and awareness about wetlands. This eagerness to engage in educational opportunities was coupled with a proactive readiness to seek out comprehensive information about wetlands. For instance, a participant from Lewisville Regional Park expressed their concern about developers impacting

wetlands, stating, *"I'm not sure I'm in favor of developers impacting existing wetlands in the first place. More public education would be helpful."* Another respondent from the same park voiced support for a state-wide educational model, noting, *"I would favor such a model because I feel conservation is important and education is a very valuable component to create awareness."*

In exploring participants' educational desires further, thematic analysis uncovered a range of preferences regarding how they wished to engage with wetland education. Many respondents indicated a need for more accessible and practical information dissemination. For example, when asked about suggestions for improving wetland education, a participant from Lewisville Regional Park highlighted the need for more readily available park information, specifically tailored for recreational users who want to minimize their impact on the ecosystem. They commented, *"I wish there was more park information available on site for people who hold recreational interests and want to be conscious of their ecosystem disturbance."* Similarly, a participant from Salmon Creek Regional Park emphasized the importance of education in understanding the broader impacts of wetlands, stating, *"Education on this topic seems important to understanding wetland effects on the surrounding areas."* These responses emphasize a strong call for enhanced educational resources through non-traditional academic channels.

Overall, the responses reveal a dominant interest in educational initiatives, correlating strongly with the perceived lack of knowledge about wetlands among Clark County residents. Most participants expressed a clear desire for educational opportunities, whether through self-directed learning or structured programs. These insights highlight the necessity of developing educational frameworks that cater to community needs, supporting the implementation of a state-

wide wetland mitigation educational model. In assessing participants' interest in educational initiatives, several prominent themes emerged. One key theme was the *"Desire for Education,"* with many respondents clearly eager to obtain more information about wetlands. This theme was closely followed by *"Suggestions for Educational Formats,"* reflecting participants' preferences for how educational content should be delivered. Common suggestions included workshops, community-based learning opportunities, and interactive experiences. These findings reveal a strong demand for structured and engaging educational formats that could enhance understanding and involvement in wetland conservation.

Over 65% of participants expressed a strong interest in increased education about wetlands, a trend consistent across various demographic groups, including different age ranges, educational backgrounds, and park locations. This widespread desire for enhanced educational resources highlights a significant opportunity for developing targeted programs. By offering workshops, informational sessions, and community events, we can address the expressed needs and preferences of the community, fostering greater awareness and support for wetland conservation.

Concerns about Environmental Mismanagement

Several participants expressed substantial concerns regarding environmental mismanagement linked to human activities, reflecting both governmental and private developer perspectives. These concerns highlight a broader distrust and skepticism about the effectiveness of current wetland management and regulatory frameworks. For instance, a participant from Captain William Clark Regional Park voiced apprehensions about the misuse of wetland requirements, stating, *"I am always concerned of wetland mitigation requirements being*

weaponized." This sentiment reflects a fear that regulatory measures intended to protect wetlands could be manipulated or exploited for ulterior motives.

In a similar vein, a participant from Frenchman's Bar Regional Park conveyed significant reservations about adopting a state-wide wetland mitigation educational model. They expressed concerns about the current government's role in implementing and executing such a model, noting, *"I would have heavy reservations on adopting this model since this would involve current government implementing and executing."* Their concern centered on the potential compromise of wetlands due to the perceived need for housing or development, as they explained, *"That wetlands would be compromised due to a 'need' for housing or the like."* Additionally, a survey participant from Whipple Creek Regional Park emphasized the necessity of incorporating nature into development plans, stating, *"Keeping nature at the forefront of our plans for development should be a top focus."* Another participant expressed a lack of awareness about governmental management of wetlands, highlighting the need for better public education. They remarked, *"There seems to be more information about government management of wetlands that I'm not aware of."*

These responses illustrate a pronounced desire for improved educational initiatives to address the current distrust in governmental procedures and private developers. As one participant from Whipple Creek Regional Park noted, *"Hopefully an informed community will make better decisions than the alternative. And the fight against misinformation and corporate propaganda is a long one."* This comment stresses the perceived gap between policy intentions and practical outcomes, emphasizing the need for a more informed and engaged public. The thematic analysis revealed that approximately 20% of survey responses highlighted concerns about mismanagement and a lack of trust in regulatory and developmental entities responsible

for wetland conservation. Participants questioned the effectiveness of existing regulatory frameworks, particularly regarding their ability to address the complexities of wetland preservation and enforce regulations rigorously. These concerns point to a broader need for increased transparency and accountability in wetland management practices.

Overall, the findings suggest that addressing these concerns requires not only enhancing public education about current wetland processes but also improving the credibility and effectiveness of regulatory practices. Implementing educational initiatives that clarify regulatory frameworks and emphasize the importance of stringent enforcement could help bridge the gap between policy and practice, fostering greater trust and support for wetland conservation efforts.

Local Context and Environmental Perception:

Local context and environmental perception had a significant impact on participants' responses, shaping their understanding and attitudes towards wetland conservation. Individuals residing in areas rich with wetland resources or those actively involved in conservation efforts demonstrated heightened awareness and support for wetland preservation. For example, a participant from Frenchman's Bar Regional Park, a resident of New Mexico who was not frequently engaged with the park but exhibited remarkable knowledge about wetlands, illustrates this trend. This non-Hispanic white individual, over 65 years old with a PhD, showed a sophisticated understanding of wetland ecosystems. They emphasized wetlands' crucial role as habitats for aquatic and avian species and their function as buffers against water fluctuations. When asked about wetland mitigation, the participant described it as *"the repair or maintenance of wetlands to benefit the local ecosystem."* Their understanding extended to compensatory wetland mitigation, where they articulated that it involves *"offsetting potential harm to wetlands*

caused by industrial construction and human activities." The participant further remarked, *"This survey motivates me to research the wetland policies and practices in New Mexico."*

In contrast, a participant from Salmon Creek Regional Park, who self-identified as Caucasian, aged between 35 and 44, with an Associate's degree or trade school equivalent, and originally from Chicago but not a Washington resident, provided insights reflective of their urban background. When asked about their familiarity with wetland areas before the survey, they admitted, *"Not much, I grew up in Chicago with mostly an urban upbringing."* Despite their limited prior knowledge about wetland mitigation or compensatory wetland mitigation, they expressed support for educational efforts, stating, *"Yes! Education surrounding nature and sustainability is always welcome."* Conversely, a resident of Washington State, identifying as White, aged between 18 and 24, and holding a bachelor's degree, demonstrated a deep familiarity with wetlands. Having grown up enjoying wetland and rainforest areas, this individual provided a detailed understanding of wetland ecosystems. They shared, *"I grew up enjoying wetland and rainforest areas, both academically and recreationally. I have a decent understanding of ecosystem cycles, particularly biological, in wetland regions mostly from living near them."* They elaborated on their knowledge, noting, *"life and mating cycles, seasonal cycles, basic plant life cycles, macro and micro invertebrates' cycles."*

These findings highlight the critical role of local context and environmental perception in shaping educational initiatives. Participants' proximity to wetland areas and their engagement with environmental issues deeply influenced their attitudes and perceptions toward wetland conservation and educational outreach. Those with direct experience or a background in environmental studies provided more nuanced and informed responses, suggesting that localized exposure to wetlands enhances understanding and appreciation. To maximize the effectiveness of

conservation education initiatives, it is essential to tailor programs to meet the specific needs and priorities of different demographic groups, based on their local context. This approach can improve public participation in wetland preservation efforts and ensure that educational programs effectively address the unique challenges and opportunities within various communities.

Lack of Understanding and Awareness:

Despite generally positive attitudes towards wetland conservation, a notable number of participants exhibited gaps in their understanding of wetlands, mitigation processes, and environmental regulations. These gaps were evident in both misconceptions and admissions of limited knowledge. For instance, responses to question 9, which asked participants about their familiarity with wetland mitigation, revealed significant misunderstandings. One participant from Whipple Creek Regional Park initially claimed to be familiar with wetland mitigation but described it inaccurately, stating, *"Yes. My understanding of wetland mitigation is to remove them by drying them up and covering them up with fill dirt, likely for development of the land."* This response indicated a fundamental misunderstanding of the concept, as wetland mitigation involves compensating for the loss of wetland functions, rather than simply removing them for development. When the same participant was later asked about compensatory wetland mitigation in questions 12 and 14, they admitted to not knowing the term or its requirements, stating, *"No. I am not familiar with this term or with the requirements."* This discrepancy highlights a critical gap in understanding and pinpoints the necessity for targeted educational interventions.

Additional responses further illustrate these gaps. A participant from Frenchman's Bar Regional Park admitted, *"I have never spent time in a wetland to my knowledge. I believe*

wetlands are almost like swamps," suggesting a basic confusion between wetlands and swamps. Similarly, a participant from Lewisville Regional Park acknowledged, *"Yes, but my understanding is low,"* indicating a recognition of their limited knowledge about wetlands. These examples reveal that while there is general support for wetland conservation, there are significant areas of misunderstanding and incomplete knowledge. The thematic analysis of responses showed recurring themes of misconceptions about wetland mitigation processes and their effectiveness. To address these issues, it is crucial to develop and implement comprehensive educational programs that clearly explain wetland functions, mitigation processes, and broader ecological impacts. Such programs will help bridge the existing knowledge gaps and foster a more informed and engaged community in wetland conservation efforts.

Inferred Influences from Demographical Data

As I delved into the demographic factors influencing participants' attitudes and understanding of wetlands, it became increasingly apparent that variables such as age, educational level, cultural identity, and frequency of park visitation all play pivotal roles in shaping their perspectives. This nuanced analysis reveals a complex interplay of factors that contribute to varying levels of awareness and support for wetland conservation.

Age and Educational Level

The analysis consistently indicated that older individuals and those with higher educational qualifications exhibited a deeper awareness and greater support for wetland conservation. This correlation is significant, suggesting that both the accumulation of life experience and advanced education contribute to a more informed understanding of ecological issues. It is often believed that older participants, drawing from decades of life experience, often

have a broader perspective on environmental changes and may have witnessed firsthand the impacts of ecological degradation. Meanwhile, higher educational attainment often equips individuals with a more comprehensive grasp of environmental science and conservation principles. This suggests that educational strategies should consider the varying levels of environmental knowledge associated with different age groups and educational backgrounds.

Cultural Identity

Cultural identity also emerged as a factor influencing participants' views on wetlands. The ethnic and cultural backgrounds of the respondents shaped their perceptions and connections to these ecosystems. For instance, Indigenous participants frequently possess a deep-rooted cultural connection to wetlands, viewing them not just as ecological features but as integral components of their cultural heritage and environmental stewardship practices. This perspective highlights the importance of acknowledging and incorporating Indigenous knowledge and values into conservation efforts.

Conversely, participants from other cultural backgrounds might emphasize different aspects of wetlands, such as their economic value or recreational opportunities. These varied perspectives feature the need for a multifaceted approach to wetland education that respects and integrates diverse cultural viewpoints. Understanding these cultural nuances can help tailor educational programs to resonate more deeply with different communities, thereby enhancing their effectiveness and inclusivity.

Frequency of Park Visitation

The frequency of park visitation also significantly impacted participants' knowledge of wetlands. Those who engaged regularly with natural spaces, such as parks and wetlands,

demonstrated a more thorough understanding of wetland ecosystems compared to infrequent visitors. This observation highlights the beneficial role of direct interaction with natural environments in fostering environmental awareness. Regular exposure to wetlands can enhance individuals' appreciation of their ecological functions and the importance of conservation efforts.

Encouraging frequent visits and interactions with wetlands could therefore be a valuable component of educational initiatives. Programs that facilitate hands-on experiences, such as guided tours, volunteer opportunities, and community events centered around wetland conservation, can help deepen public understanding and engagement. By making wetlands more accessible and providing opportunities for direct engagement, these initiatives can promote a stronger connection to and support for conservation efforts.

Implications for Compensatory Wetland Mitigation Programs

Based on my analysis, integrating tailored educational programs into compensatory wetland mitigation (CWM) efforts is not merely beneficial but crucial for enhancing public understanding, support, and involvement in wetland conservation. The data from this study highlights significant gaps in public knowledge that, if left unaddressed, could undermine the effectiveness of CWM programs. To bridge these gaps and improve CWM outcomes, it is essential to incorporate targeted educational initiatives into the CWM process.

Tailoring Educational Programs

From the findings, it is evident that educational programs need to be meticulously tailored to address the specific needs and knowledge gaps of different demographic groups. Aligning educational content with varying cultural backgrounds, educational levels, and age-related experiences ensures that the information is relevant and engaging. For instance, programs

aimed at older adults could focus on the historical changes in wetlands and their impacts, offering a broader context for understanding current conservation needs. Conversely, educational initiatives for younger audiences might leverage interactive elements and modern technology to capture their interest. Moreover, culturally tailored programs should reflect the diverse values and practices related to wetlands, promoting a more inclusive approach to conservation education.

Promoting Frequent Interaction

Encouraging more frequent and meaningful interactions with wetlands is another critical component. My research indicates that regular engagement with natural spaces, such as through park visits or community-based activities like wetland cleanups and educational workshops, plays a significant role in enhancing public knowledge and support for conservation. Individuals who have direct, repeated experiences with wetlands are more likely to become advocates for conservation efforts. Therefore, creating opportunities for frequent engagement is vital for developing a more informed and proactive public.

Fostering a Culture of Stewardship

Fostering a culture of stewardship through education is fundamental to the success of CWM programs. Providing the community with a deeper, nuanced understanding of wetlands and the importance of mitigation efforts cultivates a sense of responsibility and accountability. When individuals are well-informed about the ecological significance of wetlands and the role of CWM, they are more inclined to support stricter enforcement of mitigation requirements, advocate for stronger conservation policies, and engage in local protection efforts.

Ensuring Sustainable Frameworks

Ultimately, the effectiveness of CWM programs hinges on the support of an informed and engaged public. Addressing specific demographic needs through targeted educational strategies will not only bridge existing knowledge gaps but also contribute to more effective and sustainable wetland conservation practices. The findings from this study show that integrating education into CWM processes is a core element, not an ancillary component, essential for creating a sustainable framework for wetland preservation. Effective collaboration among government agencies, educational institutions, conservation organizations, and local communities will be crucial in developing and implementing these educational initiatives successfully.

In summary, the findings from this study reinforce the notion that integrating tailored educational programs into compensatory wetland mitigation (CWM) efforts is crucial for enhancing public understanding, support, and involvement in wetland conservation. The diverse demographic factors identified, such as age, educational level, cultural identity, and park visitation frequency, highlight the necessity of addressing specific needs and fostering a culture of stewardship through targeted educational initiatives. These programs are not merely supplementary but are integral to the success of CWM efforts. Effective environmental education can drive the success of CWM programs by providing the community with a deeper, more nuanced understanding of wetlands and the importance of mitigation. This enhanced understanding cultivates a culture of stewardship and accountability, which is vital because CWM programs rely not only on regulatory enforcement but also on public buy-in and advocacy. An informed and engaged community is more likely to support stricter enforcement of CWM requirements, advocate for stronger conservation policies, and actively participate in local

wetland protection efforts. Therefore, the implications of this research extend far beyond raising awareness; they advocate for the integration of education as a core component of CWM processes. By tailoring educational components to address the specific knowledge gaps and needs identified within the Clark County community, these initiatives can create a sustainable framework for wetland conservation. This approach ensures that CWM programs are supported by an informed, proactive public, leading to more robust and enduring conservation outcomes.

Discussion

In the initial phase of my study, I aimed to employ a quantitative survey approach, engaging with Clark County residents to delve into their perceptions and attitudes about wetlands. Designing this survey, such as the one below involved careful thought about the questions asked, ensuring they captured the nuanced perspectives and knowledge residents had with wetlands. I planned to set up designated stations at various parks frequented by locals, introducing the survey purpose and inviting voluntary participation. The survey instrument served as a crucial tool for capturing both qualitative and quantitative data on participants' demographics, wetland knowledge, awareness of wetland mitigation banking, and opinions on compensatory wetland mitigation requirements. The questions, meticulously designed and outlined in the attached document, were crafted to elicit specific insights necessary for addressing the research objectives. The development of the survey instrument involved a systematic process. This research gathered new data through the procedure of conducting public surveys about wetlands and wetland functions during designated park presence times, inviting park visitors to participate voluntarily.

The thematic analysis unveiled varying levels of awareness and understanding among participants regarding wetlands, highlighting the need for educational interventions. While some demonstrated comprehensive knowledge of wetland ecosystems and their functions, others exhibited limited understanding. Despite these differences, there was consistent support for wetland conservation across participants, with many advocating for proactive conservation measures and educational initiatives. This emphasizes the importance of fostering a culture of

environmental stewardship through targeted educational efforts, particularly in the form of a state-wide wetland mitigation educational initiative.

Contextual influences, such as residency status and familiarity with local environments, significantly shaped participants' perceptions of wetlands and attitudes toward conservation efforts. Those intimately acquainted with local wetlands expressed deep appreciation for these ecosystems, while others emphasized the need for increased awareness and engagement. Demographic factors like age, education, and cultural identity intersected with attitudes toward wetland conservation, with older participants exhibiting higher levels of education, awareness, and support for conservation efforts. Participants overwhelmingly expressed support for wetland conservation efforts, emphasizing the importance of preserving wetland habitats for biodiversity and ecosystem services. However, variations in the degree of support and discrepancies between attitudes and actions were observed, suggesting potential barriers to translating attitudes into action. Addressing these discrepancies requires a comprehensive approach that integrates educational, regulatory, and community engagement strategies, including the implementation of a state-wide wetland mitigation educational initiative to mobilize public support for conservation initiatives. Additionally, many survey participants expressed a strong desire for further education and indicated a willingness to actively seek out information about wetlands.

Moreover, the influence of local context and environmental perception on participants' attitudes toward wetland conservation was evident, illuminating the complex and multifaceted nature of wetland conservation challenges. Participants' uncertainties about the effectiveness of conservation efforts and the potential consequences of environmental decisions point to the need for transparency, accountability, and ongoing monitoring and evaluation in conservation practices. Implementing a wetland mitigation educational initiative or broader environmental

education programs can help address these uncertainties and promote informed decision-making among Clark County residents.

Overall, these findings emphasize the importance of targeted educational and outreach efforts in addressing gaps in understanding and concerns about mismanagement to foster informed decision-making and sustainable environmental practices. Leveraging these insights to inform conservation strategies and outreach efforts, including the implementation of a state-wide wetland mitigation educational initiative, can promote public engagement and ensure the long-term sustainability of wetland ecosystems. Further research should explore the effectiveness of specific conservation interventions and outreach strategies in promoting public awareness and engagement.

Conclusion

In conducting this study, I have gained valuable insights into the perceptions and attitudes of Clark County residents regarding wetlands. The analysis of survey data from a diverse participant pool has illuminated both strengths and gaps in community awareness and engagement. These findings have profound implications for the future of wetland conservation efforts and provide a clear path forward for enhancing public understanding and support.

Implications for Wetland Conservation Efforts

The results highlight a critical need to address gaps in community knowledge through targeted educational interventions. My analysis reveals that by identifying and addressing specific misconceptions and areas of limited understanding, we can develop educational programs that significantly enhance public knowledge and foster a stronger sense of stewardship. This targeted approach will help ensure that conservation efforts garner widespread support and active participation from residents.

Moreover, the insights gained from this study are instrumental in shaping policy decisions, resource allocation, and strategic planning for wetland conservation initiatives at local, regional, and state levels. Understanding community preferences and priorities allows us to design and implement effective conservation strategies that align with the values and needs of the residents. This alignment is crucial for ensuring that conservation efforts are not only effective but also supported by the community.

Recommendations for Future Research

Based on the findings, I recommend that future research delve deeper into specific aspects of wetland conservation and education. Investigating the effectiveness of various

educational outreach methods and evaluating the long-term impacts of conservation interventions will provide a more comprehensive understanding of how to engage and educate the public effectively. Additionally, examining the influence of demographic factors on attitudes toward wetlands can help refine our educational strategies and conservation efforts. Longitudinal studies that track changes in community awareness and support over time will offer valuable insights into the dynamics of environmental attitudes and behaviors. These studies can help assess the effectiveness of educational initiatives and the evolving nature of community engagement with wetland conservation. Furthermore, fostering interdisciplinary research collaborations can enrich future understandings of wetland conservation challenges and unforeseen opportunities. Such collaborations can drive the development of innovative solutions and best practices for conserving wetland ecosystems. The following detailed recommendations aim to provide clarity and guidance for addressing future research:

Evaluate Educational Outreach Methods

Assess Effectiveness of Different Strategies

- Conduct comparative studies of various educational outreach methods, such as interactive workshops, community seminars, digital platforms, and school-based programs. Utilize mixed methods to measure their effectiveness in enhancing knowledge and engagement. For instance, pre- and post-assessment surveys could evaluate changes in participants' understanding of wetland functions and conservation.
- Explore the use of multimedia tools, such as interactive apps, to simulate wetland environments and conservation scenarios. Assess their impact on increasing public awareness and engagement compared to traditional methods.

Pilot and Evaluate Educational Models

- Implement pilot programs that integrate educational components into compensatory wetland mitigation (CWM) efforts. For example, create a model where developers purchase educational credits that fund local wetland education initiatives. Evaluate these pilots through both qualitative feedback from participants and quantitative measures of knowledge gain and behavioral changes.
- Monitor and document the implementation process, including stakeholder engagement, program effectiveness, and community response. Use this data to refine and scale successful models.

Conduct Longitudinal Studies

Track Changes in Community Awareness

- Design longitudinal studies to track shifts in community awareness, attitudes, and behaviors related to wetland conservation over time. Conduct baseline surveys followed by periodic follow-ups to measure the impact of educational initiatives and conservation interventions.
- Use data analytics to identify trends and correlations between educational activities and changes in public perceptions and behaviors.

Assess Long-Term Impact of Educational Programs

- Evaluate the long-term effects of educational programs on community engagement with wetland conservation. This can include tracking participation in conservation activities, changes in volunteerism, and support for wetland protection policies.

- Investigate how sustained education influences community support for and compliance with CWM requirements and conservation efforts.

Examine Demographic Influences:

Analyze Attitudes by Demographic Factors

- Perform in-depth analyses of how different demographic factors (age, education, income, cultural background) affect attitudes toward wetlands and conservation. Segment survey data to identify specific needs and preferences within various demographic groups.
- Develop targeted educational strategies based on demographic insights. For example, tailor educational content to address the unique concerns and interests of different age groups or cultural communities.

Customize Educational Materials

- Create culturally and contextually relevant educational materials. Involve community members in the development of these materials to ensure they resonate with diverse audiences and address specific concerns.

Foster Interdisciplinary Research

Promote Collaborative Research

- Facilitate interdisciplinary research collaborations involving academia, government agencies, non-profit organizations, and the private sector. These collaborations can address complex wetland conservation challenges and develop innovative solutions.

- Organize workshops, conferences, and joint research initiatives to share knowledge and resources among stakeholders. Establish research partnerships that focus on both theoretical and applied aspects of wetland conservation.

Develop Best Practices

- Use collaborative research findings to develop and disseminate best practices for wetland conservation and education. Create comprehensive guidelines that incorporate insights from various disciplines and stakeholders.

Expand Community Involvement

Engage in Participatory Research

- Utilize participatory research methods to involve community members in the research process. This includes conducting focus groups, public forums, and community-based participatory research projects to gather diverse perspectives and feedback.
- Incorporate community input into the design and implementation of educational programs and conservation initiatives. Ensure that community voices are heard and addressed in decision-making processes.

Strengthen Community Partnerships

- Build and maintain strong partnerships with local community organizations, schools, and businesses to enhance outreach and engagement efforts. Collaborate on joint initiatives that promote wetland education and conservation.

Enhance Policy and Advocacy Efforts

Support Policy Integration

- Advocate for the integration of educational components into state and local wetland mitigation policies. Provide evidence-based recommendations to policymakers on the benefits of incorporating education into CWM frameworks.
- Develop policy briefs and reports that highlight the advantages of educational approaches and offer practical recommendations for policy implementation.

Promote Public Advocacy

- Encourage community advocacy and involvement in wetland conservation issues. Use survey findings to inform public awareness campaigns and advocacy efforts that support wetland protection and education.
- Engage with local media and community leaders to raise awareness and build support for educational initiatives and conservation policies.

In conclusion, this study has revealed significant insights into the level of understanding and awareness of wetlands among residents of Clark County. The findings not only highlight an urgent need to integrate wetland education into government policies, especially within compensatory wetland mitigation (CWM) programs, they also stress the need for a well-informed and engaged public to achieve sustainable conservation outcomes. The findings of this study noticeably show that current educational efforts are not sufficiently addressing the lack of wetland knowledge and mitigation processes within Clark County residents. Therefore, it is

imperative to refine and expand educational strategies to help bridge existing knowledge gaps and creating others.

Looking forward, future research should continue to explore factors influencing community attitudes and the effectiveness of different educational approaches. Continued research in this topic will contribute to the development of more effective conservation strategies and strengthen community commitment and capacity towards environmental stewardship. My hope is that these findings have encouraged survey participants to seek out more information regarding knowledge about wetlands, as well as raising awareness and understanding of wetland issues amongst readers and Clark County residents. I believe that continued research into mandatory-educational-initiatives tied to governmental processes will lead to more informed decision-making and sustainable development practices that not only enhance public understanding but also strengthen our collective commitment to preserving these vital ecosystems for future generations.

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