Journal of Agriculture

Effects of Human Encroachment on Wetlands: A Case of Boreal Shield, Canada

Barlow Liepert Kuijper, Arnold Lloyd Wang & Ron Viersen Goodrich

ISSN: 2616-8456

Stratford Peer Reviewed Journals and Book Publishing
Journal of Agriculture
Volume 7||Issue 1 ||Page 12-21||June||2023|
Email: info@stratfordjournals.org ISSN: 2616-8456

Effects of Human Encroachment on Wetlands: A Case of Boreal Shield, Canada

[1*] Barlow Liepert Kuijper, [2]Arnold Lloyd Wang & [3]Ron Viersen Goodrich
[1*]Postgraduate Student, McGill University
[2,3]Lecturers, McGill University
***Email of the corresponding author: barliepkuijper@gmail.com**

How to cite this article: **Kuijper, B. L., Wang, A. L., & Goodrich, R. V. (2023). Effects of Human Encroachment on Wetlands: A Case of Boreal Shield, Canada.** ***Journal of Agriculture, 7*****(2), 12-21. https://doi.org/10.53819/81018102t5173**

Abstract

Wetlands are some of the most productive ecosystems on the planet and provide a wide range of ecological, economic, and social benefits. Wetlands are threatened by human activities such as agriculture, urbanization, resource extraction, and infrastructure development, which can lead to their degradation and loss. Wetland loss can result in reduced water quality, increased erosion, and decreased biodiversity, which can impact the health of ecosystems and the species that depend on them. The study found that human encroachment on wetlands in Canada has resulted in significant wetland loss and degradation. Wetland loss and degradation can lead to the loss of plant and animal species that depend on these ecosystems. It was noted that wetland loss is a major contributor to the decline of many bird species, including waterfowl and shorebirds. Wetlands support important industries such as forestry, agriculture, and fisheries, and provide recreational opportunities for Canadians, such as fishing, hunting, and wildlife watching. The study concluded that human activities such as agriculture, urbanization, resource extraction, and infrastructure development have led to the degradation and loss of wetlands across the country. The loss of wetlands has had a significant impact on the environment. Wetlands act as natural water filters, helping to purify water by removing pollutants and sediments. The loss of wetlands has also had economic and social impacts. Wetlands provide a range of valuable resources, including timber, peat, fish, and wildlife, which support local economies and communities. The study recommended that the Canadian government should implement more stringent wetland protection policies and regulations. This could include increasing the amount of wetlands protected under legislation, improving enforcement measures, and establishing penalties for those who violate wetland protection regulations. Public education and outreach programs should be developed and implemented to raise awareness about the importance of wetlands and the negative impacts of human encroachment.

Keywords: *Human Encroachment, Wetlands, Canada*

1.0 Background of the Study

The Boreal Shield is a vast ecosystem that covers a significant portion of Canada's land area (Morison, Higgins, Webster, Emilson, Yao & Casson, 2022). It is situated in the northern regions of the country, spanning across several provinces and regions, like Ontario, Quebec, Manitoba, Saskatchewan, and the Northwest regions. The region is characterized by its rugged terrain, numerous lakes and rivers, and dense forests dominated by coniferous trees. The forests in the Boreal Shield are considered some of the largest and most intact in the world, and they play a critical role in global carbon storage (Markle, Gage, Tekatch, Wilkinson & Waddington, 2022). It is also home to a diverse array of wildlife species, including moose, black bears, wolves, lynx, beavers, and a variety of bird species. Many of these species are endemic to the region and are culturally significant to Indigenous communities who have lived in the area for thousands of years. Indigenous communities in the Boreal Shield rely on the region's natural resources for their livelihoods, including hunting, fishing, and gathering wild plants (Macfarlane & Olive, 2021). They also have a deep spiritual and cultural connection to the land, and their traditional knowledge is critical for the conservation and management of the ecosystem. However, the Boreal Shield is also under threat from resource extraction activities, including mining, oil and gas development, and forestry. These activities can have substantial impacts on the environment, like habitat destruction, pollution of water, and greenhouse gas emissions. Efforts are underway to balance conservation and resource development in the Boreal Shield. These efforts involve collaboration between government, industry, and Indigenous communities to ensure that the ecosystem is protected while also supporting sustainable economic development.

Wetlands are defined as places that are continuously or seasonally saturated with water (Pipan & Culver, 2019). They are some of the most productive ecosystems on the planet and provide a wide range of ecological, economic, and social benefits. Wetlands are found in both freshwater and saltwater environments, and can include marshes, swamps, bogs, and fens. They are home to a wide range of plant and animal species, many of which are unique to wetland environments. Wetlands are important for water purification, flood control, and erosion control (Hammer & Bastian, 2020). They also provide habitat for migratory birds, fish, and other wildlife, and are important for recreational activities such as fishing, hunting, and bird watching. Despite their importance, wetlands are threatened by human activities such as agriculture, urbanization, resource extraction, and infrastructure development, which can lead to their degradation and loss. Efforts to protect and restore wetlands are critical to ensuring their continued ecological, economic, and social benefits for future generations.

Human encroachment refers to the expansion of human activities into natural areas that were previously uninhabited or less developed (Saridnirun, Sukumal, Grainger & Savini, 2021). This can include the construction of buildings, roads, and other infrastructure, the clearing of land for agriculture or other purposes, and the extraction of natural resources. As a result, human encroachment can have significant negative impacts on natural ecosystems and the wildlife that depend on them. Bai, Xiu, Feng and Liu (2019) reported that human encroachment is often driven by population growth, urbanization, and economic development, and is a major contributor to habitat loss and biodiversity decline. Efforts to mitigate the negative effects of human encroachment on natural areas include conservation and restoration efforts, sustainable land use practices, and public education and outreach.

https://doi.org/10.53819/81018102t5173

Wetlands are an important part of the Canadian landscape, covering approximately 14% of the country's land area (Amani, Mahdavi, Afshar, Brisco, Huang, Mohammad Javad Mirzadeh & Hopkinson, 2019). Canada has a diverse range of wetland ecosystems, including bogs, fens, marshes, swamps, and wet meadows, which provide important habitat for a variety of plant and animal species. Wetlands in Canada provide a range of ecological, economic, and social benefits. They are important for water purification, as wetlands filter pollutants and sediments from water, and help regulate water flow, reducing the risk of floods and droughts. Wetlands also provide habitat for a wide range of plant and animal species, most of which are rare or endangered. In addition, wetlands support important industries such as forestry, agriculture, and fisheries, and provide recreational opportunities for Canadians, such as fishing, hunting, and wildlife watching (Balwan & Kour, 2021).

Despite their importance, wetlands in Canada are under threat from human activities. Zou, Ziegler, Chen, McNicol, Ciais, Jiang and Zeng (2022) noted that wetland loss and degradation have been significant in Canada, with some estimates suggesting that as much as 70% of Canada's original wetlands have been lost or degraded due to human activities. To address the loss of wetlands in Canada, various conservation and restoration efforts have been implemented. These include wetland protection policies, wetland restoration projects, and public education and outreach programs. In addition, partnerships between governments, Indigenous communities, and other stakeholders have been established to develop strategies for wetland conservation and management. Efforts to protect and restore wetlands in Canada are critical to ensuring their continued ecological, economic, and social benefits. Wetlands are a valuable resource that provide important ecosystem services and support important industries and communities (Saikia, 2019). By working together to protect and restore wetlands, Canadians can help ensure a healthy and sustainable future for these important ecosystems.

According to Nayak and Bhushan (2022), human encroachment on wetlands in Canada has resulted in significant wetland loss and degradation, which can have negative impacts on both the environment and human communities. Wetland loss can result in reduced water quality, increased erosion, and decreased biodiversity, which can impact the health of ecosystems and the species that depend on them. Wetlands also play a critical role in mitigating the impacts of climate change by storing carbon and regulating water flow, and their loss can exacerbate the effects of climate change. Encroachment on wetlands in Canada is driven by various factors, including population growth, urbanization, and economic development (Tian, Xu, Gao, Liu & Han, 2023). Agriculture and resource extraction activities, such as logging and mining, can also lead to wetland loss and degradation. In addition, infrastructure development, such as the construction of roads, highways, and buildings, can result in the destruction or fragmentation of wetland habitats.

Efforts to address the encroachment of wetlands in Canada include wetland protection policies, wetland restoration projects, and public education and outreach programs (Lecciones, Serrona, Devanadera, Lecciones & Yu, 2022). Wetland conservation efforts can involve the establishment of protected areas, the restoration of degraded wetlands, and the implementation of sustainable land use practices that take into account the importance of wetlands. Additionnally, partnerships between governments, Indigenous communities, and other stakeholders can be established to develop strategies for wetland conservation and management. These efforts can help ensure the

continued ecological, economic, and social benefits of wetlands in Canada, and ensure that these valuable ecosystems are protected for future generations.

2.0 Literature Review

Fok (2020) conducted study was to explore the impacts of human encroachment on the Jurong Lake Gardens in Singapore. To research 102 families close to this site, and the Director of the Wildlife Department, descriptive and cross-sectional designs were used. Quantitative information was gathered from household heads using interview schedules, while qualitative information was gathered from the Director of the Wildlife Department using interview guides. The quantitative data was analyzed using descriptive statistics including means, modes, medians, percentages, and the Mann Whitney U test. The qualitative data were provided in the form of dialogues. The study discovered seasonal and persistent spatiotemporal alterations in the Jurong Lake Gardens. These were seen in the land's size, saturation, and vegetation cover. The most detrimental land use on the site was development, which had taken over major sections of the property and was increasing bare surface areas in the wetlands. The main cause of encroachment on the Jurong Lake Gardens was the corruption and lack of oversight of authorities who permitted estate developers to exploit the sites for building. It was suggested that the Wildlife Department conduct environmental education in the villages surrounding the Jurong wetlands. Collaboration among various environmental protection institutions was also advised for the implementation of environmental regulations against encroachment on wetlands. The families were asked to report any unlawful wetlands land uses to the appropriate environmental protection authorities for action and reparation.

According to Yang, Han, Liu, Li, Pan and Xu (2022), the greatest threat to Edithvale-Seaford Wetlands ecosystems is presented by expanding and dimensionless anthropogenic activities that invade and modify them biologically, frequently for short-term human use. The primary goals of this research were to determine the amount of wetland temporal changes between 2010 and 2019, as well as the causes and implications of human wetland invasion. GIS and remote sensing techniques were utilized to evaluate high-resolution satellite images acquired in 2012, 2017, and 2019, and ground investigations including interactions between wetland populations. The findings show that the regions covered by varied wetland vegetation were 89.4% of total land cover in 2012, which subsequently fell to 80.2% in 2017, and ultimately 78.9% in 2019. Murrum (laterite soil) deposited areas increased across the wetland system. The proportion of smallholder agricultural lands climbed from 1.3% in 2012 to 2.7% in 2017 and 8.9% in 2019. Settlements also increased in 2017, rising from 4.3% to 8.9%. Encroachments are mostly caused by excessive population pressure, ineffective enforcement of wetland restrictions, and political involvement. Due to development, the wetland's area is rapidly shrinking. This process is divided into phases: murram depositing, tree planting, farming operations, and later settlements. This study reveals significant flaws in Edithvale-Seaford Wetlands monitoring methods for wetland protection and sensible usage.

Rawat and Yadav (2021) performed study to expose the influence of human activities on Tamaranga (beel) wetland in Bongaigaon district, Assam, India. The wetland, which covers an area of 627 acres, is located at 260 19'08"N latitude and 900 34'19"E longitude in Assam's Bongaigaon district. It is one of the inland wetlands that disrupts physical, chemical, and biological

processes in an ecosystem while also controlling climatic conditions. The major human activity are the usage of wetland areas for various natural wetland purposes. The average annual rainfall is 3000mm, with maximum and lowest temperatures of 360 degrees Celsius and 70 degrees Celsius, respectively. The current study focuses on the influence of human activities on operational reasons such as home construction, road construction, agricultural land, and overfishing, among others. Because to human encroachment, the area of wetland is shrinking by the day. It disrupts landscape services such as carbon, water, and nutrient cycling, water purification, flow management, animal migratory support, and so on, while also increasing the danger of severe occurrences such as floods and droughts.

Mikusiński, Bubnicki, Churski, Czeszczewik, Walankiewicz and Kuijper (2018) conducted study to analyze the magnitude and patterns of land use and land cover changes in Białowieża Forest between 1997 and 2020, and the driving causes behind these changes. The study used a mixed-method research strategy that included remote sensing and descriptive questionnaires. Remotely sensed images from 1997, 2005, and 2020 were used to categorize land use and land cover maps using the Maximum Likelihood technique to assess wetland changes. People's perspectives on the main drivers of landscape change inside the wetland were gathered through household surveys and focus group talks. The results indicated that Białowieża Forest decreased by 23.69% between 1997 and 2020. Forest vegetation fell dramatically as open land expanded, although tree cover and disturbed reeds fluctuated. Land conversion efforts inside the wetland were a primary driver of these changes. The report suggests that both national and local governments use a community-based enforcement strategy to current laws and regulations in order to slow the destruction of these forests.

Goodrich, Kepner, Levick and Wigington Jr (2018) argued that amphibian populations continue to decline due to habitat loss and fragmentation. In regions where climate change may exacerbate habitat loss, it is extremely important to keep water and land connected for the sake of amphibian conservation. The western tiger salamander (Ambystoma mavortium), an endangered species in British Columbia, Canada, was utilized as a case study to examine the impact of climate and human-caused losses in ephemeral wetlands on amphibian functional connectivity. A spatially explicit individual-based model of amphibian mobility was developed using data on the western tiger salamander's dispersal and land use. Wet, ordinary, and dry years, as well as a land management scenario in which only known breeding places are protected, are accounted for in the model in order to examine the effects of these factors on connectivity. Using a spatial network analysis, we were able to locate key ephemeral wetlands that serve as connectors between smaller networks throughout the landscape and identify potential corridors between wetland and upland terrestrial habitats. These results show how crucial it is to protect transitional wetlands. It is considered that a comprehensive approach to wetland conservation is essential to maintain sustainable amphibian populations in the face of habitat loss and climate change, as opposed to just conserving known breeding places.

Fan, Wang, Wu, Chen, Ma and Ma (2021) noted that the global community has invested much in habitat restoration in an effort to lessen the impact of habitat loss and degradation on animals. It is unclear, however, whether regenerated ecosystems can support animal groups on par with their original counterparts. Waterbirds, which must have wetlands for survival, are the subject of many wetland restoration strategies. At Chongming Dongtan, a waterbird conservation national nature

reserve in the south Yellow Sea, a year-round waterbird survey was conducted to compare the characteristics of waterbird communities in four wetland types including restored wetlands, natural tidal wetlands, and two artificial wetlands (fish ponds and farmlands). The purpose of this research was to determine whether there were any differences in waterbird diversity and species composition based on wetland type. Comparable levels of waterbird diversity were found in both restored and natural wetlands across measures of species richness, individual density, Shannon-Wiener diversity, functional diversity, and phylogenetic diversity compared to fish ponds and agricultural land. While there were many commonalities between wild and restored wetlands, the overall species composition was very different. According to non-metric multidimensional scaling research, there is a large disparity in waterbird communities across wetland types. The results show that while restored wetlands keep a wide diversity of waterbirds, they cannot take the position of natural wetlands due to the absence of period tides, which are necessary for the survival of many tideland specialists (shorebirds). The study highlights the value of natural wetlands for waterbird preservation. The variety and species composition of animal populations were thus suggested as metrics with which to evaluate the efficacy of wildlife habitat restoration.

Wang, Zheng, Zhang, Xiao, Gu, Zhang and Yan (2020) reported that although there are many urban wetland parks, evidence concerning the consequences of tourist development on microbiological diversity and ecosystem functioning is scarce. The study set out to determine how bacterial communities in China's Xixi National Wetland Park had responded to rising visitor numbers. By analyzing the variety, composition, assembly pattern, and environmental drivers of bacterial communities, the research found that tourist development greatly affected water quality, which further reduced -diversity but enhanced -diversity in open spaces for landscaping and enjoyment. Increased Simpson dissimilarity across functional wetland areas indicated that species replacement mostly accounted for changes in the composition of bacterial communities. TOC and TC were shown to be the primary drivers of bacterial populations in water and sediment in open areas, according to RDA analysis and ecological process quantification. In addition, the conventional anti-disturbance taxa (Gammaproteobacteria) and potential diseases (Bacillus) were mostly found in the wetlands due to the increasing human disturbances. The effects of tourism on bacterial populations have led to significant spatial variation in Xixi National Wetland Park, according to the present research. This study fills a gap in the literature by providing credible resources for designing effective strategies for managing wetland ecosystems and conducting ecological assessments of urban wetlands.

3.0 Research Findings

Research on the effects of human encroachment on wetlands in Canada has shown that this activity can have significant negative impacts on the environment and human communities. Human encroachment on wetlands in Canada has resulted in significant wetland loss and degradation. Studies have shown that as much as 70% of Canada's original wetlands have been lost or degraded due to human activities such as agriculture, urbanization, resource extraction, and infrastructure development. Wetland loss and degradation can lead to the loss of plant and animal species that depend on these ecosystems. It was noted that wetland loss is a major contributor to the decline of many bird species, including waterfowl and shorebirds. These wetlands play an important role in purifying water by filtering pollutants and sediments. Wetland loss and degradation can result in reduced water quality, which can have negative impacts on human health and aquatic ecosystems.

https://doi.org/10.53819/81018102t5173

Wetlands are important carbon sinks, storing significant amounts of carbon in their soils and vegetation. Wetland loss and degradation can release this carbon into the atmosphere, exacerbating the effects of climate change. Wetlands also play a critical role in regulating water flow, and their loss can result in increased flooding and droughts. Wetlands support important industries such as forestry, agriculture, and fisheries, and provide recreational opportunities for Canadians, such as fishing, hunting, and wildlife watching. Wetland loss and degradation can have negative impacts on these industries and on the communities that rely on them. Efforts to protect and restore wetlands are critical to ensure their continued ecological, economic, and social benefits for future generations.

The Boreal Shield is home to a diverse array of plant and animal species, many of which are endemic to the region. Some of the notable wildlife species found in the area include moose, black bear, lynx, beaver, and a variety of bird species. The Boreal Shield plays a critical role in global carbon storage. The vast forests in the region act as a significant carbon sink, absorbing carbon dioxide from the atmosphere and storing it in plant tissues and soils. The Boreal Shield is already experiencing the effects of climate change. Warming temperatures and changes in precipitation patterns are altering the timing of seasonal events, such as the timing of bird migrations and the onset of spring. These changes have the potential to disrupt the delicate balance of the ecosystem and affect the distribution and abundance of wildlife species. The Boreal Shield is home to many Indigenous communities, who have long-standing cultural and economic ties to the land. These communities rely on the region's natural resources for food, medicine, and cultural practices. However, they are also vulnerable to the impacts of climate change and resource extraction activities. The Boreal Shield is rich in natural resources, including minerals, oil, and gas. Mining and drilling for natural resources destroy habitats, pollute water supplies, and release greenhouse gases, just to name a few of the negative environmental effects.

4.0 Conclusion

In conclusion, the effects of human encroachment on wetlands in Canada have been significant and far-reaching. Wetlands are crucial ecosystems that provide numerous ecological, economic, and social benefits to Canadians. However, human activities such as agriculture, urbanization, resource extraction, and infrastructure development have led to the degradation and loss of wetlands across the country. The loss of wetlands has had a significant impact on the environment. Wetlands act as natural water filters, helping to purify water by removing pollutants and sediments. Wetlands also offer critical habitat for a wide range of plant and animal species, many of which are rare or endangered. The destruction of wetlands has contributed to the decline of many species, including migratory birds, fish, and amphibians.

Moreover, the loss of wetlands has also had economic and social impacts. Wetlands provide a range of valuable resources, including timber, peat, fish, and wildlife, which support local economies and communities. Wetlands also provide recreational opportunities for Canadians, such as fishing, hunting, and wildlife watching. To mitigate the negative effects of human encroachment on wetlands, various conservation and restoration efforts have been implemented across Canada. These include wetland protection policies, wetland restoration projects, and public education and outreach programs. However, more needs to be done to address the ongoing loss of wetlands in Canada and ensure their long-term sustainability. In summary, human encroachment on wetlands

https://doi.org/10.53819/81018102t5173

in Canada has had significant negative impacts on the environment, economy, and society. Efforts to protect and restore wetlands are critical to ensuring their continued ecological, economic, and social benefits for future generations.

5.0 Recommendations

The study recommended that the Canadian government should implement more stringent wetland protection policies and regulations. This could include increasing the amount of wetlands protected under legislation, improving enforcement measures, and establishing penalties for those who violate wetland protection regulations. Restoration projects should be supported and encouraged to restore degraded wetlands. This could include providing funding for restoration projects, partnering with local communities and organizations to implement restoration efforts, and prioritizing the restoration of wetlands that provide critical habitat for endangered species. Sustainable land use practices should be promoted to minimize the impact of human activities on wetlands. This could include promoting sustainable agriculture practices, encouraging the development of green infrastructure, and ensuring that resource extraction and development projects are conducted in an environmentally responsible manner. Public education and outreach programs should be developed and implemented to raise awareness about the importance of wetlands and the negative impacts of human encroachment. This could include providing educational resources for schools, developing community-based programs, and partnering with organizations and businesses to promote wetland conservation. The Canadian government should collaborate with Indigenous peoples to ensure that wetland protection and restoration efforts are culturally appropriate and aligned with Indigenous knowledge and values. This could include partnering with Indigenous communities to develop conservation and restoration plans, incorporating Indigenous knowledge and practices into wetland management strategies, and ensuring that Indigenous peoples have a voice in decision-making processes related to wetland conservation and management. Generally, a multi-faceted approach is needed to address the negative effects of human encroachment on wetlands in Canada. By implementing these recommendations, it is possible to protect and restore wetlands, ensuring their ecological, economic, and social benefits for future generations.

REFERENCES

Amani, M., Mahdavi, S., Afshar, M., Brisco, B., Huang, W., Mohammad Javad Mirzadeh, S., ... & Hopkinson, C. (2019). Canadian wetland inventory using Google Earth Engine: The first map and preliminary results. Remote Sensing, 11(7), 842. https://doi.org/10.3390/rs11070842

Bai, L., Xiu, C., Feng, X., & Liu, D. (2019). Influence of urbanization on regional habitat quality: A case study of Changchun City. Habitat International, 93, 102042. https://doi.org/10.1016/j.habitatint.2019.102042

Balwan, W. K., & Kour, S. (2021). Wetland-An Ecological Boon for the Environment. East African Scholars Journal of Agriculture and Life Sciences, 4(3), 38-48. https://doi.org/10.36349/easjals.2021.v04i03.001

Fan, J., Wang, X., Wu, W., Chen, W., Ma, Q., & Ma, Z. (2021). Function of restored wetlands for waterbird conservation in the Yellow Sea coast. Science of the Total Environment, 756, 144061. https://doi.org/10.1016/j.scitotenv.2020.144061

Fok, S. Y. B. (2020). Chattel Land: Legal and Labor Histories of Reclamation in Singapore (Doctoral dissertation, University of Minnesota).

Goodrich, D. C., Kepner, W. G., Levick, L. R., & Wigington Jr, P. J. (2018). Southwestern intermittent and ephemeral stream connectivity. JAWRA Journal of the American Water Resources Association, 54(2), 400-422. https://doi.org/10.1111/1752-1688.12636

Hammer, D. A., & Bastian, R. K. (2020). Wetlands ecosystems: natural water purifiers?. In Constructed wetlands for wastewater treatment (pp. 5-19). CRC Press. https://doi.org/10.1201/9781003069850

Lecciones, A. J. M., Serrona, K. R. B., Devanadera, M. C. E., Lecciones, A. M., & Yu, J. (2022). Creative approaches in engaging the community toward ecological waste management and wetland conservation. In Circular Economy and Sustainability (pp. 297-317). Elsevier. https://doi.org/10.1016/B978-0-12-821664-4.00020-0

Macfarlane, D., & Olive, A. (2021). Whither Wintego: Environmental Impact Assessment and Indigenous Opposition in Saskatchewan's Churchill River Hydropower Project in the 1970s. Canadian Historical Review, 102(4), 620-646. https://doi.org/10.3138/chr-2020-0011

Markle, C. E., Gage, H. J., Tekatch, A. M., Wilkinson, S. L., & Waddington, J. M. (2022). Wetland Successional State Affects Fire Severity in a Boreal Shield Landscape. Wetlands, 42(7), 87. https://doi.org/10.1007/s13157-022-01606-x

Mikusiński, G., Bubnicki, J. W., Churski, M., Czeszczewik, D., Walankiewicz, W., & Kuijper, D. P. (2018). Is the impact of loggings in the last primeval lowland forest in Europe underestimated? The conservation issues of Białowieża Forest. Biological conservation, 227, 266-274. https://doi.org/10.1016/j.biocon.2018.09.001

Morison, M. Q., Higgins, S. N., Webster, K. L., Emilson, E. J. S., Yao, H., & Casson, N. J. (2022). Spring coherence in dissolved organic carbon export dominates total coherence in Boreal Shield forested catchments. Environmental Research Letters, 17(1), 014048. https://doi.org/10.1088/1748-9326/ac462f

Nayak, A., & Bhushan, B. (2022). Wetland Ecosystems and Their Relevance to the Environment: Importance of Wetlands. In Handbook of Research on Monitoring and Evaluating the Ecological Health of Wetlands (pp. 1-16). IGI Global. https://doi.org/10.4018/978-1-7998-9498-8.ch001

Pipan, T., & Culver, D. C. (2019). Wetlands in cave and karst regions. In Encyclopedia of caves (pp. 1156-1164). Academic Press. https://doi.org/10.1016/B978-0-12-814124-3.00135-7

Rawat, K., & Yadav, A. K. (2021). Sustainable Practices for Conservation of Wetland Ecosystem. Wetlands Conservation: Current Challenges and Future Strategies, 129-139. https://doi.org/10.1002/9781119692621.ch7

Saikia, J. L. (2019). Deepor Beel wetland: Threats to ecosystem services, their importance to dependent communities and possible management measure. Natural Resources and Conservation, 7(2), 9-24. https://doi.org/10.13189/nrc.2019.070201

Saridnirun, G., Sukumal, N., Grainger, M. J., & Savini, T. (2021). Living with human encroachment: Status and distribution of Green Peafowl in northern stronghold of Thailand. Global Ecology and Conservation, 28, e01674. https://doi.org/10.1016/j.gecco.2021.e01674

Tian, A., Xu, T., Gao, J., Liu, C., & Han, L. (2023). Multi-scale spatiotemporal wetland loss and its critical influencing factors in China determined using innovative grid-based GWR. Ecological Indicators, 149, 110144. https://doi.org/10.1016/j.ecolind.2023.110144

Wang, B., Zheng, X., Zhang, H., Xiao, F., Gu, H., Zhang, K., ... & Yan, Q. (2020). Bacterial community responses to tourism development in the Xixi National Wetland Park, China. Science of the Total Environment, 720, 137570. https://doi.org/10.1016/j.scitotenv.2020.137570

Yang, Z. M., Han, L. F., Liu, Q. P., Li, C. H., Pan, Z. Y., & Xu, K. (2022). Spatial and temporal changes in wetland in Dongting Lake Basin of China under long time series from 1990 to 2020. Sustainability, 14(6), 3620. https://doi.org/10.3390/su14063620

Zou, J., Ziegler, A. D., Chen, D., McNicol, G., Ciais, P., Jiang, X., ... & Zeng, Z. (2022). Rewetting global wetlands effectively reduces major greenhouse gas emissions. Nature Geoscience, 15(8), 627-632. https://doi.org/10.1038/s41561-022-00989-0