Designing, Creating, and Regulating the Ohio River

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> On December 12, 1826, John James Audubon wrote of the Ohio Valley,
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> "A century hence… Nature will have been robbed of many brilliant charms, the rivers will be tormented and turned astray from their primitive courses, the hills will be leveled with the swamps, and perhaps the swamps will have become a mound surrounded by a fortress of a thousand guns."[1]

The accuracy of Audubon's prediction is striking. Nearly 200 years later, the Ohio River hardly resembles the one that flowed through the early nineteenth century. The wetlands are, indeed, essentially non-existent. The Ohio's sandy river banks have been replaced by muddy shorelines; the abundant diversity of fish and mussels has largely disappeared;[2] the once relatively shallow, clear, flowing stream is now a series of artificial, dark and cloudy pools of water; the numerous shifting islands and sand bars have been greatly reduced; and the extreme variability in the water level is no longer experienced in the tamed river. How could it be that the Ohio had been "robbed of its many brilliant charms?"

Nineteenth century navigation journals, scientific articles, newspaper articles, and government documents, especially those from the Army Corps of Engineers, provide insight to answer this question. Sources show that these changes were set into motion by a 19th century mentality that river alterations, referred to as improvements, were necessary for the growth of the expanding nation.

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[1] Maria R. Audubon, *Audubon and His Journals, Vol. 1* (New York: Charles Scriber's Sons, 1897), 183.
[2] W.D. Pearson and B. J. Pearson, "Fishes of the Ohio River," *The Ohio River: Its History and Environment*, The Ohio Journal of Science, Vol. 89, No. 5 (1989), 184; Ralph W. Taylor, "Changing Ohio River Mussel Populations," *The Ohio River: Its History and Environment*, The Ohio Journal of Science, Vol. 89, No. 5 (1989), 188.

Similar to Richard White's Columbia River, Mark Cioc's Rhine River, and many other rivers, the Ohio is a "multipurpose river" that was significantly altered to meet the needs of industrialization.[3] However, the Ohio River has a different niche in history. Narratives of reservoir dams, flood control, irrigation, and hydro-electricity production dominate river histories.[4] These alterations to waterways certainly had devastating ecological impacts, but the Ohio's environmental story is one of environmental impact due to another set of concerns. Since the Ohio runs through a well-watered region, the river was not relied upon for irrigation; in addition, its modest drop has made it unattractive for major hydropower project. This leaves navigation left as the river's primary function. As primarily a navigation river, society's fears for the Ohio were physical obstacles and not necessarily too much water, but at times, too little. The goal was to regulate the water level of the Ohio throughout the year.

The 50 years between 1830 and 1880 mark the beginning of significant, human-induced ecological change in the Ohio River. With the aim of navigational improvement, engineers sanctioned by the local, state, and federal governments changed the riparian habitat. This change profoundly impacted the movement, protection, reproduction, and survival of animals, while encouraging the increased movement and settlement of humans westward.[5] To facilitate river travel and the new large barges and steamboats, which were introduced to the river in 1811 and multiplied to hundreds by the 1830s, the government removed elements of the habitat

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[3] Richard White, *The Organic Machine: The Remaking of the Columbia River* (United States: Hill and Wang Critical Issues, 1995); Mark Cioc, *The Rhine: An Eco-Biography, 1815-2000* (Seattle: University of Washington Press, 2002).

[4] David Blackbourn, *The Conquest of Nature: Water, Landscape, and the Making of Modern Germany* (New York: W.W. Norton & Company, Inc, 2006); Donald Worster, *Rivers of Empire: Water, Aridity, and the Growth of the American West* (Oxford: Oxford University Press, 1985).

[5] It has been claimed that in the 1840s, over two million people moved to the Ohio Valley.; William Eckman Kreisle, "Development of the Ohio River for Navigation, 1825-1954," Master's Thesis, University of Louisville, 1971, 78.

systematically and with increasing speed.[6] The removal of "obstructions" was followed by the placement of permanent structures that artificially deepened the river, dividing the landscape in an unnatural manner. As river improvements were progressively connected with the success of the region and nation, the river became less affiliated with its natural aspects in the minds of Ohio Valley residents. The Ohio River grew to resemble a large canal, artificial and greatly diminished ecological diversity.

River navigators and observant sportsmen, such as Audubon, could not easily overlook these river changes and the ramifications of the engineers' projects. However, the Ohio appeared to nineteenth century engineers and government officials as an obvious resource waiting to be exploited. As the river guide author Zadock Cramer claimed, "Indeed, the very appearance of the placid and unbroken surface of the Ohio invite trade and enterprise."[7] The idea of a regulated river, in which the water level was artificially controlled for a desired height year-round, guided engineers' actions throughout the nineteenth and twentieth centuries. While flooding was an issue, engineers initially chose to focus on low- water control works to address the low water that plagued the river travelers more often than flooding and posed as an impediment to commerce and general navigation. The low-water controls of the 1880s grew the public's confidence in the Corps of Engineers' alterations of the Ohio Valley and eventually the government entity would implement flood control measures on the Ohio River as well during the twentieth century. However, I would like to focus on the various efforts to first clear the riparian habitat of

[6] Often, travelers and explorers in the late eighteenth and early nineteenth century noted the various animals, such as bears and deer, they saw crossing the Ohio River. With the current depth of at least nine feet, even if these species had not been pushed out of their habitats, it would be virtually impossible to fight the currents and depths to cross the river.

[7] Zadock Cramer, *The Navigator, 7th Edition* (Pittsburgh: Cramer, Spear & Eichbaum, 1811), 32

navigational obstacles between the 1830s and 1850s that took place before efforts to build a river suitable for boats.[8]

The condition of the Ohio River in the early nineteenth century simply did not permit steamboat navigation with ease. Rather, the boats praised for travelling in the deeper Hudson and Delaware Rivers at the remarkable rate of four miles an hour against the wind and tide, struggled to navigate the seasonably and geographically variable Ohio. Flatboats and keelboats were traditionally used in the riverway, but they were extremely limited compared to the coal-carrying steamboats, which carried the Pennsylvania coal that came on the market around the War of 1812 and would replace wood as the primary fuel by 1850. The risk of being held up by low water limited commerce to seasons that had relatively predictable freshets, or river rises.[9] These two seasons were the spring, commonly referred to as the "coal rise" in the mid-1800s (February to April), and the fall (October to early December). With the growing demand for eastern coal, the commercial limit to these two seasons was seen as not enough.

Beyond this, droughts were devastating to commerce. 1819 was a particularly bad year for drought, rendering the river closed to steamboats for eleven months.[10] Reacting to the impact of this significant drought and the growing importance of the steamboats and the navigability of the river as settlements moved west, several Ohio Valley states met in Pittsburgh in 1819 to make plans that would encourage river improvements. During this meeting, state representatives in the joint commission mapped out 102 obstructions, such as snags and sandbars, between the

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[8] The phrase "build a river suitable for boats" plays off of Captain Sobieski Jolly's reaction to the significant alterations to the Ohio River. Jolly asserts that rather than investing so much into the manipulation of the river, "the best plan would be to build boats to suit the river and not ask the Government to build the river to suit the boats;" Captain Sobieski Jolly Papers (Jolly Papers), 1876-1898, Mss 1046, Cincinnati Museum Center, 84.

[9] Cramer, 34-6; Louis C. Hunter, *Studies in the Economic History of the Ohio Valley: Seasonal Aspects of Industrial and Commerce Before the Age of Big Business and the Beginnings of Industrial Combination* (Northampton, Mass: Smith College, 1934); "Coal Rise" note: Kreisle, 106

[10] "The Ohio River," *Connecticut Courant*, September 21, 1819, 3. ProQuest Historical Newspapers; "Ohio Drought," *Connecticut Courant*, January 21, 1820, 3. ProQuest Historical Newspapers.

cities of Pittsburgh and Louisville. The 1820s, thus marked the beginning of federal efforts to improve the Ohio River for steamboats.[11]

Through the 1824 Federal General Survey Act, Congress granted the U.S. Army Corps of Engineers authority over navigational studies, and the federal government increasingly became involved in Ohio River improvements.[12] The first Rivers and Harbors Act passed in 1827 and the Corps of Engineers began removal of all sunken trees, limbs, roots of trees, and logs.[13] An efficient and well-designed technology did not exist yet for doing so, though. So the U.S. Army opened up a competition for the best snag removal device, offering a $1,000 prize for the best design. A year later, "Uncle Sam's Toothpullers," the popular name for these snag-removal boats, were put to work removing obstructions on the Ohio. By 1837, more than 3,000 snags had been removed from the river.[14]

Focused on the benefits of the snag removal, the government officials and local residents did not consider the possibilities of any detrimental effects to the river. Sunken logs and trees provided improvement to the habitat. Insects and fish could settle within and around these "navigational obstructions," which instead of being referred to as "sunken trees" had become

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[11] Sherman L. Frost and William J. Mitsch, "Resource Development and Conservation History Along the Ohio River," *The Journal of Science*, v. 89, no. 5 (1989), 145; William F. Gephart, "Transportation and Industrial Development in the Middle West," (doctoral thesis, Columbia University, 1909), 215.

[12] Frost & Mitsch, 146.

[13] For the purposes of this essay, I have chosen to leave out the majority of the bureaucratic history of the Corps of Engineers. However, it may be important to note the following: In July 2, 1818, the Corps of Topographic Engineers, who officially handled river projects, was placed under the Corps of Engineers, as opposed to continuing to answer to the Army Commanding General as initially set up when Congress created the new group in 1813, during the War of 1812. On June 21, 1831, the Topographic Engineers would become a separate bureau of the Water Department. The two engineers departments would once again be consolidated in 1863, though, as the Corps of Engineers, or "Office of Chief of Engineers." (Kreisle, 58)

[14] Charles Ambler, *A History of Transportation in the Ohio Valley* (Glendale, CA: Arthur H. Clark Company, 1932), 317; More on the design and capabilities of the snagboat: The snagboats were able to remove snags up to 75 tons. They were designed with two hulls with an "iron-sheathed snag beam" joining the two hulls. It would work by running the boat towards the snag at full speed, forcing the obstruction out of the water. Then, the operators would drag the snag onto the boat and cut it into pieces. ["Engraving of Steam Snag Boat A.H. Sevier," On the Water, Smithsonian National Museum of American History, amhistory.si.edu/onthewater/collection/TR_336779.html]

refashioned as "snags" and "sawyers" purely based on their danger to boats.[15] As these habitats were systemically removed, engineers began selecting for species that did not depend on these habitats for shelter or food.[16] In the process they decreased the biodiversity within the river.

In addition, snag-removal addressed a symptom, not the root, of the Ohio River's problems. The Ohio faced a larger historical issue of erosion. Louis Hunter, an economic history professor who studied the Ohio River for over twenty years, asserted, "It early became apparent in dealing with the snag problem that prevention was as important as cure. The erosion of tree-lined banks was recognized as a principal cause of snag formation."[17] The natural flow of the water, accentuated by the Engineers' projects, allowed for the riverbanks to cave in and caused the trees to fall in the river in the first place.[18]

Once the navigational benefits of snag removal were widely realized, the practice was actually encouraged and further publicized by residents of the Ohio Valley themselves as they responded to considerable push back from other portions of the country on the constitutionality and legitimacy of the Ohio River projects in the 1840s.[19] In 1844, arguing that the navigability of the Ohio "is not of local concern or sectional character," citizens of Cincinnati petitioned

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[15] Rationale for the various terminology, from Serial Set, House Doc. 35, 11. as quoted in Erik F. Haites, James Mak, and Gary M. Walton, Western River Transportation: The Era of Early Internal Development, 1810-1860 (Baltimore: The John Hopkins Press, 1975), 90: "Of the trees which are in this way precipitated into the river, some are borne off by the stream, some are lodged upon the shores, where they form 'rafts,' obstructing the navigation of certain 'branches,' and require to be avoided with great care… Others of these trees become fixed in the bed of the river. When so fixed as to preserve an immoveable position, the are called 'planers;' but when, being inclined from the vertical, and pressed upon the current, they move in regular or rather in uninterrupted oscillations, they are called 'sawyers;' 'snags' is a term applied to either."

[16] G. Mathias Kondolk, Matt Smeltzer, and Lisa Kimball, *Freshwater Gravel Mining and Dredging Issues* (Berkeley, CA: Center for Environmental Design Research, 2001), 8-10. <wdfw.wa.gov/publications/00056/wdfw00056.pdf>

[17] Louis C. Hunter, *Steamboats on the Western Rivers: An Economic and Technological History* (Cambridge: Harvard University Press, 1949), 181, 192-198, 235-6, 272-5.

[18] Michael P. Marchioni, "Economic Development and Settlement Patterns in the Flood Plain of the Upper Ohio Valley with Special Reference Given to Flood Damage Reach 11 (Pt. Pleasant, West Virginia to Marietta, Ohio," dissertation, University of Cincinnati, 1971, 109-110.

[19] Kreisle, 76; Paul F. Paskoff, "Politics: Polk and Post-Polk," *Troubled Waters: Steamboat Disasters, River Improvements and American Public Policy, 1821- 1860* (Baton Rouge: Louisiana State University Press, 2007), 64-109.

Congress, "to expend a liberal portion of the public treasure in removing the obstructions." Emphasizing the significant growth in settlement and industry that had occurred, Cincinnatians urged the federal government to continue funding the improvements of the Western river.[20] The widespread support of changes to the river was clearly set into motion.

Sandbars also posed problems for navigation. Local governments installed dikes to push apart sandbars, but these attempts were relatively unsuccessful in themselves. Dredging of the river to remove sandbars and deepen the river channel was the next major step. As early as 1843, the corps used scrape boats on the Upper Ohio, in which the scraper dragged the river bottom to increase the depth of water. In 1878, daily dredging was applied to the entire channel to create and maintain the first uniform depth of six feet.[21]

The clearing of the river removed natural shelters for aquatic animals in the sunken trees and vegetation on the riverbed. For fish, the continuous act of dredging in the river was probably the most harmful as it disturbed the gravel and rubble on the bed. Beyond the effect on fish, gravel extraction increases riverbed erosion and exaggerates downstream flooding. The idea of a clear, navigable hydro-highway transformed the Ohio River ecosystem.

At the same time the river was being cleared of all of natural obstructions, the main troubling question was how to achieve a consistent, reliable and deep level of water that would

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[20] Quote from the booster's letter to Congress: "It is impossible to consider these great arterial channels without perceiving their connexion with each other, and tracing their ramification to the utmost extremities of our country. The West is no longer a frontier; it is the heart of the Union. This is not only geographically true, but it is true in every sense. The centre of population, of production, and of consumption is here. We furnish the greater portion of the exports and consume the greater portion of the imports that make up the sum of the foreign commerce of the nation. Our rivers are no longer margined by silent forests: cities, towns, villages, and cultivated fields, enliven their shores, and bear testimony to the industry, resources, and refinement of the country." ("Memorial of a Number of Citizens of Cincinnati, Ohio Praying the Removal of Obstructions in the Navigation of the Ohio and Mississippi Rivers," March 12, 1844, 28th Congress, 1st Session, Senate, 7. The Cincinnati Museum Center Library and Archives, Cincinnati, Ohio.)

[21] Kreisle, 67; Ambler, 397; [21] Louis C. Hunter, *Steamboats on the Western Rivers* (Cambridge, Mass: Harvard University Press, 1949), 223-4; Some dikes were built near Henderson (1825), Scuffletown and Sister Islands (1831), and French and Cumberland Islands (1832). [*The Ohio River* (Washington D.C.: Government Printing Office, 1935)]

allow year-round travel. The first major federal project to deepen the relatively shallow river resulted from a 1822 report. Wing dams were installed to confine the water current within narrow banks and provide a sufficient volume of water to wash a decent current for itself.[22] This technological innovation, in other words, assisted but did not take over natural processes. Strategically placed, they complemented the naturally created "succession of navigable pools" provided by sandbars during low water and let boats find pockets of the river current, or at least a safe place to dock.

This began in May 1824 when Congress appropriated $75,000 for the installation of experimental wing dams and the removal of snags. Work began under the Topographic Engineer Major Long within the year with the problematic sandbar just below Henderson, Kentucky. By the 1830s, the Engineers began feeling relatively confident with the success of their projects and further built dams at the Sisters Island in 1831 and the French and Cumberland Island in 1832 to create a minimum 3-foot channel. By 1842, 111 wing and training dikes, as well as 47 back channel dikes, were established, changing the Ohio's ecology by transforming its flow.

By the 1850s, conversation began on creating a "slack water" system along the entire river to ensure an effective river depth since low water continued to be a frequent issue, costing merchants in the form of delay.[23] The arrival of the railroad in the Ohio Valley initially led to less emphasis on alterations to the river for navigational convenience as the railroads seemed to ensure the rapid, reliable, and uninterrupted transportation that merchants demanded, especially

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[22] "Memorial of a Number of Citizens of Cincinnati" (1844), 30; Kreisle, 62-69; "Letter from S. H. Long, Major Top. Engineers, January 12, 1826," Doc. No 145: Sand Bars of the Ohio, "Message from the President of the United States Transmitting the Information Required by a Resolution of the House of Representatives of the 21st Instant, in Relation to the Measures Which Have Been Taken to Improve the Navigation over the Sand Bars in the Ohio River; &c., &c., The Cincinnati Museum Center Library & Archives, Cincinnati, Ohio; R. R. Jones, *The Ohio River: Charts, Drawings, and Description of Features Affecting Navigation, War Department Rules and Regulations for the River and Its Tributaries, Navigable Depths and Tables of Distances for Tributaries* (Washington: Government Printing Office, 1922), 150.

[23] Col. Ellwood Morris, C.E. *Treatise on the Improvement of the Ohio River*. Pottsville: Printed by Benjamin Bannan, 1857. *Google Documents*; Morris, *Treatise on the Improvement of the Ohio River*, 6.

as demand for coal continued to rise. By the late nineteenth century, though, concern grew that industry had become too dependent on the railroads. The national farmer's movement supported river improvements, believing that the revitalized competition would drive down the increasing railroad rates.[24]

From 1878 to 1929, the Corps of Engineers took on a significant program of building 51 locks and dams to create and maintain nine feet river depth. This has been referred to as the "canalization" of the Ohio River.[25] The hopes of economic benefit due to the new river were substantial; the mining, manufacturing, commercial, and agricultural sectors and the new Ohio Valley Improvement association strongly supported the project. The dams were a technology borrowed from France known as the wicket dam. The wickets allowed for predictability in navigation by raising or lowering individual wickets in specific portions of the waterway depending on the high or low flow of the river and water level needs.[26] The system provided an extra 3 feet of ensured water depth, allowing the large steamboats to predictably carry significantly more commerce. The possibility that the locks and dams would raise the water levels and exaggerate flooding of the river was raised, but this would be denied by engineers.[27] Not only did these lock and dams raise the water level, but it also created permanent pools of water that would concentrate fish and lead to overfishing.

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[24] Vance, The Improvement of the Ohio River," *Annals of the American Academy of Political and Social* Science, Vol. 31, American Waterways (1908), 141; Ambler, 397; Albert E. Cowdrey, "Pioneering Environmental Law: The Army Corps of Engineers and the Refuse Act," *Pacific Historical Review*, Vol. 44, No. 3 (Aug, 1975), 331-349; Kreisle, 127-9.

[25] Leland R. Johnson, *The Davis Lock and Dam, 1870-1922* (Pittsburgh: U.S. Army Engineer District, 1985), vii.

[26] Vance, "The Improvement of the Ohio River," *Annals of the American Academy of Political and Social* Science, Vol. 31, American Waterways (1908), 145; The flowing French rivers implemented the wicket dam: Seine, Marne, Yonne, and Meuse. (Kriesle, 117-120); In the 1830s and 1840s, the states of Pennsylvania and Ohio also began experimenting with various lock and dam designs on smaller rivers. (Johnson, *The Davis Island Lock and Dam*, 9).

[27] Milnor Roberts, C.E., "Improvement of the Ohio River, Explanatory Remarks on the 'Review of Ellwood Morris," 6: "In considering the additional rise to be caused by high floods in consequence of the proposed dams, Mr. Morris presses the theory that all floods will be augmented to the full extent of the height of water already in the river."

While the developments greatly assisted commerce, the Corps also decelerated the water's velocity and transformed the river into a permanent series of slack water pools. These pools tended to localize and concentrate pollution. The taming of nature through engineering led to a more predictable flow, but the alterations inadvertently influenced the river's natural dilution and flushing processes previously relied upon for carrying pollution and filth down the river. This was critical in an increasingly settled and industrialized Ohio Valley.

However, wastes quickly accumulated in the river as it travelled from one city to the next, creating increasingly worse environmental and human health problems for the cities downstream.[28] Often, this led to unprecedented concentrations of filth in cesspool, especially in times of drought.[29] Communities along the Ohio River, suffering through the unanticipated outcomes of the transformation of the river, attempted to band together to find a permanent and agreeable solution to the surmounting pollution issues. However, the solutions, culminating in the creation of an interstate governing body known as the Ohio River Valley Sanitation Commission, were unconcerned with challenging the unnatural structures installed by the Corps that accentuated the pollution. Rather, it was widely accepted these structures were necessary and became permanent fixtures of the river.

Even after the river became less important for commerce, the riparian habitats were permanently changed and the government continued to maintain the human-made structures. In 1826, Audubon witnessed the beginning of habitat destruction in and surrounding the Ohio River. Informed by the changes on the very river and surrounding forests he frequented, he

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[28] Edward Clearly, *The ORSANCO Story: Water Quality Management in the Ohio Valley under an Interstate Compact* (Baltimore: John Hopkins Press, 1967), 17.

[29] In 1930, drought conditions resulted in stagnation of water behind the Army Corps of Engineers' dams for at least a period of ten months. ("Minutes of Special Meeting of Health Commissioners Signatory to the Ohio River Interstate Stream Conservation Agreement," Department of Health Central Files 1936-1965 (Water Resources), Series 1434 Box 53526, The Ohio History Society, Columbus, Ohio; Clearly, 23)

commented on these changes with strong language of "torment[ing]" the rivers and diverting their courses. In the five decades after Audubon wrote these words, the river was substantially altered physically but also, consequently, in terms of its healthy biodiversity. This would set into motion a series of events that would result in the removal of the Ohio as important resource for humans due to a decrease in available fish and mussels and increased pollution of the river.