

WETLANDS POLICY ANALYSIS: IDENTIFYING ISSUES AND SOLUTIONS OF
CURRENT WETLANDS RESTORATION AND CONSERVATION PRACTICES

by

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ABSTRACT

Wetlands conservation policy began nearly 75 years ago with the Federal Water Pollution Control Act of 1948. Through time, policy and conservation practices have evolved with the introduction of new laws and decisions on significant court cases. To improve the efficiency of wetland restoration, protect the ecosystem services provided by wetlands, and establish a framework for policy moving forward, it is essential an analysis of past and current policy be conducted. Therefore, my analysis highlights significant issues with current policy, why current policies fail to protect ecosystem services of wetlands and suggests solutions to improve policy moving forward. Few studies exist which critically analyze the policy and legislation surrounding wetlands management in the U.S., limiting our understanding of the management framework, and leaving wetlands vulnerable to further degradation. It is important we understand why these policies, and the legislation guiding them, have not been effectively implemented in preventing and reversing the loss of wetlands in the U.S. My policy analysis will examine existing policies, laws, and guidance to determine the reasons why we are continually losing wetlands in the U.S. today. My analysis will also offer new direction moving forward to mitigate continued loss of wetlands, and, finally, make recommendations of how to improve aspects of wetlands conservation and restoration through policy change and framework implementation.

Introduction

Defining the Problem

The loss of wetlands in the U.S. is still occurring at a staggering rate. In 1989, Congress ordered the Department of the Interior (DOI) to conduct an assessment of the wetlands lost between the years of 1780 and 1980, a 200-year period (Dahl et al. 1990). The resulting report found the U.S. originally had 392 million acres of wetlands, 221 million acres of which lie in the lower 48 states. When assessed in 2009, an estimated 280 million acres, 110 million acres in the lower 48 states, was all that remained (Dahl 2011). This change represents a 50% loss of wetlands in the contiguous states (Dahl et al. 2011). Wetlands degradation can be attributed to natural causes such as climate change, erosion, subsidence, invasion by non-native plant species, desertification, and drought. However, many of these disturbances can be attributed to anthropogenic impacts including increasing population pressure, urbanization, mining, oil and gas development, overgrazing, logging, and infrastructure construction (especially those in riverine systems) across the country (US EPA 2017).

In 2002, the Bush Administration endorsed the “no-net-loss” of wetlands concept (Office of the President 2008). This concept, originally declared by President George H. W. Bush in 1988, worked to balance wetlands losses and gains in the short term, and to achieve net gains in the long term. As a result, from 1998 to 2004, there was a net increase in wetland acreage (Fig. 1), but this statistic is slightly misleading and groups all wetlands into one classification. In fact, the net increase was observed in saltwater systems, comprised of intertidal marine shorelines and estuarine flats, bars, and shoals. However, freshwater wetlands observed a net loss, primarily from rural development and silvicultural operations (Dahl 2011). Urban and rural development accounted for 23% of wetland losses, totaling an estimated 128,570 acres. These updated figures, and the way they are calculated, are determined by how wetlands are identified and categorized.

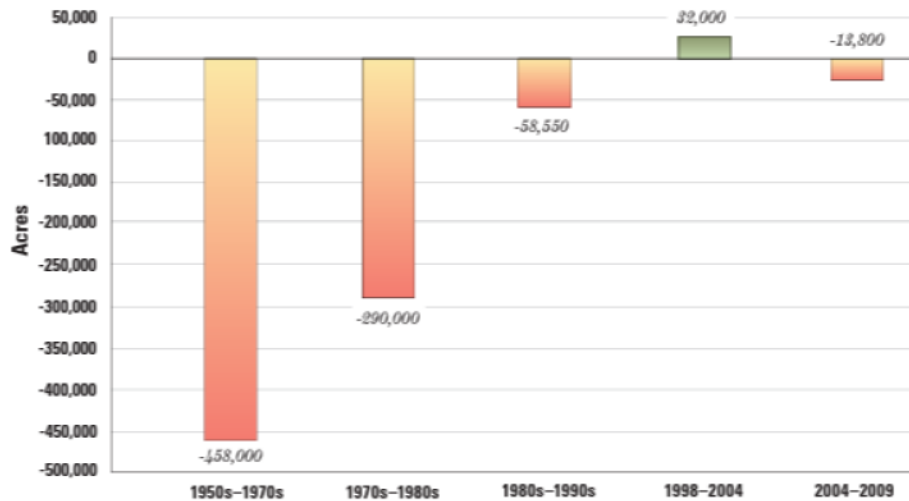


Figure 1. Average annual net loss and gain estimates of wetland acreage in the conterminous United States, 1954-2009.

Estimates of error are not graphically represented. Source: Dahl et al. 2011.

The policies protecting wetlands in the United States have evolved significantly throughout the years. The establishment of the Federal Water Pollution Control Act in 1948 was the first step by a federal agency to regulate wastewater standards. Later expanded into the Clean Water Act in 1972, this act made it illegal to discharge pollution into “navigable waters”. The term “navigable waters” would prove to be a crux of federal wetlands policy and protections in the country, as it would be challenged in court cases which ultimately change the definition of “navigable waters” through history.

Climate change has adverse impacts on wetlands across the globe. Variation in temperature and precipitation directly influences wetland hydrology and biogeochemistry, which are key processes to the structure and function of wetlands (Mitsch et al. 2009). Rising temperatures and reduced precipitation events have the potential to damage and/or eliminate wetlands entirely. In the U.S., climate change projections indicate warmer average temperatures. These warmer average temperatures lead to reduced snowpack, earlier peak flows, lower summer base flows, reduced groundwater recharge, and wetland degradation and loss.

From agricultural development draining and filling wetlands for almost 200 years, recently reduced legal protections for wetlands due to vague wetland definitions in policy, and the threat of climate change

on the landscape, wetlands continue to be altered and destroyed (Vileisis 1999). It is more important than ever to not only protect the extant wetlands but to work to restore perturbed wetlands. To be successful in both conserving and restoring wetlands on the landscape, policy must be critiqued, and a process developed to promote efficient, systematic conservation projects with specific objective goals. My analysis of wetlands policy, past, present, and future, will identify how to conserve these vital ecosystems more efficiently.

Wetland Values

Values of Functional Wetlands

Historically, draining and development of wetlands was promoted for the sake of economic progress in the country. As the value of functional wetlands begins to be identified, we are forced to alter the way we manage the landscape. As an example, to produce hydroelectric energy and mitigate the threat of floods, agencies would destroy native wetlands and establish dams and reservoirs to control flows (U.S. Bureau of Reclamation 2023). In hindsight, we are now realizing the development of this infrastructure was not only inefficient, but also replaced an ecosystem service which was already being provided by the native wetland in the form of flood mitigation.

Wetlands provide many ecosystem services when they are in their native, intact state. Many of these ecosystem services provide the human population with benefits we would otherwise rely on the development of infrastructure to provide. These services include, but are not limited to:

- Wildlife and waterfowl habitat (sanctuaries for threatened and endangered species)
- Water purification
- Water storage and mitigated flood impacts; increased base flow levels to mitigate drought
- Recreation and aesthetic values

Wetlands typically provide a variety of values when they are in a healthy condition. These values decline as wetlands are altered, managed, or degraded. Decreases in overall size of wetlands, the location

of wetlands, and their proximity to adjacent waterways can also impact the magnitude of these values. Although stream restoration efforts can restore values such as wildlife sanctuaries and aesthetics on a shorter temporal scale, values such as water purification and flood mitigation take longer to fully develop and return to full value functionality. Although wetlands make up only about 3% of global surface area, new studies estimate that natural wetlands deliver about 43.5% of the total global monetary value of ecosystem services from natural biomes (Davidson et al. 2019).

The Millennium Ecosystem Assessment Report (Millennium Ecosystem Assessment Report 2005) is a comprehensive report identifying the various ecosystem services provided by wetlands, specifically, the services that have long been recognized as important in wetlands (Mitsch and Gosselink 2007).

Ecosystem-human services from wetlands are most notably provisional services, including food (fish and shellfish), materials (timber), and fiber (reed grass) production (Nyman 2011). Supporting and regulating services provided by wetlands, including nutrient cycling and water purification, are essential functions sustaining human populations. The principal supply of renewable freshwater for human use comes from an array of inland wetlands, including lakes, rivers, swamps, and shallow groundwater aquifers according to the Millennium Ecosystem Assessment Report. The demand for these provisioning services will strongly increase due to the projected growth of the global population, economies, and changing consumption patterns.

A global economic assessment of 63 million hectares (156 million acres) of wetlands estimated their value at \$3.4 billion per year (Brander 2010) while other estimates value global wetlands up to \$14.9 trillion (Pearce 1998). These values are derived from wetland ecosystem services including the cleaning and removal of pollutants from water improving water quality, flood control, recreation, and providing fish and wildlife habitat.

Wetlands conservation and management is inherently difficult to plan. In the short term, land use practices (development and agriculture) increase the supply of provisional services (e.g., food and materials), but in the long term they stunt the capacity of these systems to provide services such as water supply, climate regulation, and recreational opportunities (Millennium Ecosystem Assessment 2005).

Flood Protection

Flooding causes more damage in the U.S. than any other severe weather-related event; recent figures from the Federal Emergency Management Agency (FEMA) found monetary flood damage in the U.S. to total about \$5 billion annually and reported an average of 119 flood related deaths per year. Wetlands play a major role in flood management, directly controlling frequency and intensity of floods. Wetlands act as natural buffers, slowing and storing significant amounts of floodwater. Estimates claim for every 1% increase in wetlands in stream adjacent areas, peak stream flows decreased by almost 4% (Mitsch 2000). In marine environments, coastal wetlands function as storm surge protectors, acting as a barrier between tropical storms and inland communities. An assessment by the Working Group for Post-Hurricane Planning for the Louisiana Coast found wetlands, including marshes and forested wetlands, provide a significant and sustainable buffer from wind-wave action and storm surges (Working Group for Post-Hurricane Planning for the Louisiana Coast 2006). Additionally, post-storm flooding impacts are mitigated by the holding and slow release of floodwater stored in these wetlands. One study estimated that a 6-inch rise in water over a 10-acre wetland can place more than 1.5 million gallons of water into storage with no harm to the surrounding biota (Neiring 1966). Not only does this storage help to mitigate peak flows and flood intensity, but this increased inundation period allows for water to percolate through the soil layers, removing pollutants.

Water Purification and Supply

When water enters a wetland, it is slowed down and retained for an extended period. During this holding time, sediment settles out of the water column, plant roots and microorganisms absorb excess nutrients from fertilizers, manure, leaking septic tanks and various anthropological activities, resulting in cleaner water (Brix 1994). Wetlands also remove heavy metals from water during this holding time (Cheng 2002.) The Environmental Protection Agency (EPA) states the Congaree Swamp, a 35 square mile bottomland hardwood swamp located in South Carolina, performs the water treatment equivalent of a \$5 million water treatment plant. Groundwater recharged through wetlands plays an important role in

water supply, providing 1.5 to 3 billion people globally (Millennium Ecosystem Assessment 2005).

Wetlands areas containing large, clean amounts of water also provide habitat for many wetland-reliant species.

Wildlife Habitat

From an aspect of biodiversity, freshwater wetlands make up only 1% of the earth's land cover, but these same wetlands are home to greater than 40% of the world's species (Mitra et al. 2003). To protect this sensitive habitat in support of waterfowl populations, organization such as Duck's Unlimited, have protected, restored, and/or managed over 12 million acres through direct cooperation with both private and public landowners (Ducks Unlimited 2023). According to the Natural Resources Conservation Service (NRCS), 150 bird species and 200 fish species are wetland dependent. Additionally, 900 terrestrial species use wetland habitats in the United States periodically (NRCS 2001). The Prairie Pothole Region, located in the northern plains, is home to 10% of the wetlands in the U.S., but supports 50% of U.S. mallard, northern pintail, and green-winged teal production (Ducks Unlimited 2023). These habitats provide key holdover locations for migratory species across the country and these species provide recreation opportunities for the populace.

Recreation Opportunities and Aesthetics

Migratory waterfowl provide both recreational and aesthetic value to the landscape, whether through hunting or viewed and photographed. Because these values do not have a listed market price, it is difficult to measure the amount of service they provide to the system. However, the sale of Federal Duck Stamps, established by Franklin D. Roosevelt in 1934 by the signing of the Migratory Bird Hunting Stamp Act, is one metric by which we are able to judge this service. The Duck Stamp Act returns 98 cents of every duck stamp dollar to the Migratory Bird Conservation Fund to purchase or lease wetlands and wildlife habitat to be added to the National Wildlife Refuge System (USFWS 2023). Since its inception in 1934, the Duck Stamp Act has returned nearly \$800 million dollars to fund and protect more than 5.7 million

acres of habitat. The value of this opportunity can be seen in the economic impact of recreation in wetlands.

Wetlands-based recreation provides substantial economic impacts and net economic benefits, totaling \$118 million of aggregate expenditures (Bergstrom 1990). Recreational activities including hiking, bird watching, hunting, and fishing all contribute to this economic value. The economic impact of hunting and fishing totals \$201.4 billion annually, supporting 1.5 million jobs and generating billions of dollars in state and federal taxes (National Wildlife Federation 2020.) Although these figures represent hunting and angling activities across all lands in the U.S., it helps to understand the impacts recreation, including recreation supported by wetlands, has on the economy.

It is important to identify the values wetlands provide to protect them from the various threats they face. Objectively quantifying wetlands values and ecosystem services is one way to improve conservation effectiveness.

Threats to Wetlands

Climate Change

Climate change is altering hydrologic conditions to varying degrees across the globe. These changes are often hard to predict with some areas warming and becoming drier, while others are trending cooler and wetter. Wetlands are considered as one of the more vulnerable ecosystems to climate change because of their inability to adapt to these changing conditions (Mitsch et al. 2012). Additionally, these changes in climate can have impacts on the ability of wetlands to be restored to native conditions. This means not only are we losing the values native wetlands provide, but also losing the ability to restore them on the landscape (Winter 2000).

Urban and Agricultural Development

Historically, the most fertile land is the first to be selectively developed for agricultural production. From crop fields on river floodplains to rice fields, wetlands are typically selected for agriculture due to their high fertility (Verhoeven 2009). From pre-settlement times to the 1980s, total wetlands loss is assumed to be about 110 million acres in the US (Dahl 2011). This loss is largely attributed to drainage for agricultural and urban development, extreme river management, water pollution from upstream watersheds, and climate change. One of the major threats to wetlands in the U.S. is the ebb and flow of wetlands protections under law. As the definitions of wetlands change, so do the protections they have. With the lack of clear, unchanging wetlands definitions, these protections are forever at risk.

Rural and agricultural development is a dynamic threat, as the magnitude of the impacts from these threats is ever changing with increases in global population. It is important to identify the type of threat to best manage the impacts it may have on wetlands. Dynamic threats can be hard to predict, and therefore make developing effective conservation strategies difficult. Categorizing these threats is one way to effectively manage them.

Ultimate vs. Proximate Threats

Ultimate (dynamic) threats include increasing human population, expanding global development, and climate change. These threats generally fall outside the scope of landscape management, as it is hard to predict how these factors will impact ecosystem processes in the future. Proximate threats are localized versions of ultimate threats, and include habitat loss through agriculture and urban development, natural resource extraction, such as timber and fossil fuels, and/or encroachment of invasive species (Wilson et al. 2005). While ultimate threats can seem static when viewed through large spatial and temporal scales, proximate threats are dynamic, expanding and contracting in magnitude, and operating as spatiotemporal mosaics on the landscape. To mitigate these threats, we must predict their impacts when developing restoration methods. These predictions should be based in science, using what we have learned through post-monitoring of previous projects to effectively implement policy.

Weak Implementation of Policy

Contributing factors of wetlands conservation efforts failing to achieve significant or desired results can be a result of “weak enforcement and fragmented organizations” (Adekola et al. 2012). Although there are a multitude of policies and laws protecting wetlands, they continue to be degraded across the country. The continued loss of wetlands may be a result of weak enforcement of these regulations by regulating agencies and is amplified by the ever-wavering policy stances of new political regimes.

“Almost half of NRCS’s field offices are not implementing one or more aspects of the conservation provisions of the 1985 act as required” (US Government Accountability Office 2003). The arbitrary boundaries of wetlands areas and the organizations responsible for managing them may also reduce communication when developing wetlands management policy.

The Use and Misuse of Wetlands Definitions: How changing definitions impact policy and protections

The determination of whether an area qualifies as a wetland is based on whether it contains a specific combination of soils, plants, and hydrology. The primary guiding document for wetlands classification is the *Wetlands Delineation Manual*, produced by the US Army Corps of Engineers Waterways Experiment Station in 1987. This technical report establishes the criteria, field indicators, and methods for identifying and delineating jurisdictional wetlands in the United States. Wetlands delineation is one step required under Section 404 of the Clean Water Act (CWA). In addition to this manual, there are supplemental manuals, which provide guidance based on which specific region the wetlands delineation is being performed.

The earliest definition of wetlands can be found in the Swampbuster provisions of farm legislation and in the Emergency Wetlands Resource Act of 1986. This definition, identifying only three characteristics of a wetlands, does not get any more specific, leaving room for interpretation. This means wetland identification and delineation stands on a case-by-case basis, with the ultimate decision being made by the responsible agency as guided by the *Wetlands Delineation Manual*. To further complicate matters,

many wetlands only contain some of these characteristics for some portion of time or may not first appear to be wetlands to some.

Although there are varying definitions for wetlands, the Environmental Protection Agency (EPA), under 40 CFR 120.2, Waters of the United States (WOTUS), defines wetlands as “areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas” (Federal Register 2020). Recent changes to WOTUS are reducing the wetlands which qualify for protections under the CWA, leaving wetlands vulnerable to continued development and degradation. Wavering definitions for wetlands also leave these sensitive ecosystems vulnerable to the impacts of global climate change.

Previous studies have often ignored important factors that affect wetland persistence in the landscape, such as 1) the role of connectivity between wetlands and other water bodies in exchanging water, nutrients, and organisms; 2) spatiotemporal variation in water depth and extent that affects wetland functions; and 3) the propagation of impacts from upstream to downstream in catchments and in wetlands connected to rivers (Reis et al. 2017). Policy plays a role in the connectivity of wetlands segments, particularly in the protections under the CWA and the provisions of the section on WOTUS.

Wetlands restoration in the U.S. begins with the policy governing water and wetlands. Policy is the critical element of wetlands restoration, providing guidance for application of wetlands methods, permitting activity on the landscape, and determining if areas qualify as wetlands and subsequently for conservation of these areas.

Current Status and Extent of Wetlands

The U.S. Fish and Wildlife Service (USFWS) is the principal federal agency tasked with identifying and classifying wetlands in the U.S. Updated biannually, the National Wetlands Inventory (NWI) is the primary dataset for wetlands classification. In addition, the agency also tracks wetlands status and trends, helping identify areas which are experiencing adverse impacts. The NWI claims the identification of

wetlands at 90% accuracy, while classification accuracy is about 75% (USFWS 2023). Validation studies of NWI data have revealed that substantial numbers of wetlands were overlooked by the interpreters of the aerial photographs used to delineate and map wetland fragmentation (Stolt 1995).

Due to the nature of the *Wetlands Delineation Manual*, statistical variation exists between each individual's data collection and subsequent determination of wetlands status and extent. This variation is caused by measurement error, which is comprised of two components, accuracy and precision. Accuracy is the average measured values and the true values, while precision is how close all of the measured values are to each other (Grubbs 1973). This difference introduces statistical variation into wetlands status and extent. Additionally, the way wetlands are categorized is a much broader system and can alter the wetlands values.

Although there was a net gain of wetland land type area from 1998 to 2004 (Fig. 1), mostly due to the enforcement of the CWA and the implication of the “No Net Loss” policy, any gain is 1) comprised of open water stormwater and similar ponds (which are counted under the USFWS NWI system (Dahl 2006), 2) a simple metric of land cover type, and 3) does not replace the ecosystem services provided by the native wetlands lost.

The usual metric for wetlands overall condition is typically based on acreage. However, with recent studies on the values wetlands provide, specifically ecosystem services, my analysis shows the need to shift the focus from wetland extent to the magnitude of ecosystem services provided by the wetlands. This focus on ecosystems values helps fully replace the ecosystem services being removed by development, and subsequently restored as part of Section 404 of the CWA. A shift in direction would also place emphasis on the conservation of native wetlands as they provide a higher level of ecosystem services when compared to restored or newly established wetlands.

Wetland Policy and Law

Simply put, wetlands law is the set of standards which govern the processes and management of wetlands on the landscape. Wetlands policy is a set of protocols and procedures which are designed to

implement that law. In the U.S., this system is problematic for a number of reasons: 1) wetlands law and the protections provided by that law, are not guided by quantitative metrics for their values, 2) wetlands law does not clearly define areas on the landscape which qualify as wetlands, therefore leaving many wetlands vulnerable to threats, 3) these laws and protocols are everchanging, and consistently being challenged in court. These regular challenges in court, and their subsequent determinations, often mean another change to the law and/or policy governing wetlands. Wetlands restoration is made more challenging due to this aspect of the process.

Major Wetlands Policy Action Through History

Federal Water Pollution Control Act Amendments (1948) – established permit program regulating discharge of dredged and fill materials into waterways.

Water Bank Program (1970s) – first agricultural program to temporarily protect wetlands. Water Bank provided annual per acre payments to owners of eligible wetlands and adjacent uplands who agreed not to burn, drain, fill, or otherwise destroy the character of enrolled areas for the life of the contract. (NRCS 2023).

Clean Water Act (1972)– 40 C.F.R. Subchapters D, N, and O (Especially parts 100-140, 401-471, and 501-503).

- The EPA and Army Corps of Engineers use the 1987 Corps of Engineers Wetlands Delineation Manual and Regional Supplements to define wetlands for Section 404 of the CWA. Section 404 requires a permit for the discharge of dredged or fill material into the waters of the US, including wetlands.
- In 2008, the EPA and U.S. Army Corps of Engineers jointly established regulations clarifying requirements regarding compensatory mitigation. Compensatory mitigation means the restoration (re-establishment or rehabilitation), establishment (creation), enhancement, and/or preservation of wetlands, streams, and other aquatic resources (US EPA 2023).

- The purpose of compensatory mitigation is to offset “unavoidable adverse impacts” which occur only after proper avoidance and minimization methods are followed.

Administrations have made many changes to the CWA and WOTUS, establishing some “fast-tracking” 404 permit processes, changing how wetlands are classified and the protections they receive, and altering the compensatory mitigation practices.

Understanding No Net Loss Policy

In 1987, the US EPA convened with the National Wetlands Policy Forum (NWPF), a wide array of stakeholders whose goal was to “address major policy concerns about how the nation should protect and manage its valuable wetland resources (Wetlands Policy Forum 1988).” The forum settled on a “no net loss” approach, recommending that:

...the nation establish a national wetlands protection policy to achieve no overall net loss of the nation’s remaining wetland base, as defined by acreage and function, and to restore and create wetlands, where feasible, to increase the quality and quantity of the nation’s wetland resource base (National Wetlands Policy Forum 1988).

The EPA, under Section 404 of the Clean Water Act, addresses the discharge of dredged and fill materials in the waters and wetlands of the United States (EPA 2014). As part of this permitting process, the EPA is required to verify that any lost wetlands functions must be restored through the mitigation process of creating new wetlands or preserving existing wetlands and enhancing their functionality.

Unfortunately, performance reporting from the EPA’s annual plan assumes all mitigation efforts will meet performance standards. To compound the issue, there is no comprehensive wetland survey currently which can detail precisely the current status of our nation’s wetlands (NWF 2005).

Under the Section 404 program, not all wetlands are treated equally. There are a number of activities exempt from the regulatory requirements. As part of the 1977 statutory provisions, which include farming, ranching, and forestry (as specified in Section 404(f) and previously converted croplands (wetlands drained, dredged, filled, leveled, or otherwise altered before December 23, 1985, to promote

agricultural production). One possible solution to avoid the varied treatment of wetlands is to develop and implement a tiered wetland classification system. A tiered wetland classification system would designate particular wetlands as having the highest value, and therefore the highest level of protection, and less valuable wetlands where alteration would be allowed for the sake of political, social, or economic benefit.

Influential Court Cases

The first jurisdictional question to reach the Supreme Court was whether Section 404 of the Clean Water Act applies to wetlands that are adjacent to navigable waterways, but not necessarily navigable waterways themselves. In *United States v. Riverside Bayview Homes Inc.* (474 U.S. 121 (1985)), the court unanimously agreed that the Army Corps of Engineers could in fact regulate such wetlands. They determined the Corps had authority to regulate wetlands due to the fact they are “integrally” connected to navigable waterways, meaning they supported the flow of these navigable systems. Without this decision, agencies would not be able to protect the quality of navigable waterways without the ability to protect adjacent wetlands.

This decision led to the question of whether the Corps had authority over isolated wetlands, or wetlands which on the surface, sit apart from navigable waterways. Specifically, the Corps noted the importance of these isolated wetlands as migratory bird sanctuaries, and therefore the need to protect them. The Supreme Court decided in *Solid Waste Agency of Northern Cook County v. United States Army Corps of Engineers* (531 U.S. 159 (2001)), that the Corps did not in fact have authority over these isolated wetlands, stating the migratory bird rule overstepped the Corps regulatory powers. After addressing wetlands adjacent to navigable waterways, and wetlands isolated from waterways, the next question brought to the Supreme Court pertained to wetlands connected to navigable waterways through ditches, drains, and creeks.

In *Rapanos v. United States* (547 U.S. 715 (2006)), the Supreme Court ruled the “waters of the United States” include only “relatively permanent, standing or flowing bodies of water,” not “transitory puddles or ephemeral flows of water.” One aspect influencing this ruling was the implications of this broad

interpretation of a wetland's definition. In regulating the authority of the Corps, the Supreme Court decided this interpretation would allow the Corps too much authority over interstate waterways. As part of this ruling, Justice Kennedy stated the Corps needed to show “significant nexus” between the wetland in question and the navigable waterway, measured by the wetland's contribution to the chemical, physical, and biological integrity of the waterway, in order to have authority over that waterway.

In the recent supreme court case *Sackett v EPA* (598 U.S. No. 21-454, 2023) decided in 2023, the definition of wetlands was once again challenged. On a recently purchased property in Idaho, the Sacketts had begun backfilling in preparation to build. The EPA informed them in 2021 the property contained wetlands, and their backfilling had violated the Clean Water Act, which prohibits the discharge of pollutants into “waters of the United States.” The EPA claimed the area on the property qualified as “waters of the United States” because of its proximity to a ditch, which subsequently fed into a creek, then a lake, a navigable body of water. The court ruled in favor of the Sacketts, stating the property in question did not qualify as wetlands and therefore were not protected as “waters of the United States”. In light of this decision, the EPA and U.S. Department of the Army produced an amendment to the 2023 definition of “waters of the United States”. This court decision means wetlands which do not directly adjoin rivers, lakes, or other bodies of water, no longer qualify as wetlands. This decision impacts many swamps, bogs, fens, and marshes around the country which do not have a surface water interface.

These decisions are important in the world of wetlands policy and law because they set precedents for future policy and litigation in the courts. The question “what qualifies as ‘waters of the United States’?” is the crux of wetlands protections in the United States. With the ebb and flow of wetlands protections based on Section 404 of the CWA, and the definition of “waters of the United States”, regulatory agencies remain in limbo when attempting to implement the laws and policies developed to protect wetlands.

Wetlands Policy Actors

Private Entities and Initiatives (*American Rivers, Ducks Unlimited, Society of Wetland Scientists*):

Ducks Unlimited (DU), started in 1937 during the Dust Bowl when North America's drought situation caused severe declines in waterfowl populations in the country, is one of the foremost organizations supporting wetlands in the U.S. In support of waterfowl, DU's mission is to conserve, restore, and manage wetlands and adjacent habitats in North America. In February 2022, numerous partners, including DU, were awarded \$1 billion dollars in funds for the federal Great Lakes Restoration Initiative. This project aims to improve Great Lakes Areas of Concern through wetland conservation. The Great Lakes provide drinking water for over 30 million people and habitat for 3,500 species of fish and wildlife. Without efforts from private entities like DU, these projects would be less efficient and successful.

Private entities such as DU are important as they are able to bridge the disconnect between federal, state, and private organizations. Private entities are able to take advantage of various government funding programs which support wetlands conservation and restoration. When private entities are able to obtain this funding, they also bring with them a large audience which both funds and supports these private organizations through donations and volunteering, helping to make conservation efforts more achievable.

State and Local Actors (*Association of State Wetland Managers, Montana Fish, Wildlife & Parks*):

Low-tech, process-based stream restoration projects on the landscape are only one example of land managers applying law and policy. Restoration efforts which utilize beaver and beaver analog methods, is an example of agency actions aiding wetland restoration. Such actions can be carried out as part of existing policy, yet also provide new directions in practical restoration activities that help shape policy directions. At the state level, Montana Fish Wildlife & Parks (MT FWP) biologist Torrey Ritter, has been working to identify the importance of beavers in the ecosystem, and how we as humans can utilize the beaver as a land rehabilitation tool (MTFWP 2021). Initial steps of this work require an understanding of where beavers currently exist on the landscape. The combination of aerial imagery and data collected in the field are used to evaluate the status of beaver on the landscape. This information helps identify

ideal areas for reintroduction and colonization. After selecting degraded sections of stream, MTFWP installed low-tech, process-based beaver mimicry structures. This early restoration work provides steppingstones for beavers to reestablish in the area. These cheap and simple restoration techniques will then be applied to tributaries, further encouraging existing beaver populations to colonize these areas they had previously abandoned due to degradation.

The use of low-tech, process-based stream restoration methods allows managers to successfully implement projects with low staff and little funding. By identifying historic beaver habitat in the early surveys, biologists hope to increase the odds of beaver recolonization in newly restored stream reaches. When beavers recolonize these areas, there is a chance they will adopt the restoration efforts, continuing the redevelopment of the wetland on the landscape.

Federal Agencies

Federal agencies and programs involved in wetland conservation in some way include the Environmental Protection Agency, U.S. Geological Survey: National Wetlands and Aquatic Research Center, Natural Resources Conservation Service: Stream Restoration, NRCS: Wetlands, NOAA Habitat Conservation/Restoration Center, USACE: Wetlands Research and Technology Center. Several examples illustrate the role federal agencies play, and the ways that the agencies seek to advance wetland conservation.

A stream restoration project using beaver dam analogs, on the Scott River, located in California, conducted by the Scott River Watershed Council in conjunction with the U.S. Forest Service & NRCS, saw many hydrogeomorphic and ecological benefits resulting from wetland restoration. Benefits ranged from the creation of slow-water habitat for salmonid species upstream of the BDAs, increases in rearing capacity of juvenile salmonid species, raised surface water levels upstream of BDAs, increased groundwater levels in the immediate restoration area, restored perennial streamflow both above and below BDAs, cooler water temperatures in BDA ponds, and an increase in beaver activity around BDAs (Yokel et al. 2018).

The removal of excess nutrients from the water improved overall water quality resulting in improved habitat for fish and aquatic life. In the Scott River restoration project, juvenile salmonid rearing was improved in slow-moving water habitat in the ponds upstream of BDAs. The restoration project conducted a passive integrated transponder (PIT) study in 2017. The study found 97% of juvenile Coho salmon moved above one BDA, while 89% moved upstream of both BDAs. Juvenile salmon were more likely to cross BDAs by jumping over them rather than using side channels for passage, reinforcing the theory BDAs improve fish passage in a watershed (Lokteff et al. 2013). Adult salmon were able to spawn above all BDAs every year after construction. Total area of wet habitat (i.e., streams, ponds, permanently inundated wetlands) increased by 11%, creating habitat for all life stages of salmonid species. Habitat rearing capacity for juvenile Coho salmon increased by 2000% when compared to pre-project numbers (Yokel et al. 2018). This habitat is likely to continue developing with an observed increase in beaver activity in the restoration area. Beavers were observed expanding and maintaining artificially installed BDAs (Goldfarb 2018).

The installation of BDAs increased surface water elevation above dams. This increase in surface water helped to retain flow throughout the summer months in reaches that had historically run dry. The Scott River Watershed Council estimated 1,600 linear ft. of stream above and below BDA installation sites were previously observed to go dry but retained water throughout summer months following implementation. In addition to surface water increases, groundwater levels increased as well. It is estimated groundwater rose at least 15 cm for every 30 cm of height BDAs were raised; this effect was noticed nearly 1 km upstream of restoration sites (Yokel et al. 2018). Groundwater levels increased as far as 350 meters downstream, however these increases were not as significant as upstream increases. BDAs also increased groundwater recharge and storage capacity during high winter and spring flows (Westbrook et al. 2006; Yokel et al. 2018).

BDA installation created deep cool pools upstream of dam locations. Overall, stream temperatures cooled during the months after installation. These temperatures were in the optimal range for Coho salmon and other salmonid species. However, some temperature spikes were observed in summer months

in sites with very low flow conditions. With increased time and development of BDAs, these spikes were reduced in the following seasons. The ability to hold larger volumes of water in upstream ponds buffer temperature spikes (Majerova et al. 2015). Side channel sites also benefited from the installation of BDAs, with lower observed temperatures throughout summer months (Yokel et al., 2018). The high biological productivity of wetlands and strong selection pressures of an aquatic system have produced biodiversity richness only observed in wetlands (Gibbs 1995).

Although the Scott River BDA restoration project is only one example of the outcomes of BDA installation, it observed outcomes similar to other BDA projects throughout the U.S. Further analysis of observed outcomes of additional restoration projects, over a longer period of time would help increase confidence in the data, as well as improving methods of monitoring and installation. Nevertheless, the benefits BDAs provide a watershed far outweigh the potential negative impacts. Overall, low-tech process-based restoration practices are low risk and high return, requiring fewer resources to accomplish similar objectives of more expensive restoration practices. Because low-tech, process-based methods are efficient, low risk to stakeholders, and require minimal resources they fulfill the effectiveness principle in a systematic conservation plan.

These are examples of policy being effectively applied on the landscape by varying levels of agencies. But how can we develop a more uniform framework for all agencies to apply? One possible solution is the application of a systematic conservation planning approach, which incorporates low-tech, process-based methods to restore wetlands.

Wetlands Restoration Solutions

Systematic Conservation Planning

Originally developed in 1983 by Kirkpatrick, systematic conservation planning works to address the issues we encounter in restoration and conservation work. Despite the common objective to protect wetlands, there is no unified assessment approach, as each is designed to address specific goals (Kleindl et al. 2023). The incorporation of a broad and systematic approach with specific objectives into the public

policy framework would aid land management agencies in preventing further loss of wetlands and increase the effectiveness of restoration efforts. Systematic conservation planning is a multi-step operational approach that was developed to increase conservation efficiency and facilitates a transparent, inclusive and defensible decision-making process (Cimon-Morin and Poulin 2018). Systematic conservation planning seeks to identify configurations of complementary areas that achieve explicit and generally quantitative conservation objectives (Pressey et al. 2007). Dynamic frameworks are needed in systematic conservation planning to account for the temporally variable connectivity of natural wetland mosaics in the landscape. The key steps in the development of a systematic approach include: 1) collecting data on biodiversity features and setting quantitative targets about their desired conservation outcomes, 2) listing management options, their costs and the impacts on stakeholders, 3) setting constraints (maximum cost or impact on stakeholders), and 4) maximizing the outcomes under these constraints (Margules & Pressey 2000).

In a study of applying a systematic conservation planning framework, Cimon-Morin et al. (2014) found that targeting the functional human-ecosystem services when using a systematic conservation approach enabled projects to achieve conservation objectives more effectively. Specifically, restoration efforts should be designed by setting conservation objectives for ecosystem services supplied with regard to cost efficiency. Another analysis of systematic conservation planning in freshwater ecosystems identified additional guiding principles of systematic conservation planning (Linke et al. 2010). In my analysis, one new guiding principle is introduced, comprehensiveness. Other analyses of systematic conservation planning also include connectivity as one of the guiding principles. For sake of my analysis, all guiding principles were analyzed in an effort to identify the best practices when applying a systematic conservation approach to wetlands conservation and restoration.

There are six guiding elements of systematic conservation planning which all work together to develop successful management strategies (Watson et al. 2011):

1) Representativeness – fundamental principle in systematic conservation planning; refers to how well protected area networks contain representative samples of every feature of biodiversity that we aim to protect.

2) Persistence (adequacy) - protected areas should be designed to maximize persistence; this involves the analysis of viability of restoration efforts, the configuration of protected areas (connectivity vs. fragmentation) and predicting which ecological processes are needed to sustain biodiversity.

3) Efficiency – when the impact of conservation actions on the rest of society is minimized, there is a better chance for the action to succeed politically and socially. Managers should strive to achieve biodiversity objectives at the lowest possible cost. This cost may reflect the financial burden of implementing and managing restoration projects but can also include the costs of lost opportunities for economic development. A key advantage of systematic conservation planning lies in its holistic, complimentary based approach, helping to reduce the impact of conservation on other stakeholders (Linke et al. 2010).

4) Flexibility – many restoration objectives can be achieved through various methods. It is important for management agencies to consider economic, political, and social elements of restoration projects, this means a key principle of the overall project is flexibility.

5) Comprehensiveness – comprehensive approaches include full ranges of species, processes, and ecosystems in the study region (Linke et al. 2010; Possingham et al. 2006). Systematic conservation plans should be developed to avoid bias towards certain species or bioregions. These biases often arise from data limitations, spatial and temporal scope of the project, and varied degrees of degradation.

6) Connectivity – connectivity generally speaks to the exchange of elements between two habitats, communities, or ecosystems (Daigle et al. 2020). Connectivity is both spatial (e.g., hydrologic connectivity) and non-spatial (e.g., disease, genetics). Connectivity is an important element to include in systematic conservation planning, as it helps to fulfill the comprehensive guiding principle through the inclusion of all elements of a given system. When designating reserve areas (or areas where restoration is

being performed), the goal should be to represent the biodiversity of the region while separating this biodiversity from the processes which are threatening them.

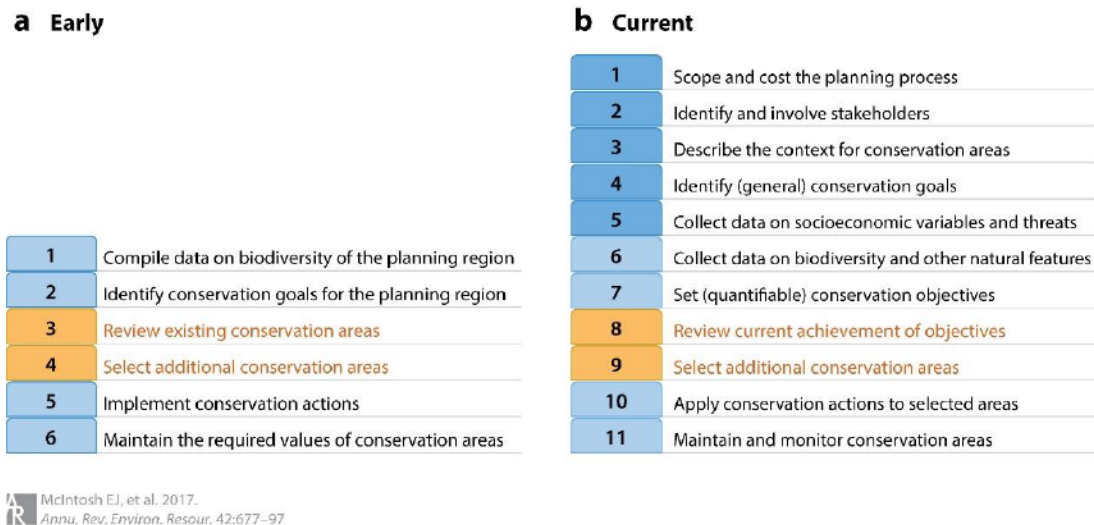


Figure 2. Stages of systematic conservation planning. Systematic conservation planning is an iterative process, rather than linear, and feedback in response to new data or considerations with stakeholder engagement throughout. Orange stages focus on spatial conservation steps. Source: McIntosh et al. 2017.

Systematic conservation plans developed by these guiding principles are the most effective way to move forward with freshwater ecosystem conservation. It is important to define where systematic conservation planning will exist in the world of wetlands policy. This approach will act as a guide for individual wetlands conservation, restoration, and newly established wetland areas. As an example, when Section 404 of the CWA requires the establishment of “new” wetlands to counteract the destruction of other wetlands, the systematic conservation framework will be applied to guide where, how, and to what extent the replacement wetlands are established. Under this holistic approach, all elements of wetlands restoration are addressed, helping to resolve the issues seen in current policy.

To provide clarity for the variety of agencies at play in wetlands conservation, states are often turning to developing their own framework. One recent example of this is California’s development of the *California Environmental Flows Framework* (California Water Quality Monitoring Council 2021). This

document provides technical guidance to help land managers efficiently develop scientifically defensible environmental flow recommendations. These recommendations include instream flow amounts which strike balance between human and ecological demands for water. As with most frameworks being developed, the hope is to improve the speed, consistency and standardization by which these decisions are made statewide. One common issue with all policy, framework, and law is the reliance on vague definitions which are changed through significant court litigation and decisions.

Economic and social values protected and established as part of wetlands conservation and restoration should be an objective and quantitative measure of effective systematic conservation planning. Social and economic impacts are more easily measured and can help agencies promote conservation and restoration of wetlands on the landscape. Through a systematic conservation plan with a focus on quantitative objectives, agencies are also able to portray the value of these efforts to the public, gaining public trust, and future public support of these actions.

With a clear focus on quantitative objectives in conservation and restoration planning, agencies can more effectively implement land management practices which protect against the various threats to wetlands in the present and future. It is important to identify these threats and how they may impact the values wetlands bring to the landscape, to develop a systematic conservation plan more effectively.

As part of the systematic conservation planning approach, it is important to identify wetlands restoration methods which effectively fulfill the requirements of the guiding principles. Low-tech, process-based wetlands restoration methods, including post-assisted log structures (PALS) and beaver dam analogs (BDAs), are two examples of these methods.

A systematic conservation plan developed for the restoration of wetland environments requires locating, configuring, implementing, and maintaining these areas to promote the persistence of the biodiversity and values included within and provided by these areas. Through a holistic approach, including both spatial and temporal aspects of wetlands, restoration practices should work to restore the values native wetlands provide. This approach should address the fact that biodiversity and wetland values are not static in nature, and continually develop through natural processes (e.g., beaver

reintroduction following recently restored and newly established wetland development. It is also important to conserve both native and restored wetlands from the adverse impacts humans are having on these sensitive areas. Through well-designed, systematic conservation planning methods, these desired outcomes can be achieved.

Although the list of physical and biological processes in nature is endless, ecosystem processes should be identified to both guide and develop monitoring programs for wetlands restoration efforts. When selecting these processes, it is important to select processes we know and understand, especially in the context of spatial limitations. Processes which are directly affected by restoration efforts can be effective tools for monitoring project success. As an example, fine-scale processes like soil inundation are a quality candidate to track change as it is easy to monitor and operates within achievable spatial and temporal boundaries. However, broad-scale processes such as hydric soil development, are beyond the influence of restoration efforts, as these processes operate on large temporal scales.

“Planning only for biodiversity pattern is likely to jeopardize the persistence of many processes, especially those requiring conservation management over large or specially configured areas” (Pressey et al. 2007). As part of the guiding elements of the systematic conservation planning approach, efficiency of conservation efforts would be increased through the inclusion of lateral and longitudinal components of the wetlands area, fulfilling the comprehensive and connectivity elements of the plan. In addition to spatial scales, it is also important to include the temporal modifier when operating in wetlands ecosystems. In particular, wetlands which are prone to seasonal connectivity to adjacent habitats. This seasonal connectivity is easily misidentified depending on timing of project and can lead to the failure of the wetland project area to qualify for protections under the ever-shifting definition of WOTUS.

The goal of any restoration effort on the landscape is to develop a plan which will naturally continue development and improvement of ecosystem services. In wetlands restoration projects applying low-tech, process-based methods, this means the reintroduction of beavers to these native ecosystems. This restoration to the native condition means human influence is no longer necessary for the landscape to sustain the ecosystem services and values provided by wetlands.

Inclusion of Low-tech, Process-based Wetlands Restoration Methods (PALS and BDAs) & Beavers

Beavers are ecosystem engineers, being the only organism, other than humans, capable of creating wetlands (Muller-Schwarze 2003). When a beaver dam is constructed, the area behind the dam becomes flooded, converting a stream or channel into a pond or series of smaller ponds (Whiles 2013). Upland trees suffer one of two fates, being used for food and construction material for the dams by beavers, or dying when the upland soil floods and becomes anoxic. This loss of trees opens the canopy above the newly formed pond, initiating the growth of aquatic plants (Parker et al. 2007). This condition can last for many years, but eventually the beaver will move out of the system, causing the dams to breach and drain the ponds, allowing upland trees and shrubs to reestablish in the habitat (Hay 2010).

This period of inundation is key to many hydrologic, biogeochemical, and ecological processes (Naiman et al. 1988; Naiman et al. 1994). Ponds created from damming hold more precipitation and snowmelt, slow velocity, control discharge, and allow sediment flowing downstream to settle. Additionally, the capacity to slow and hold larger quantities of water for longer periods of time has the potential to raise the water table and change oxygen dynamics in the system. This change in oxygen regime will shift vegetation from upland to hydrophytic vegetation (Mitsch et al. 2009). Each of these factors play an important role in the development and expansion of wetlands. These wetlands expand, providing more habitat for fish, wildlife (waterfowl in particular), and vegetation.

To replicate the benefits beaver activity has on a watershed, restoration methods called beaver dam analogs (Pollock et al. 2014) or post assisted log structures have been developed (Fig. 3). Of the various ways to restore wetlands, low-tech process-based methods are practical, affordable, and can be applied to different types of wetlands across the globe (Wheaton et al., 2019). BDAs are human-made structures installed to mimic dams created by beavers. These low-tech process-based installations are a simple, cost-effective, and non-intrusive approach to replicating the effects beaver activity has on a landscape. Typically, BDAs are installed in areas where a wetland has been drained or channelized, degrading the natural characteristics of the area. They are used to reestablish and restore wetlands damaged through anthropological activity, including development, agriculture, and mining (Pollock et al. 2007). The goals

of BDA installations are to reestablish the once native extent of the wetland in a manner designed to be autonomous in its continued development through time (Wheaton et al. 2019).

The use of a low-tech process-based restoration method such as BDAs allows land managers and agencies to remedy degraded wetlands through cost-effective and non-intrusive means. These methods also fulfill many of the guiding principles in a systematic conservation plan.



Figure 3. Two examples of Beaver Dam Analogs and Post-Assisted Log Structures installed in Western streams. Branches and organic material are woven between the posts to mimic beaver dams, slowing the flow of water, causing ponding. Sources:

USDA & Mitsch et al. 2009.

Managing Threats in Conservation Planning

Expanding threats to wetlands can be addressed through three approaches: 1) adjusted representation targets, 2) locating threat-specific actions, and 3) scheduling conservation actions (Pressey et al. 2007). Larger representation targets are recommended for biodiversity features which may not subsist outside of the spatial scope of the project. Effective conservation planning can also include a variety of threat-specific actions. Appropriate actions within or outside of project areas can include the management of disturbance vectors (reduce activity on landscape), restrictions against harvesting, and restoration of native conditions. Scheduling conservation actions involves planning the order of events in which areas will be actively managed throughout the whole development of restored areas. The key here is

acknowledging the timing of restoration project development and how it relates to the development of dynamic threats operating adjacent to wetlands. Conservation outcomes are poorer if expanding (dynamic) threats are ignored as compared to when they are accounted for through the scheduling of conservation actions (Pressey et al. 2004).

Wetlands often exist in these dynamic areas, where urban and agricultural development is common. Therefore, restoration areas are particularly susceptible to the impacts of dynamic threats, and systematic conservation plans must include actions to mitigate these threats.

Potential Areas of Concern

Conservation planning on today's landscape faces three broad challenges as identified by Pressey et al. (2007):

- 1) biodiversity processes always need attention, regardless of whether they are explicitly recognized,
- 2) most planning situations involve dynamic threats, regardless of whether they are considered, and
- 3) modern land management agencies are realizing shortcomings in management practices, but many remain distant from adopting systematic methods and the roles modern conservation tools can play.

Although there are many positive impacts low-tech, process-based restoration methods bring to a watershed, there are also areas of concern which cannot be ignored. Unpredictable responses, including flooding due to overestimated structure success or structure failure can damage infrastructure in adjacent areas (Charnley et al. 2020). Flooding and structure failure also have the potential to create new stream channels in undesirable areas. Any damage to BDA structures requires additional time, money, and resources to repair and maintain. But under the "risk to stakeholders" section of a systematic conservation plan, they are still relatively low risk.

Discussion

Alternative Policy Approaches: Suggestions for the Future

Wetland policy and law should be guided by a valuation framework, helping to bring consistency to the management of wetlands in the US. This valuation framework should be developed with each of the guiding principles of a systematic conservation plan (Reis et al. 2017). The organization of systematic conservation planning ensures decisions include all threats, values, actors, and policy involved in wetlands protection efforts. My analysis shows these guiding principles, paired with objective, ecosystem value-based goals, will help produce a successful wetlands restoration policy. Not all entities operate under the same guidance when making decisions about wetlands conservation and management. Policy should encourage the application of effective and practical approaches to wetlands management. One example of a framework was developed in the state of California, with the CEFF, however implementing a systematic conservation plan framework which crosses arbitrary physical land boundaries would further improve efficiency and consistency in wetlands management. A valuation framework for wetlands preservation should also include guidance for monitoring the development of projects.

My analysis has also shown the need for a more stringent pre- and post-monitoring framework of wetlands restoration work which will promote the effective application of different wetlands conservation and restoration approaches across all agencies. Increased efficiency in wetlands restoration work will help stretch limited funding for these projects, while gaining public trust in the process. Additionally, a consistent process for selecting wetlands eligible for restoration, determining which approaches fit each wetland best, and effective post-monitoring of wetlands restoration work, will all contribute to our overall understanding of wetlands restoration and conservation.

Developing a better framework for wetlands policy is one way in which we as the public can hold politicians and agencies accountable for the funding and processes applied to conserving our critical wetland resources. My analysis suggests the implementation of a systematic conservation planning model would promote effective restoration. Additionally, through my analysis of various conservation

approaches determined the application of wetlands restoration policy needs political and social success to provide a platform on which to build further actions.

Figure 4 helps illustrate the interconnectivity of policy, science, actors, and practice and how they produce various outcomes. By applying a more holistic approach, such as a systematic conservation plan, to wetlands policy development, we improve the overall outcome.

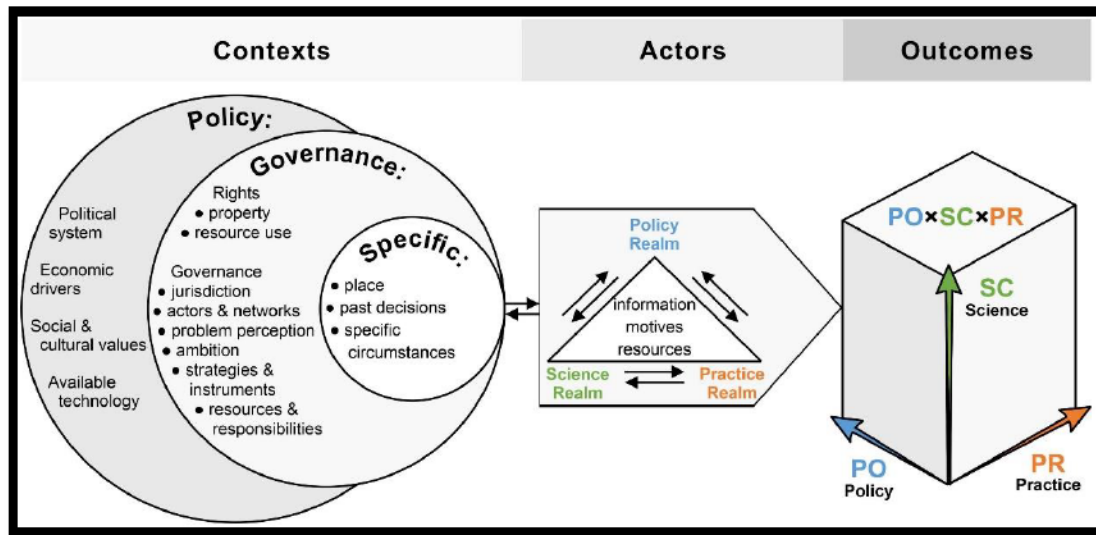


Figure 4. The various components that influence decision and action of wetland restoration. This figure helps to visualize how policy, science, and the application of methods come together in the production of wetlands. (Clare et al. 2022).

Conclusions

This analysis of wetlands policy elucidates five main ideas and directions for solutions to current problems:

- 1) The establishment of a framework based on the Systematic Conservation Planning model would include new methods which solve many of the issues identified in this analysis. A systematic conservation planning model would provide a consistent framework for multiple agencies to implement, helping to address the issue of crossing physical boundaries such as state or federal lands. A systematic conservation approach also puts an emphasis on ecosystem values provided

by wetlands rather than simply wetlands acreage. This helps with efficiency and the protection of wetlands which provide the most human-ecosystem value.

- 2) It is important the Systematic Conservation Plan includes an element identifying the difference between replacement wetlands (as part of the Section 404 permit mitigation requirements), restored wetlands, and the conservation of native wetlands. Specifically, the conservation plan should emphasize the importance of the ecosystem services provided by the wetland. This focus on the services provided by the wetland is important because of the varying degrees of services each wetland type provides. For example, a newly established wetland may provide recreational and water storage services to the landscape, but it will fail to provide water purification services.
- 3) Low-tech, process-based restoration methods, including BDAs and PALs are a good fit for Systematic Conservation Plans, as they restore degraded wetlands and streams in a cost-effective manner. Additionally, they can easily be developed to check each of the four boxes of the Systematic Conservation Plan criteria, which means the new policy is more likely succeed politically, economically, and socially, establishing a strong platform to continue to expand conservation actions upon.
- 4) As included in a systematic conservation approach, an amendment should be made to Section 404 of the Clean Water Act to require pre- and post-monitoring of restoration projects which focuses on identifying the functional wetland values which have been lost and or restored. This will hold permittees more accountable when replacing wetlands which are being developed. Instead of basing the replacement on land cover (acreage), the permitting process will require the replacement of the functional services the native wetland provided originally.
- 5) To ensure the success of the systematic conservation planning approach, wetlands restoration policy needs to address the dynamic threat of human alteration to these vulnerable pieces of the landscape. To combat the challenge of working in a dynamic landscape, policy must be designed with flexibility, a key component of systematic conservation planning, to allow for adjustments as new data is collected about wetlands conservation.

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