yet been established and water quality is difficult to measure, due in part to the highly variable and seasonal surface water characteristics of most wetland types.

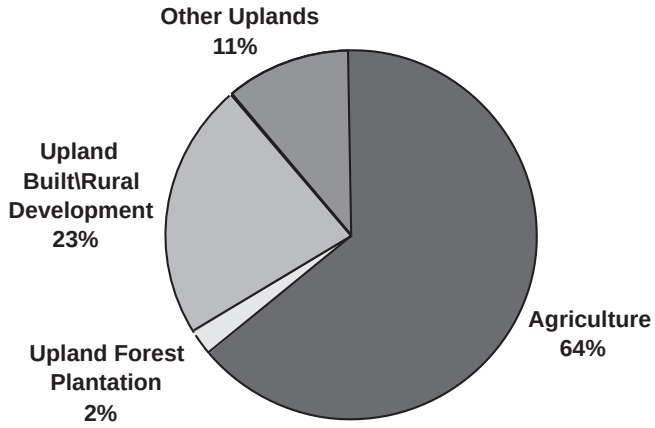
Threats, strengths, and examples

Wetland resource health can be adversely affected either directly or indirectly by human activities. Activities such as filling, draining and discharge of pollutants directly eliminate or degrade wetlands. Activities such as groundwater withdrawals or poor upland land management indirectly degrade adjacent wetlands. In highly altered regions such as the Willamette Valley or Coastal lowlands, the types, distribution, and functions of wetland ecosystems are far different than they were historically, which increases risk and also constrains management and restoration options. In addition, it is important to recognize that activities that cause wetland loss and degradation are sometimes indirectly promoted through public policies and programs intended to achieve other social or economic goals, such as economic development, increased density requirements within urban growth boundaries, waterfowl management, or protection of farmland (some of which is wetland).

Regulations and policies aimed at maintaining Oregon's wetland resource base have significantly reduced, but not prevented, wetland loss. A recent study of wetland change in the Willamette Valley ecoregion found that between 1982 and 1994, wetland loss continued to occur at an average rate of 546 acres per year (Daggett et al., 1998). A total of 6,877 acres of wetland were converted to upland land uses, representing 2.5 percent of the 1982 wetland acreage in the valley (**Figure 3.4-1**).

Although wetland condition was not directly evaluated, changes between wetland types provide indirect information about wetland degradation. For example, conversion of forested wetland to farmed or other emergent types (2,200 acres) indicates a loss of structurally complex wetland habitat, including riparian habitat. The study also revealed wetland gains, mostly from abandoned or intentionally restored agricultural land. However, losses continue to outpace gains by about three to one.

Figure 3.4-1. Causes of net wetland loss to Willamette Valley upland, 1982 to 1994.



Because impacts and trends vary considerably among regions, a similar study has been initiated for the Coast Range ecoregion. The results of this study should be available in 2002.

Threats to wetlands vary greatly by ecoregion and dominant land uses. For example, in the Great Basin ecoregion, major risks include poor grazing management and invasive species, whereas in the Willamette Valley ecoregion the major risks include fill for development, increased agricultural drainage, fragmentation, and pollution from urban and agricultural runoff.

Current threats to wetland health include:

- Loss due to unregulated (no permit required) or unpermitted (violation) urban and rural development (Shaich, 2000)
- Loss or degradation due to agricultural expansion or improved drainage on existing fields (USFWS, 1997; Morlan and Peters, 1999)
- Loss or degradation due to surface water diversion, groundwater withdrawal, ditching streams, and stormwater systems designed to move water quickly off the landscape (Boggess and Woods, this report; Oregon Division of State Lands, 1989)
- Grazing activities that damage vegetation and degrade streams, which lowers water tables, thereby drying streams and adjacent riverine wetlands (Kauffmann et al., 1985)
- Eutrophication due to nitrogen or phosphorus loading from agricultural or urban runoff and insufficient wastewater treatment (Adamus, 1998)
- Degradation by contaminants such as heavy metals, pesticides, oil and other pollutants and by sediment overloads from poor management of adjacent uplands
- Invasive, non-native plant and animal species that replace native species (Arnold and Anthony, this report)
- Fragmentation of wetlands into smaller, isolated units that become more vulnerable to eradication; fragmentation also impedes wildlife movements between habitat types and the smaller wetlands cannot support wildlife species that require large habitat units (Gibbs, 1993).

A number of wetland resource strengths can also be identified. Wetlands tend to be highly resilient, absorbing a considerable amount of abuse while still providing valued services. Also, wetlands that are degraded from a wildlife habitat standpoint, for example, may still provide a high level of flood storage. Many degraded wetlands can be restored to highly functional, if not historical, condition with minimal cost. In addition, degraded wetlands are often "self-restoring" if the actions that cause chronic degradation—such as cultivation, levees, or pollutants—are removed or minimized.

Since the late 1970s, many public policies, regulations and programs—and numerous private programs—have focused on protecting and restoring wetlands. Examples include:

- State Removal-Fill Law—requires permit for wetland alterations and compensatory mitigation for permitted wetland impacts
- Sections 404 & 401 of the federal Water Pollution Control Act—similar provisions to above law and water quality standards for receiving waters
- State and federal policies setting goal of "no-net-loss" of the wetland resource
- Statewide Land Use Planning Program—cities and counties must develop protection programs for wetland resources under Goals 5 and 17
- Acquisition of important wetland sites by land trusts and public land management agencies
- Substantial increase in public funding for voluntary wetland/aquatic system restoration

The city of Eugene provides the most prominent example of successful wetland planning by a local government in Oregon. When the city discovered that much of the industrial-zoned land in West Eugene was wetland, the city embarked on developing a Wetland Conservation Plan (WCP). WCPs are an optional approach to Goal 5 wetland protection programs—more difficult to develop but with a larger "payoff" in terms of both resource protection and development certainty.

The West Eugene Wetland Plan was adopted in 1992 and approved by the state in 1994. Plan elements include a detailed wetlands inventory and function and value assessment; plan goals; designation of wetlands for protection, restoration or development; a mitigation bank program; and an acquisition program for priority wetlands (City of Eugene and Lane Council of Governments, 1992).

The plan accomplished several wetland protection goals, including land use designations and zoning provisions that provide an additional level of protection, and public acquisition of more than 2,200 acres of wetlands and adjacent uplands from willing sellers. The plan also provided advantages for developers and the business community through plan designation of specific wetlands or portions of wetlands for development, state and federal plan approval which speeds permitting for development parcels, and a mitigation bank program operated by the city, which provides an alternative for developers to meet compensatory mitigation needs in a timely, relatively hassle-free, manner.

As was envisioned in the goals, the plan has facilitated a co-evolution of economic growth and wetland preservation in the West Eugene area (Lane Council of Governments, 1999).

Significant ant numbers of acres of drained or diked wetlands are being restored throughout the state. For example, the Klamath Basin in the East Cascades ecoregion has been subjected to massive drainage activity dating back to the Swampland Act in 1860 (Fretwell et al., 1996). During the past fifty years, approximately 30,000 acres of wetlands adjacent to Upper Klamath Lake have been diked and drained. At the same time, water quality in the lake has declined and two indigenous fish species—the Lost River and shortnose suckers—have been listed as endangered.

In response to these concerns, a local citizens group proposed federal acquisition of drained wetlands for the purpose of wetland restoration. Congress appropriated $2.4 million for the Bureau of Land Management to purchase the 3,200 acre Wood River Ranch property. Numerous partner groups helped to develop a resource management plan and fund restoration work.

Restoration was begun in 1996. Habitat restoration will include 1,600 acres of seasonal wetland, 1,200 acres of permanent marsh, and more than six miles of meandering stream channel habitat. In addition, 1.7 miles of the lower Wood River channel will be restored along with 25 acres of adjacent floodplain wetland (Wedge Watkins, pers. com., 1999).

Projections and conclusions

Data are not available for making accurate projections for wetland resource health but are sufficient to conclude that risks outweigh strengths. The best available data, from the Willamette Valley study, indicate that wetland losses will continue, though at much slower rates than estimated historical loss rates. Public awareness of wetland functions and services, and resultant policies and laws aimed at wetland protection and management, have slowed the rate of wetland loss. There are limited reliable data, however, on wetland health trends.

Certain trends can be expected to continue, even though the rates and resource health impacts cannot be accurately predicted. Continued population growth and economic development inevitably increase risk to wetland resource health. Direct losses of wetlands and degradation of wetland health will continue to occur. Wetlands most at risk will be the "drier" wetland types and those in urbanizing areas because they will be under the most pressure for conversion to other uses. Cumulative impacts—the accumulation of many individual actions that combined degrade wetlands—can be expected to increase, particularly in the most populated and rapidly-growing regions of the state like the Willamette Valley, Umpqua and Rogue River Valleys, and the Coast.

Unpredictable factors that could substantially affect wetlands include:

- Climatic fluctuations—wetlands are transitional between uplands and aquatic sites and even small changes in

groundwater levels can dramatically affect wetland persistence and health.

- Agricultural practices—changes in practices, economic conditions, or environmental policies and regulations can increase or decrease manipulation of agriculturally managed wetlands.
- Economic conditions—commercial, industrial and residential development is directly related to general economic trends.
- Public/political will to support or improve wetland protection laws and programs and to adequately fund local wetland planning and wetland resource acquisition and restoration.

Without changes in the current wetland management regime, data and trends indicate that wetland ecosystem health will continue to deteriorate. Wetland regulations alone are not sufficient for protecting wetland functions and services. Regulations are not comprehensive, it is difficult to address cumulative impacts or multiple objectives through a regulatory program, and the burden falls unevenly on wetland landowners. Wetland planning in urban areas has the potential to resolve many wetland use conflicts and protect important wetland resources through appropriate zoning and land use regulations. For it to work well, financial and technical assistance is crucial.

Wetland protection through acquisition or restrictive covenant and wetland restoration by private and public entities are also crucial and such programs have grown dramatically in the last decade. Most of the funding has been provided by federal programs. Challenges include using public funding for aquatic resource restoration strategically to ensure that landscape-scale functions and processes are restored and projects are sustainable over the long term. Effective restoration is needed not only to "hold the line" on wetland resource loss but to restore some of the state's original wetland resource base (Good & Sawyer, 1998). A "net gain goal" of wetland area by 2020 would help to move the state in that direction.

What data are available and how complete are they?

Estimates of historical wetland loss in Oregon are approximate and drawn from a variety of sources (Akins, 1970; Oregon Division of State Lands, 1989; Dahl, 1990). The Willamette Valley study of recent wetland change has a relatively high level of reliability (Bernert et al., 1999). The estimate of former extent of Willamette Valley wet prairie was derived from 1850s era General Land Office Survey notes correlated with topography and soils data (Christy et al., 1998). The Oregon Natural Heritage Program database containing wetland plant community and wetland-dependent species data is based largely upon field data but reflects uneven levels of investigation in different regions and for different groups of species (Christy and Titus, 1997). Studies of particular wetland types can provide data that are relatively complete and reliable, such as the evaluation of the extent and condition of Agate Desert vernal pools (Borgias and Patterson, 1999).

Priority information needs

The primary need is to develop and support a program for measuring and monitoring wetland ecosystem health. Pilot studies are underway in the Willamette Valley that will provide reference site data on the condition and functions of important regional wetland types. Additional studies in priority regions would add considerably to our knowledge of wetland resource health. High priority data needs include:

- National Wetlands Inventory (NWI) maps digitized statewide
- Additional Local Wetlands Inventories (more detailed than NWI) within urban areas
- Oregon Hydrogeomorphic Wetland/Riparian Assessment Project expanded beyond Willamette Valley ecoregion pilot study
- Sampling (at reference sites) of biological indicators of wetland health
- Comprehensive sampling and published description of wetland plant communities to complete the statewide wetland community classification
- Digital county soil survey data (soil series level) statewide
- Land Use/Land Cover mapping at regular intervals
- Wetland status and trends studies for additional ecoregions

Although Oregon's wetlands comprise only a small fraction of the state's land base, the ecosystem goods and services they deliver have disproportionately high value. Historical losses of wetlands due to urbanization and resource development have been huge and, despite recent protective measures, losses continue, albeit at much lower rates than historically. As Oregon's population and economy continue to grow, additional wetland conversion is inevitable. Protection remains vital, but restoration of former or degraded wetlands will also be needed to maintain or increase the valuable services these ecosystems provide.

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