The National Wetlands Inventory in Yellowstone

Yellowstone's wetlands have been mapped as part of the U.S. Fish and Wildlife Service's National Wetland Inventory, a Congressionally mandated program to identify, classify, and map all wetlands in the United States—information that has never been available before. The wetland maps are available to park managers for use in the development of resource management strategies, environmental impact assessments, natural resource inventories, habitat surveys, and site-specific project planning.

National Wetland Inventory (NWI) maps consist of wetland boundaries added to a black and white version of a 1:24,000-scale, 7.5-minute U.S. Geological Survey topographic base map (Figure 1). Wetlands are identified and classified according to guidelines found in "Classification of Wetlands and Deepwater Habitats of the United States" (Cowardin et al. 1979), which defines wetlands as:

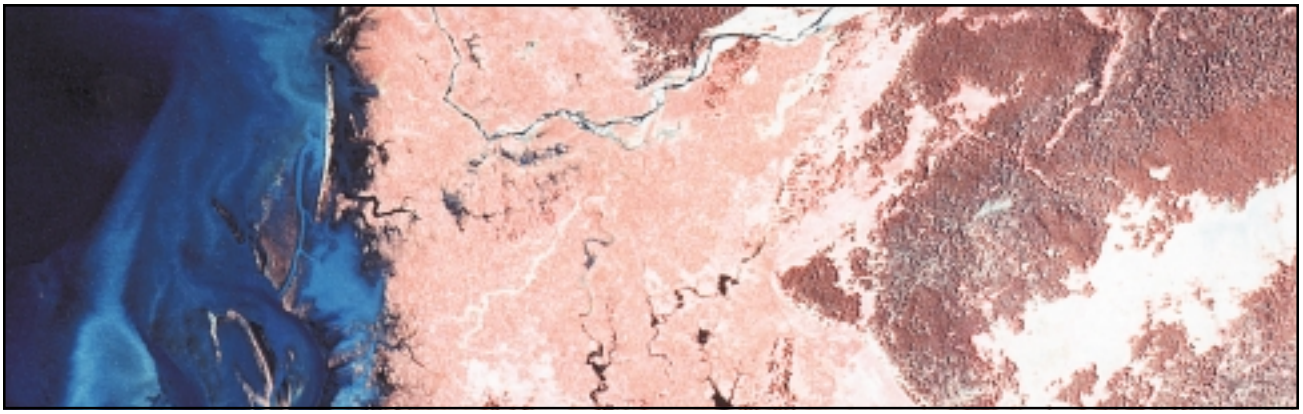
> ". . . lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. For purposes of this classification wetlands must have one or more of the following three attributes: (1) at least periodically, the land supports predominantly hydrophytes [wetland plants], (2) the substrate is predominantly undrained hydric soil, and (3) the substrate is nonsoil [does not support vegetation] and is saturated with water or covered by shallow water at some time during the growing season of each year."

The Cowardin classification system and the NWI maps include deepwater habitats—permanently flooded lands where the water depth in the deepest part of the basin exceeds 6.6 feet at low water. Throughout this booklet, the term "wetlands" is used generically to include both wetlands and deepwater habitats.

The procedures used to map the wetland resources of Yellowstone National Park were the same procedures used throughout the country. This process ensured that Yellowstone's wetland data are consistent with and comparable to wetland data collected elsewhere. The production of accurate wetland maps is dependent upon the availability of good aerial photography (Figure 1), field reconnaissance, photointerpretation, review of draft maps, production of final maps, production of a digital data base, and many quality-control steps.

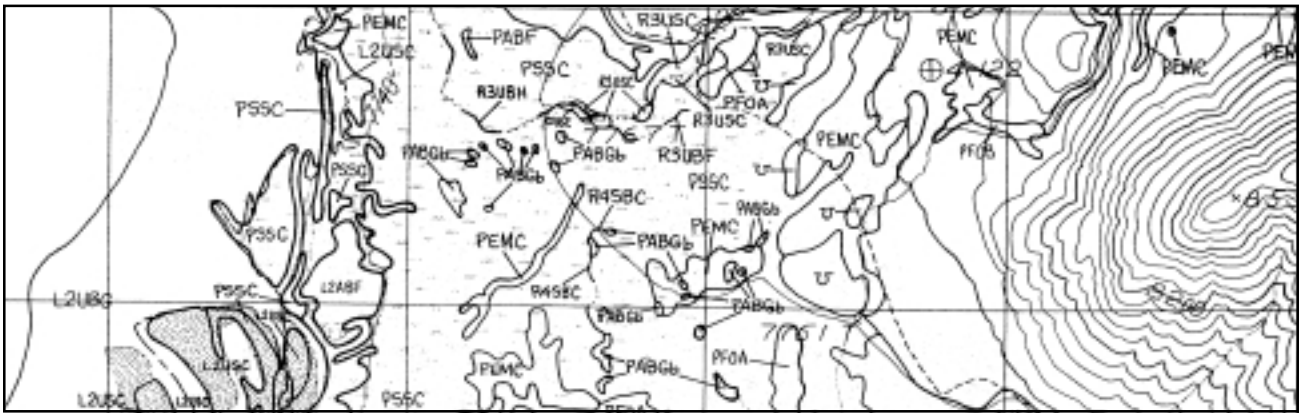
Wetland identification and classification were produced through stereoscopic interpretation of 1:58,000-scale color infrared photography taken primarily in August and September of 1982, 1983, and 1984. Field reconnaissance was performed prior to photo interpretation to correlate photographic signatures with different landscape features and habitats on the ground. Technicians identified wetland habitats by vegetation and soil types using input from park personnel. Collateral information, including topographic maps, SCS soil surveys, and USGS water resources data, was also used to ensure accurate delineation. The wetland classifications are shown as a series of number and letter codes that are identified in a legend at the bottom of the map (Figure 2).

The USFWS produced draft maps, then conducted a second field review to correct errors, such as wetland omissions, upland inclusions, and incorrect classifications, made during initial



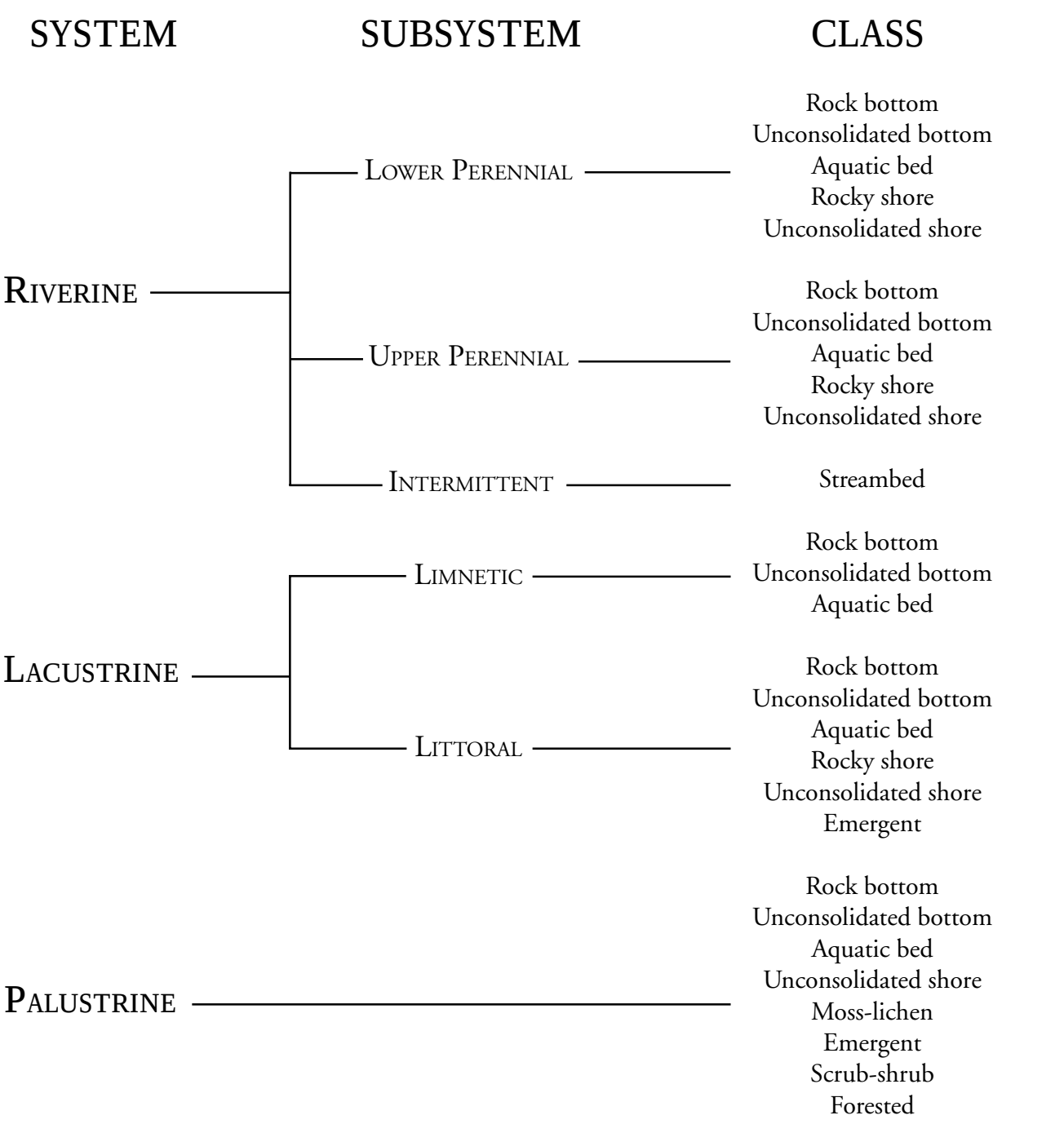
A. Undelineated photo.

B. Delineated photo.



C. National Wetlands Inventory final map.

Figure 1. Color infrared aerial photography before (A) and after (B) photointerpretation, and the resulting National Wetlands Inventory final map (C).



WATER REGIMES		SPECIAL MODIFIERS
A. Temporarily flooded	G. Intermittently exposed	b. Beaver
B. Saturated	H. Permanently flooded	d. Partially drained
C. Seasonally flooded	J. Intermittently flooded	h. Diked/Impounded
F. Semipermanently flooded	K. Artificially flooded	x. Excavated

Figure 2. National Wetlands Inventory map legend used for Yellowstone National Park.

photointerpretation. The corrected final paper maps were completed in 1997. Maps were digitized to transfer the data into an electronic database. The information was then placed in geographic information systems (GIS) for computerized data analysis, such as the calculation of statistics on wetland types and acreages (see Appendix), and production of a variety of ancillary products such as color-coded maps.

The National Wetland Inventory classifies all wetlands in the United States into five major systems. Three of these are found in Yellowstone: lacustrine (lakes, reservoirs, and large or deep ponds), riverine (rivers and streams), and palustrine (wet meadows, swamps, marshes, potholes, fens, bogs, and small shallow ponds) (Figure 3). Each system is divided into subsystems and then into classes that describe the general appearance of the wetland in terms of hydrologic characteristics, dominant vegetative form, and composition of the substrate. It is these descriptive classifications that are found on the NWI maps.

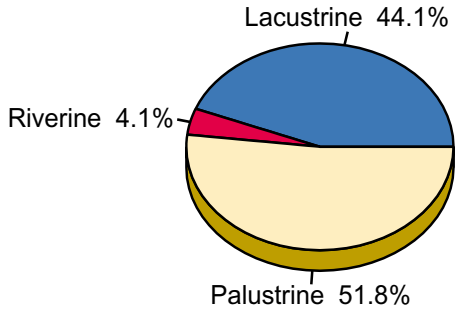


Figure 3. Yellowstone's wetlands are identified as lacustrine, riverine, or palustrine.

Because of scale limitations on NWI maps, individual plant names and dominance types are not used. For example, one cannot tell from an NWI map what species of shrubs are present in the scrub-shrub dominated wetland. That type of information must be obtained elsewhere, such as from descriptions or maps of the park's vegetation (Despain 1990).

The National Wetland Inventory identified 57 categories of wetlands occupying over 228,766 acres or 357 square miles (10.3 percent) of Yellowstone (see Appendix). Yellowstone's *lacustrine wetlands,* lakes and ponds (defined as being greater than 20 acres in size or having a water depth exceeding 6.6 feet at low water), occupy 100,888 acres or 4.5 percent of the park, and constitute 44.1 percent of the park's wetlands. Lacustrine wetlands are classified as either littoral or limnetic based on the water depth (Figure 4). In general terms, the littoral zone is that part of the lake or pond that is less than 6.6 feet deep, and the limnetic zone is that part that is more than 6.6 feet deep. The littoral zone is often the most productive area of the aquatic system because it includes the area of maximum light penetration and therefore supports the greatest amount of aquatic life.

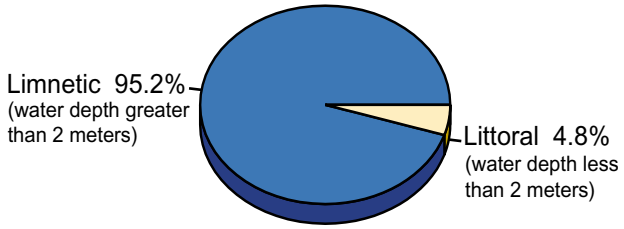


Figure 4. Nearly all of the park's lacustrine wetlands are limnetic. Yellowstone Lake is 90% of the total acreage.

Riverine wetlands (Figure 5) occupy 9,350 acres or 4.1 percent of the park's wetlands. Streams in the riverine system may be intermittent, flowing part of the year and leaving a dry creek bed at other times of the year. Other streams are perennial and have continuous water in channels classified as lower perennial, which are meandering and slow moving, or upper perennial, which are rapidly flowing and display cascading whitewater conditions. Eighty-eight percent of Yellowstone's streams are upper perennial. While all upper perennial streams do not display whitewater conditions, they

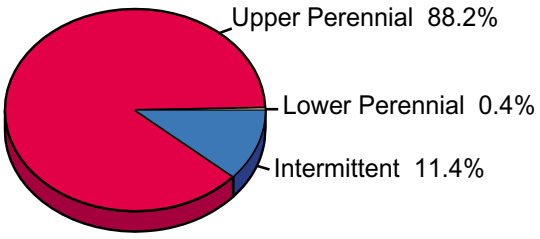


Figure 5. Yellowstone's river systems (upper and lower perennial and intermittent) form an intricate pattern of water movement throughout the park.

still maintain characteristics such as being highly oxygenated and maintaining high velocity, and are characterized by either gravel or rocky substrates.

The third category of wetlands found in Yellowstone is *palustrine wetlands*. While most vegetated wetlands are included in the palustrine system, lacustrine and riverine systems can also be vegetated, with the most dominant life form being the nonpersistent "emergents," the herbaceous grasses and forbes (Figure 6). Palustrine wetlands are described by either the dominant life form (trees, shrubs, emergents, mosses and lichens, or aquatic plants) where vegetation covers 30 percent or more of the substrate; or the physiography and composition of the substrate (rock bottom, unconsolidated bottom, or unconsolidated shore) where there is less than 30 percent vegetative cover. Palustrine wetlands occupy 118,528 acres of the park, 51.8 percent of the park's wetlands.

The NWI maps further describe wetlands by the water regimes present (Figure 7). Water regimes range from saturated soils, with little or no standing water, to flooded soil conditions lasting a few weeks during the growing season, to water bodies that contain open water throughout each year. Water depth may be a few inches located in a small catchment basin to several hundred feet, in

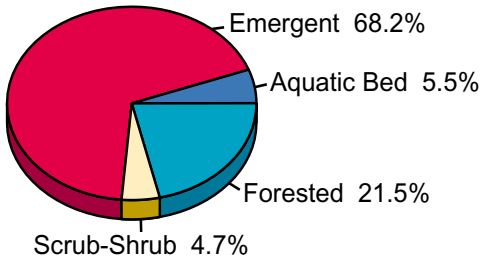


Figure 6. Vegetated wetlands are distributed throughout the park, with the emergent class the most dominant.

the case of Yellowstone Lake. The water regime often determines the type of aquatic vegetation that dominates a specific site. Due to the variety of its water regimes, Yellowstone supports an array of aquatic vegetative species ranging from dwarf spikerushes and sedges to towering cattails and bulrushes. Wetlands with greater water depth support rooted and floating pondweeds and beautiful expanses of lily pads.

Paper copies of Yellowstone's wetland maps may be acquired by contacting the Regional Map Distribution Center in Brookings, South Dakota, at (605) 688-5890. Digital data can be downloaded through the NWI home page on the Internet at http://www.nwi.fws.gov.

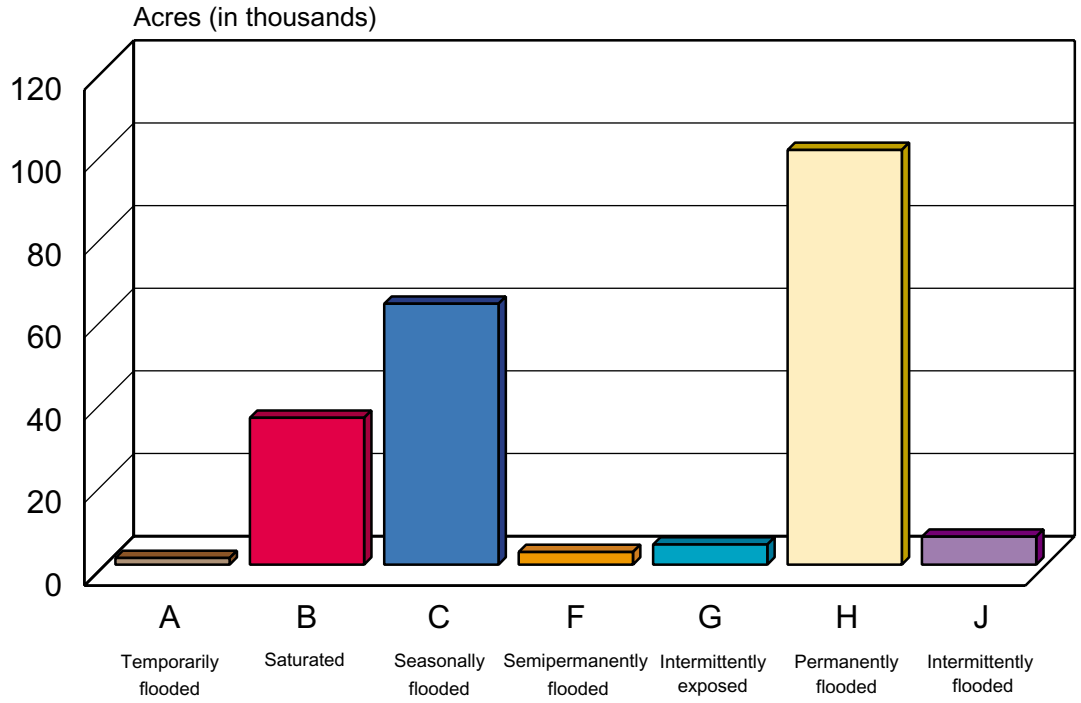


Figure 7. Water regimes in Yellowstone range from temporarily flooded to permanently flooded.

Right: waterfall in backcountry thermal area (J. Whipple).